OPERATION AND MAINTENANCE MANUAL

TOWN OF AMHERST

WASTEWATER TREATMENT PLANT

RUTLEDGE CREEK

AMHERST, VIRGINIA

January 2007

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TABLE OF CONTENTS

APPENDICES

CONTENTS

CHAPTER 1 - INTRODUCTION

CHAPTER 1
INTRODUCTION

MANUAL USER'S GUIDE

The Operation and Maintenance Manual is the primary reference book for the Rutledge Creek Wastewater Treatment Plant (WWTP). This manual should be updated as necessary to reflect plant improvements and to comply with the most current environmental regulations set forth by the Virginia Department of Environmental Quality (DEQ) and the United States Environmental Protection Agency (EPA). This document presents recommendations for proper operation and maintenance of the WWTP. As such, the word "shall" is construed as "should" and the content of this manual is subject to the final discretion of the WWTP superintendent and the Town of Amherst in accordance with state and federal law. Users of this manual should refer to the Table of Contents section located at the beginning of the manual for primary information categories. Each individual chapter is preceded by an additional contents section to facilitate location of specific information in that particular chapter.

DEFINITION OF TERMS

The following definitions and terms should be used as a reference during the proceeding chapters.

Activated Sludge – Sludge floc produced in raw or settle wastewater by the growth of zoogleal bacteria and other organisms in the presence of dissolved oxygen, and accumulated in sufficient concentration by returning floc previously formed.

Activated Sludge Process –A biological sewage treatment process in which a mixture of sewage and activated sludge is agitated and aerated. The activated sludge is subsequently separated from the treated sewage (mixed liquor) by sedimentation, and wastes are returned to the process as needed.

Aerobic – Conditions in which free, elemental oxygen is present. It is also used to describe organisms, biological activity, or treatment processes that require free oxygen.

Alkalinity – A term used to represent the content of carbonates, bicarbonates, hydroxides, and occasionally borates, silicates, and phosphates in water. It is expressed in parts per million of calcium carbonate.

Anaerobic – Conditions in which no oxygen (free or combined) is available. Also used to describe organisms, biological activity or treatment processes which function in the absence of oxygen.

Anoxic – A biological environment that is deficient in molecular oxygen, but may contain chemically bound oxygen, such as nitrates and nitrites.

Biochemical Oxygen Demand – BOD is used to determine the oxygen required to biologically stabilize the organic matter present in wastewater. It is the principle measurement to determine the strength, in terms of oxygen required, of municipal wastewater.

5-Day Biochemical Oxygen Demand (BOD_5) – The quantity of oxygen used in the biochemical oxidation of organic matter during a five-day period at $20^{o}C$ under laboratory conditions.

Biological Nutrient Removal – The removal of nitrogen and/or phosphorous from wastewater using biological methods of treatment.

Chemical Oxygen Demand (COD) – COD provides a measure of the oxygen equivalent of that portion of the organic matter that is susceptible to oxidation by a strong chemical oxidant. The COD value will be greater than the BOD_5 value because more organic substances can be chemically oxidized than biologically oxidized. For many types of waste, the BOD_5 and COD results can be correlated. The COD data is used in the same manner as the BOD_5 test, but since it takes only 3 to 5 hours to obtain COD test results compared to 5 days for test results, the data is more readily available for use for treatment plant control and operation.

Chlorination – The application of chlorine to water, sewage, or industrial wastes, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

Chlorine Residual – Chlorine residual may be defined in terms of free chlorine residual, which is the sum of chlorine hypochlorous acid, and hypochlorite ion, or total chlorine, which is the sum of all chlorinated compounds plus free chlorine.

Dechlorination – The removal of chlorine from a substance.

Denitrification – A biological process by which nitrate is converted to nitrogen gas.

Detention Time – The theoretical time required to displace the contents of a tank or unit at a given rate of discharge.

Dewatering Sludge – The process of removing a part of the water in sludge by any method, such as draining, evaporation, pressing, centrifuging, exhausting, passing between rollers, or acid flotation, with or without heat. It involves reducing from a liquid to a spadable condition rather than merely changing the density of the liquid (concentration) or drying (as in a kiln).

Diffuser – A device with holes, nozzles, or the equivalent, or a porous plate or tube through which air is forced and divided into minute bubbles for diffusion in liquids.

Digested Sludge – Sludge digested under aerobic or anaerobic conditions until the volatile content has been substantially reduced (usually around 50 percent).

Digestion – Digestion is the decomposition or degradation of biodegradable organic material, either in the presence of oxygen (aerobic digestion), or in the absence of oxygen (anaerobic digestion), This degradation is carried out by the bacteria and other microscopic organisms present. The complex organic compounds making up organic waste materials are converted to simpler, more stable forms of matter.

Disinfection – The killing of the larger portion (but not necessarily all) of the harmful and objectionable microorganisms in, or on, a medium by means of chemicals, heat, ultraviolet light, etc.

Dissolved Oxygen (DO) – Molecular oxygen dissolved in wastewater.

Diurnal – The cyclic characteristics of wastewater composition and waste stream flow during a 24-hour period.

Domestic Wastewater
Wastewater derived principally from dwellings, business buildings, institutions, and the like. It may or may not contain groundwater, surface water, or storm water.

Effluent – The flow leaving a tank, channel, or treatment process.

Endogenous Phase – The endogenous phase of microorganism growth occurs when the available food source is at a minimum and the microorganisms are forced to metabolize their own protoplasm without replacement.

Eutrophication – The enrichment of a body of water with nutrients which in the presence of sunlight stimulate the growth of algae and other aquatic plants.

Extended Aeration – A modification of the activated sludge process which provides for aerobic sludge digestion within the aeration system. The concept envisages the stabilization of organic matter under aerobic conditions and disposal of the end products into the air as gases and with the plant effluent as finely divided suspended matter and soluble matter.

Facultative Anaerobic Bacteria – Bacteria which can adapt themselves to growth in the presence, as well as in the absence, of oxygen. Sometimes referred to simply as facultative bacteria.

First-Stage Biochemical Oxygen Demand – That part of oxygen demand associated with biochemical oxidation of carbonaceous, as distinct from nitrogenous, material. Usually, the greater part, if not all, of the carbonaceous material is oxidized before the second stage, or substantial oxidation of the nitrogenous material takes place. Nearly always, at least a portion of the carbonaceous material is oxidized before oxidation of nitrogenous material even starts.

Floc – Small gelatinous masses formed in a liquid by the reaction of a coagulant added thereto, through biochemical processes, or by agglomeration.

Flocculation – In water and wastewater treatment, agglomeration of colloidal and finely divided suspended matter after coagulation by gentle stirring by either mechanical or hydraulic means. In biological wastewater treatment where coagulation is not used, agglomeration may be accomplished biologically.

Grease – In wastewater, a group of substances including fats, waxes, free fatty acids, calcium and magnesium soaps, mineral oils, and certain other nonfatty materials.

Heterotrophic Organisms – Bacteria that thrive only on organic materials for energy and growth.

Hydrogen Ion Concentration (pH) – The pH value is an expression of the intensity of the acid or alkaline condition of a solution.

Influent – The wastewater entering a tank, channel, or treatment process.

Inverse Sludge Index – Properly called sludge density index. It is the reciprocal of the sludge volume index multiplied by 100.

Mechanical Aeration

1. The mixing, by mechanical means, of wastewater and activated sludge in the aeration

tank of the activated sludge process to bring fresh surfaces of liquid into contact with the atmosphere.

2. The introduction of atmospheric oxygen into a liquid by the mechanical action of paddle, paddle wheel, spray, or turbine mechanisms.

Microorganisms – Minute organisms, either plant or animal, invisible or barely visible to the naked eye. Among the microorganisms at an active sludge plant are bacteria, protozoa, and rotifers.

Mixed Liquor – A mixture of activated sludge and sewage in the aeration tank and undergoing activated sludge treatment.

Nitrification – The oxidation of organic nitrogen into nitrate through biochemical action.

Nitrobacter – A genus of bacteria that oxidizes nitrite to nitrate.

Nitrosomonas – A genus of bacteria that oxidizes ammonia to nitrite.

Organic Nitrogen – Nitrogen combined in organic molecules such as proteins, amines, and amino acids.

Oxic – A biological environment which contain molecular oxygen; aerobic.

Oxygenation Capacity – In treatment processes, a measure of the ability of an aerator to supply oxygen to a liquid.

Oxygen Saturation – The maximum quantity of dissolved oxygen that liquid of given chemical characteristics, in equilibrium with the atmosphere, can contain at a given temperature and pressure.

Peak Demand – The maximum momentary load placed on a water or wastewater plant or pumping station. This is usually the maximum average load in one hour or less, but may be specified as instantaneous, or with some other defined short time period.

Raw Wastewater – Wastewater before it receives any treatment.

Reactor – A tank where a wastewater stream is mixed with bacterial sludge and biochemical reactions occur.

Sampler – A device used with or without flow measurement to obtain an aliquot portion of water or waste for analytical purposes. May be designed for taking single sample (grab), composite sample, continuous sample, or periodic sample.

Sanitary Sewer – A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions; together with minor quantities of ground, storm, and surface waters that are not admitted intentionally.

Screening – The removal of relatively coarse floating and suspended solids by straining through racks or screens.

Scum Collector – A mechanical device for skimming and removing scum from the surface of a settling tank.

Secondary Clarifier – A tank through which effluent from some prior treatment process flows for the purpose of removing settleable solids.

Secondary Wastewater Treatment – The treatment of wastewater by biological methods after primary treatment by sedimentation.

Second-stage Biochemical Oxygen Demand – The part of the oxygen demand associated with the biochemical oxidation of nitrogenous material. As the term implies, the oxidation of the nitrogenous materials usually does not start until a portion of the carbonaceous material has been oxidized during the first stage.

Sewage – The spend water of a community. This term is now being replaced in technical usage by the preferable term wastewater.

Sludge – The settleable solids separated from liquids during the treatment process.

Sludge Age – In the activated sludge process, a measure of the length of time a particle of suspended solids has been undergoing aeration, expressed in days. It is usually computed by dividing the weight of the suspended solids in the aeration tank by the weight of excess activated sludge discharged from the system per day.

Sludge Bulking – A phenomenon that occurs in activated sludge plants whereby the sludge occupies excessive volumes and will not concentrate readily. Typically the result of an overpopulation of filamentous bacteria

Sludge Index – Properly called sludge volume index (SVI). It is the volume in millimeters occupied by 1 g of activated sludge after settling of the aerated liquid for 30 minutes.

Standard Methods – Methods for the examination of water and wastewater published jointly by the American Public Health Association. The American Water Works Association and the Water Pollution Control Federation.

Storm Sewer – A sewer that carries storm water and surface water, street wash and other wash waters, or drainage, but excludes domestic wastewater and industrial wastes.

Supernatant – Liquid removed from settled sludge.

Suspended Solids - Suspended solids are those solids, which can be filtered from a water sample. The suspended solids concentration also includes the settleable solids. The suspended solids test indicates the quantity of sludge that will develop during sedimentation.

Total Solids - Total solids include suspended solids, settleable solids, and dissolved solids.

Turbidity - The turbidity of water indicates the amount of suspended solids in the water that interfere with the passage of light through the water. Measuring the turbidity of the effluent indicates the efficiency of the settling process.

Ultimate Biochemical Oxygen Demand

1. Commonly, the total quantity of oxygen required to satisfy completely the first-stage biochemical oxygen demand.
2. More strictly, the quantity of oxygen required to satisfy completely both the first-stage and the second-stage biochemical oxygen demands.

Volatile Solids - Volatile solids describes the inorganic compounds in the total solids. Only inorganic compounds remain after the solids are fired at 600^{o}C. The term "volatile" can be applied to suspended as well as total solids. Volatile solids are usually expressed in mg/1 of volatile solids.

VPDES Permit – Virginia Pollutant Discharge Elimination System permit which authorizes the discharge of treated wastes and specifies the conditions which must be met for discharge.

Waste Activated Sludge – The waste sludge (or WAS) is the activated sludge removed from the activated sludge system for final disposal. It may also be called Excess Activated Sludge.

Waste Load Allocation – The maximum load of pollutants each discharger of waste is allowed to release into a particular waterway.

PERSONNEL RESPONSIBILITIES

To ensure the efficient and economical operation of the Rutledge Creek WWTP, it is important that plant personnel completely understand their responsibilities. The intent of this manual is to define the responsibilities of each person and to provide necessary information and procedures so that each task can be effectively performed. Specific responsibilities according to particular job titles are presented in Chapter 4, "Personnel." It is important to realize that some individuals may have the responsibilities of several job types. For example, an operator may have both operational and maintenance responsibilities. The following is a brief summary of the responsibilities of various personnel.

Managerial Personnel Responsibilities

1. Establish staff requirements, prepare job descriptions, develop organizational charts, and assign personnel.
2. Provide good working conditions, safety equipment, and proper tools for the personnel.
3. Analyze and evaluate plant operation and maintenance functions.
4. Inspect plant periodically.
5. Maintain treatment system operational and management records.
6. Establish good working relationship with personnel.
7. Provide personnel with job security and career advancement.
8. Establish training programs.
9. Provide incentive for personnel.
10. Motivate personnel to achieve maximum efficiency of operation.
11. Maintain good public relations.
12. Prepare budgets and reports.
13. Recommend plant improvements and additions.
14. Supervise administration, operation, and maintenance of entire plant.
15. Establish scheduled operation of maintenance procedures.

Operational Personnel Responsibilities

1. Operate treatment facilities.
2. Know proper operational procedures.
3. Know individual responsibilities and duties.

4. Monitor gauges, meters, and control panels.
5. Observe variations in operating conditions and interpret meter and gauge readings and test results.
6. Start and stop pumps, aerators, engines, and generators.
7. Open, close, or adjust valves and gauges.
8. Maintain shift logs and records.
9. Keep informed of the best operating and maintenance practices.
10. Participate in training programs.
11. Keep abreast of information in wastewater treatment periodicals.
12. Assist supervisors in preparing an adequate budget.
13. Advise supervisors of operating problems or potential operating problems.
14. Keep aware of safety hazards and follow safety procedures.
15. Know operational efficiencies of processes and units.
16. Prepare to discuss plant with visitors.
17. Make operating decisions in the absence of supervisory personnel.
18. Supervise collection of samples.
19. Supervise and perform chemical, bacteriological, and physical tests and analyses of the wastewater.
20. Assist management personnel in maintaining plant records.
21. Provide routine procedures to be followed.
22. Evaluate and interpret test results and establish test priorities.
23. Prepare periodic reports for submission to State or Federal regulatory agencies.
24. Provide direct and indirect instructions on plant operation regarding chemical or physical adjustments or changes.

Maintenance Personnel Responsibilities

1. Perform preventive maintenance and repairs on mechanical machinery and equipment.
2. Maintain buildings and structures.
3. Lubricate equipment and check for malfunctions.
4. Replace packing in pumps and valves.
5. Replace bearings in motors, pumps, and other equipment.
6. Adjust alignment of shafts.

7. Check clearances on equipment.
8. Clean out pipes and perform other plumbing and pipe fitting tasks.
9. Help install and set up new equipment in accordance with manufacturer's recommendations and instructions.
10. Assist in keeping maintenance records.
11. Maintain manufacturer's literature on plant equipment.
12. Drive, load, and unload truck.
13. Clean equipment in plant.
14. Paint and perform other minor maintenance.
15. Dig and refill trenches.
16. Clean drains, ditches, and culverts.
17. Perform yard work.
18. Remove snow and ice from walkways, driveways, and equipment.
19. Perform maintenance tasks under supervision of electrician or maintenance personnel.
20. Collect and dispose of trash.
21. Inspect, repair, calibrate, and maintain electrical and/or electronically operated and controlled systems, equipment, and fixtures.
22. Make routine decisions on problems of an electrical nature.
23. Help install new equipment.
24. Supervise laborer or maintenance personnel.
25. Maintain maintenance records.
26. Repair wiring and lighting systems, meters, outlets, and panels.
27. Interpret schematics and specifications.

TYPE OF TREATMENT SYSTEM

The Rutledge Creek Wastewater Treatment Plant incorporates a variety of unit processes. Primary treatment occurs at the headworks facility, which consists of a mechanical screen and vortex grit removal that aid in removing large solids and grit from the influent wastewater. Secondary biological treatment utilizes a phased isolation ditch (PID) called the Kruger Double Ditch (D-Ditch) to achieve BOD and ammonia removal. The D-Ditch is designed to operate in either phased or continuous modes. Under normal operation, the D-Ditch functions in continuous mode, employing combinations of two phases: nitrification (ammonia reduction) and settling. A waste activated sludge (WAS) vault enables control of the food to microorganism (F/M) ratio by allowing settled sludge in the oxidation ditch to be wasted to the aerobic digesters for sludge stabilization. Wastewater flows through tertiary effluent filters for polishing after exiting the oxidation ditch. An ultraviolet (UV) disinfection channel provides effluent disinfection before post aeration is performed by a cascade aerator. The plant is designed to treat an average design wastewater flow of 0.6 million gallons per day (mgd) and a peak design flow of 1.2 mgd.

It should be noted that the current plant flow is much less than the design flow of 0.6 mgd. This situation allows the plant to incorporate denitrification (total nitrogen removal) phases into its full 24-hour treatment cycle. In the future, as the plant flow approaches design conditions, the denitrification phases will have to be eliminated in order to achieve adequate nitrification. When the plant reaches its design flow, the removal of total nitrogen will require modifications to the plant design. These modifications are discussed in the Basis of Design Report for Nutrient Removal in Appendix 12.

The Virginia Pollutant Discharge Elimination System (VPDES) permit (No. VA0031321) establishes the effluent limitations, maximum discharge, and monitoring requirements for the WWTP. Future flows in excess of these values may be accommodated with expansion and modification. Chapter 2 presents a detailed description of the permits and standards related to the Rutledge Creek WWTP. In addition, the VPDES permit is presented in Appendix 1.

DESCRIPTION OF PLANT TYPE AND FLOW PATTERN

General Flow Pattern

Figure 1-1 illustrates the basic flow diagram of the Rutledge Creek Wastewater Treatment Plant. In the course of the following discussion, reference should be made to Figure 1-1.

Influent Sources

The principal influent source for the Rutledge Creek WWTP is a 24-inch gravity sewer line that enters the plant west of the headworks facility. Wastewater from the 24-inch influent line originates from the wastewater collection system servicing the Town of Amherst, Sweetbriar College, Zane Snead Industrial Park, and L. Barnes Brockman, Sr. Business and Industrial Park.

Preliminary Treatment Facilities

The primary treatment process at the headworks includes a step screen and a vortex grit removal unit. The screening facility consists of a mechanical step screen and a manual bar screen. The mechanical screen is located in the primary channel and removes coarse material and debris from the wastewater. The screened material is discharged into a screenings compactor where they are washed, dewatered and compacted before being transported to a waste container where it is held for final disposal offsite. During extremely high flow conditions, or when mechanical screen maintenance is required, the flow can be diverted into a secondary channel equipped with a manual bar screen. After exiting the screen channels, the wastewater is discharged into the vortex grit unit for removal of small inorganic solids.

The vortex grit unit separates inorganic solids from the wastewater by rapidly increasing the flow velocity, thereby accelerating sedimentation and causing grit particles to drop out of suspension The grit slurry is collected in a trap beneath the circular vortex unit and transferred to a grit washer/classifier using an airlift pump. The grit washer/classifier separates organic material from the grit slurry and deposits the washed grit material into a dumpster where it is held for landfilling. A 12-inch emergency overflow into the aerobic digesters is provided in the headworks facility in case an operational problem should cause the influent pump station wet well to overflow. Furthermore, the overflow into the digesters provides emergency flow control during extremely high flow conditions triggered by wet weather inflow and infiltration (I/I). After the high flow has subsided, the untreated wastewater can be pumped out of the digesters and into the treatment system using the digester supernatant pumps.

Influent Pump Station

The influent pump station consists of three self-priming Gorman-Rupp suction lift wastewater pumps. The pumps are equipped with variable speed drives (VFDs) and 40 HP motors. Each pump is rated for 860 gpm at 88 ft TDH. An air bubbler system monitors the water level and transmits signals back to the influent pump station PLC. The PLC controls the lead/lag arrangement of the three pumps and communicates with the VFDs to increase or decrease pump speed based upon the water level signals from the air bubbler system. The use of VFDs allows consistent flow into the D-Ditch by attenuating influent spikes.

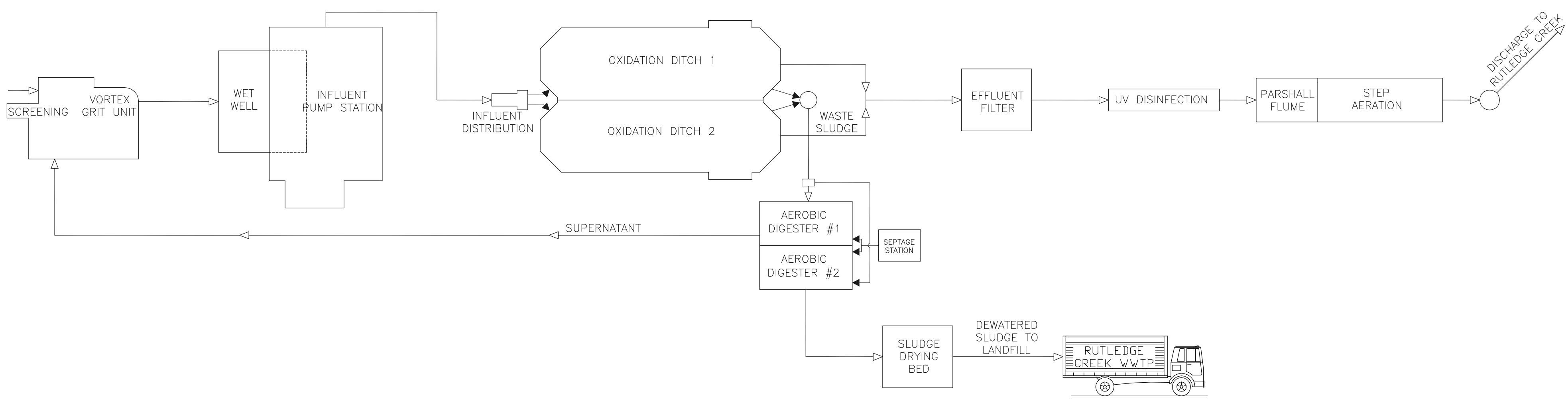
Activated Sludge Secondary Treatment Facilities Description

Secondary biological treatment is provided by a Kruger Double Ditch (D-Ditch), which is a continuous flow phased isolation ditch. The D-Ditch is a modified activated sludge biological treatment process that utilizes extended hydraulic detention times to remove biodegradable organics. The oxidation ditches ambient conditions alternate between oxic, anoxic and quiescent phases to accomplish nitrification, denitrification, and clarification. Flow into the ditches is controlled by a motor actuated influent distribution box and is alternated depending on the ditch phasing schedule. During oxic phases, brush aerators provide dissolved oxygen transfer, circulation, and aeration in the ditch. Microbial growth is fostered by the dissolved oxygen and the mixing process ensures contact between microorganisms and incoming wastewater. The oxygen transfer efficiency produced by the brush aerators can be varied by adjusting the disc submergence and rotational speed. During anoxic phases, the rotors are turned off and submersible mixers are turned on. The submersible mixers allow activated sludge to remain in suspension while dissolved oxygen content is minimized. This condition promotes anoxic conditions and the process of denitrification.

As required by the plant's VPDES permit to control total hardness, a lime solution is added to the wastewater in the distributor box, just upstream of the D-Ditch. The lime solution also serves as an alkalinity control for the influent wastewater. When the alkalinity of the influent wastewater is inadequate to sustain the biological reaction in the oxidation ditches, the lime solution provides an alkalinity source for buffering pH.

Tertiary Effluent Filter

After supernatant is decanted by adjustable effluent weirs in the oxidation ditches, it flows by gravity to an effluent polishing filter that enhances BOD and TSS removal. The Kruger Hydrotech Discfilter employs woven cloth filter elements installed on multiple rotating discs. The filter allows a large filter area within a small footprint and is mounted in a 22-ft. 8-in. square concrete structure with enough room for a future unit if needed. The Discfilter features a continuous gravitational flow which remains continuous even during the backwash cycle. The filter facility includes an inlet channel, filtered water channel, and emergency bypass channel.



Engineers Surveyors Planners Associates	DRAWN:	EFA	TITLE: PROCESS FLOW DIAGRAM	FIGURE:	1–1
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				DATE:	12/2005

Ultraviolet and Chlorine Disinfection

Wastewater flows by gravity from the polishing filter to the ultraviolet (UV) disinfection channel. The disinfection channel exposes the wastewater to high levels of ultraviolet wavelength electromagnetic energy while a weir maintains proper channel depth. This energy neutralizes pathogens in the wastewater. A submersible non-potable water (NPW) located at the downstream end of the UV channel pumps disinfected effluent to the NPW disinfection building. From there, the non-potable water system provides plant process water for chemical feed systems and yard hydrants.

Post-aeration Facility

Wastewater flows by gravity from the UV disinfection channel to the effluent Parshall flume and post-aeration facility. At the post-aeration facility, dissolved oxygen content is augmented by a twelve-step cascade aerator and then discharge through a 20-inch gravity sewer to Rutledge Creek.

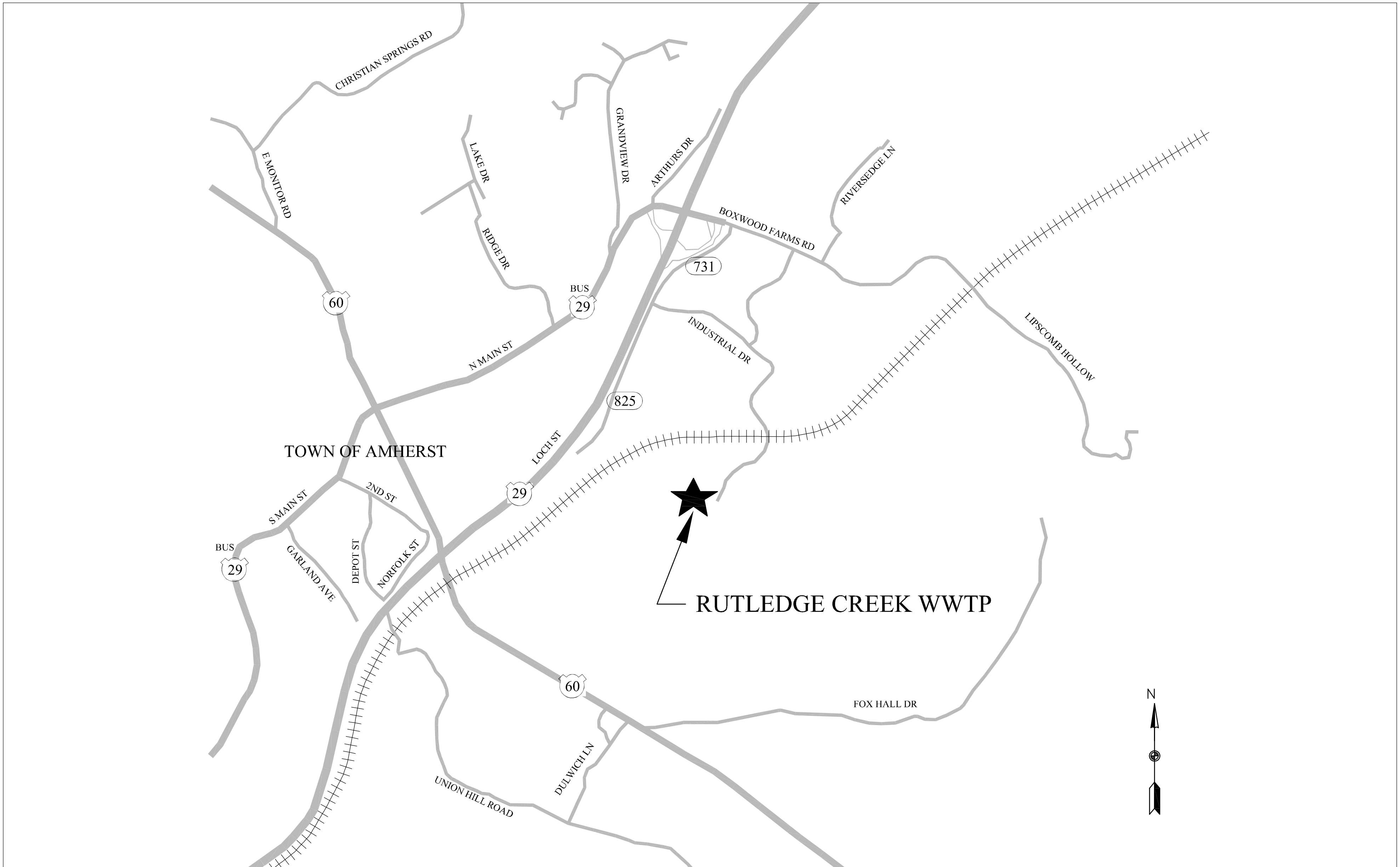
Sludge Handling Facilities

Waste activated sludge from the D-Ditch is sent to two aerobic digesters. The digesters are converted aeration basins from the original WWTP. The square concrete digesters are capable of holding and treating 219,000 gallons of waste sludge each. The digesters are provided with two positive displacement blowers that provide diffused aeration and mixing. The digesters also have the ability to receive septic tank waste through a septage receiving facility. Following treatment, stabilized sludge is transferred to the sludge drying beds. A polymer is mixed with the sludge during application to the beds to facilitate dewatering. Rutledge Creek WWTP is equipped with eight square-shaped sludge drying beds. Each drying bed measures approximately 22-ft x 22-ft. The drying beds are provided with roof covers to maintain a dry environment during rainfall. Dewatered sludge is removed and hauled to the Amherst County Landfill for final disposal.

FACILITY INFORMATION

The Rutledge Creek Wastewater Treatment Plant is located in Town of Amherst, Virginia. Facility information is presented below. Figure 1-2 presents a location map for the WWTP.

Address:	Rutledge Creek WWTP 448 Industrial Drive Amherst, VA 24521
Phone:	(434) 946-5769
Contact:	Mr. Thomas W. Fore Town of Amherst Superintendent of Water and Wastewater



W/W ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN: EFA	TITLE:		FIGURE:	1–2
		RUTLEDGE CREEK WWTP LOCATION		SCALE:	N.T.S.
	APPROVED: HFW			DATE:	12/2005

CONTENTS

CHAPTER 2 – PERMITS AND STANDARDS

CHAPTER 2
PERMITS AND STANDARDS

DISCHARGE PERMIT

In accordance with the State Water Control Law of the Code of Virginia and the provisions of the Federal Water Pollution Control Act Amendments, the quality and quantity of effluent discharged from the wastewater treatment plant is regulated by a Virginia Pollutant Discharge Elimination System (VPDES) permit. The permit establishes specified effluent limitations based on State established water quality standards. The discharge permit also establishes certain monitoring and operational requirements. In addition to the discharge permit, the Town will be required to comply with a general permit which will be prepared in the year 2006. When this permit is adopted, its compliance schedule will be related to the average point source concentrations of total nitrogen and total phosphorous in the James River basin. The Town of Amherst is authorized by the State Water Control Board under VPDES permit No. VA0031321 to discharge treated wastewater to the Class III Rutledge Creek, within the James River Basin. A copy of the current permit is included in Appendix 1 of this manual and should be referenced for details such as effluent limitations (beginning of Part I, Page 1), reporting monitoring results, etc. The following sections provide a summary of pertinent features of the current VPDES. Since the VPDES permit is a living document and undergoes changes regularly, it should always be consulted for the most current information regarding effluent limitations, monitoring requirements, operational requirements, and action procedures.

<u>Reports of Unauthorized Discharges</u>

An unauthorized discharge is considered a discharge of sewage, industrial waste, other wastes or any noxious or deleterious substance into or upon State waters. This includes discharges that may reasonably be expected to enter State waters. During such an event, DEQ should be notified immediately, or no later than 24 hours after the discovery of the event. A written report of the unauthorized discharge shall be submitted to DEQ within five days of its discovery. The current VPDES permit should be consulted for the requirements of the written report. A typical written report shall include the following information:

1. A description of the nature and location of the discharge;

2. The cause of the discharge;
3. The date on which the discharge occurred;
4. The length of time that the discharge continued;
5. The volume of the discharge;
6. If the discharge is continuing, how long it is expected to continue;
7. If the discharge is continuing, what the expected total volume will be; and
8. Any steps planned or taken to reduce, eliminate and prevent a reoccurrence of the present discharge or any future discharges not authorized by the permit.

Upon any unauthorized discharge, the current VPDES permit (Appendix 1) should be consulted for detailed action procedures. In addition to the VPDES permit procedures, Figure 6-7 (Chapter 6) is a recommended form to be executed during a manhole overflow, bypass situation, or unusual or extraordinary discharge event.

Reports of Unusual or Extraordinary Discharges

Unusual or extraordinary discharges include but not are limited to (1) unusual spillage of materials resulting directly or indirectly from processing operations; (2) breakdown or processing or accessory equipment; (3) failure or taking out of service some of all of the treatment works; (4) flooding or other acts of nature; and (5) bypass situations in which untreated sewage could be expected to enter State waters.

If an unusual or extraordinary discharge occurs, DEQ should be promptly notified by telephone, and in no case later than 24 hours. The notification should provide all available details of the incident, including any adverse affects on aquatic life and the known number of fish killed. A written submission covering these points should be provided within five days of the time the permittee becomes aware of the circumstances covered by this paragraph.

Upon the event of an unusual or extraordinary discharge, the current VPDES permit (Appendix 1) should be consulted for detailed action procedures. In addition to the VPDES permit procedures, Figure 6-7 (Chapter 6) is a recommended form to be executed during a manhole overflow, bypass situation, or unusual or extraordinary discharge event.

Reports of Noncompliance

Noncompliance which may adversely affect State waters or may endanger public health should be reported to DEQ immediately.

1. An oral report should be provided within 24 hours from the time the permittee becomes aware of the circumstances. The following should be included as information to be reported within 24 hours:
    a. Any unanticipated bypass; and
    b. Any upset which causes a discharge to surface waters.
2. A written report should be submitted within 5 days and should contain:
    a. A description of the noncompliance and its cause;
    b. The period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue, and
    c. Steps taken or planned to reduce, eliminate, and prevent reoccurrence or the noncompliance.
3. Any instance of noncompliance which is not described within the VPDES permit should be submitted to DEQ in writing at the time of the next monitoring report submission. See the current VPDES permit for details on the report content.

Upon a noncompliance event, the current VPDES permit (Appendix 1) should be consulted for detailed action procedures.

The immediate (within 24 hours) reports required by the current VPDES permit may be made to the Department's Regional Office at (434) 582-5120 (voice) or (434) 582-5125 (fax). For reports outside normal working hours, leave a message and this shall fulfill the immediate reporting requirement. In the event of an emergency regarding discharges that may adversely affect State water or human health, the Virginia Department of Emergency Services 24-hour telephone service should be immediately contacted at 1-800-468-8892. In the event of a hazardous discharge into State waters, downstream water users must be notified as soon as possible. Currently, there are no immediate downstream users of the Rutledge Creek WWTP outfall. A complete list of emergency telephone numbers can be found in Chapter 9 (p. 9-2)

Records Retention

Records of monitoring information required by the current VPDES permit related to the permittee's sewage sludge use and disposal activities and any sludge records should be retained for a period of at least five years. The plant should retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period of retention will be extended automatically during the course of any unresolved litigation regarding the regulated activity or regarding control standards applicable to the plant, or as requested by the Board.

Duty to Comply and Penalties

Any permit noncompliance is considered a violation of the State Water Control Law and Clean Water Act, except that noncompliance with certain provisions of the current permit may constitute a violation of the State Water Control Law but not the Clean Water Act. Permit noncompliance is grounds for enforcement action, permit termination, revocation and reissuance, modification or denial of a permit renewal application. The permittee should comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act within the time provided in the regulations that establish these standards or prohibitions or standards for sewage sludge use or disposal, even if the current permit has not yet been modified to incorporate the requirement.

Approaching Design Flow Plan or Action

The current VPDES permit requires that a plan of action for ensuring continued compliance with the terms of this permit shall be submitted to the Department of Environmental Quality, South Central Office, 7705 Timberlake Road, Lynchburg, Virginia 24502, when the monthly average flow influent to the sewage treatment plant reaches 95 percent of the design capacity authorized in this permit for each month of any three consecutive month period. The plan of action should be received at the South Central Office no later than ninety (90) days from the third consecutive month for which the flow reached 95 percent of the design capacity. The plan is required to include the necessary steps and a prompt schedule of implementation for controlling any current or reasonably anticipated problem resulting from high influent flows. Failure to timely submit an adequate plan is considered a violation of the permit.

Operator Certification

The VPDES permit requires the Rutledge Creek WWTP to employ a Class II licensed wastewater works operator whose license is current and valid. The license is required to be issued in accordance with Title 54.1 of the Code of Virginia and the regulations of the Board for Waterworks and Wastewater Works Operators. Chapter 4, “Personnel,” provides a more detailed description of the requirements and qualifications of the WWTP personnel.

Toxics Management Program

The current VPDES permit requires acute and chronic toxicity tests to be conducted quarterly for a period of five quarters using 24-hour flow-proportioned composite samples of final effluent from outfall 001. If it is determined from the data that no limit is needed, then acute and chronic toxicity testing of the outfall will continue annually.

Pretreatment Program

The Town has a pretreatment program that has been approved and is an enforceable part of the permit. The current “Pretreatment Program Procedures Manual” in Appendix 16 provides the details of the program. An annual report must be submitted to the DEQ that describes the Town’s progam activities over the previous year. Refer to the current permit for specifics that are required to be included in the report.

CONTENTS
CHAPTER 3 - DESCRIPTION, OPERATION, AND CONTROL OF WASTEWATER TREATMENT FACILITIES

CHAPTER 3
DESCRIPTION, OPERATION, AND CONTROL OF WASTEWATER TREATMENT FACILITIES

GENERAL

Proper operation and control is the key to the efficient performance of the Rutledge Creek Wastewater Treatment Plant (WWTP). Detailed descriptions of the various units are contained in this chapter along with guidance on the proper operation and control of the units and descriptions of alternate and emergency operational modes of the units. While reading this chapter, reference should be made to Figure 1-1, “Process Flow Diagram,” the appropriate figure for the specific unit being studied, and the Valve Index table in Appendix 2.

The intent of this chapter is not to replace manufacturer's instructions on operation and maintenance of specific equipment. Manufacturer's literature should be reviewed whenever performing maintenance, during non-routine operation of equipment, and whenever operating problems are encountered. A list of major equipment items and equipment manufacturers is included in Appendix 3.

Detailed design criteria for all major equipment at the Rutledge Creek WWTP are presented in Appendix 4 of this manual. A list of the record drawings is presented in Appendix 5.

The description of analytical techniques in this chapter is not meant to replace Standard Methods for the Examination of Water and Wastewater. The laboratory should have the latest DEQ approved edition of the document on hand.

HEADWORKS

Description

Influent wastewater flows into the WWTP through a 24-inch sewer that enters the headworks facility for the plant. The influent sewer discharges to a 4-ft. deep dual concrete channel. The primary channel consists of a Huber Technology fine mechanical step screen with ¼-inch openings. The mechanical screen is equipped with a NPW scour line that fluidizes particles that may collect at the base of the screen. The secondary channel contains a manual bar screen with 1½-inch bar spacings. Screenings are compacted by a Huber Technology Wash Press and discharged to a nearby dumpster for offsite disposal.

After screening, wastewater flows into a 7-ft. diameter vortex grit unit. The Westech Grit System utilizes a gear drive unit and gear box to rotate a torque tube to create a vortex in the circular chamber. Grit particles are forced out of suspension by the combination of the vortex action and gravitational forces. The particles fall out into a collection pit located beneath the vortex chamber. A non-potable water scour line fluidizes the grit before a grit pump transfers the slurry to a shaftless screw grit washer/classifier designed by Combs Integrated Technologies. The screw conveyor separates grit particles from the slurry mixture and deposits them into a dumpster for disposal. The liquid portion of the slurry overflows into a 6-inch waste pipe that drains back to the beginning of the headworks.

The headworks facility contains a 12-inch overflow pipe that transfers influent wastewater to the aerobic digesters if necessary. This operation is used as an emergency procedure if the influent pump station fails and to control infiltration and inflow (I&I) during wet weather. If the influent pump station wet well completely fills, the excess will overflow through a 10-inch pipe to one of the aerobic digesters. The overflow can later be pumped from the digesters to the headworks by the supernatant pumps.

Major Components

- Mechanical Step Screen
- Screenings Compactor
- Vortex Grit Unit
- Stopgates

- Manual Bar Screen
- Grit Pump
- Grit Classifier
- Dumpster
- Water Scour Pipe

<u>Relationship to Adjacent Units</u>

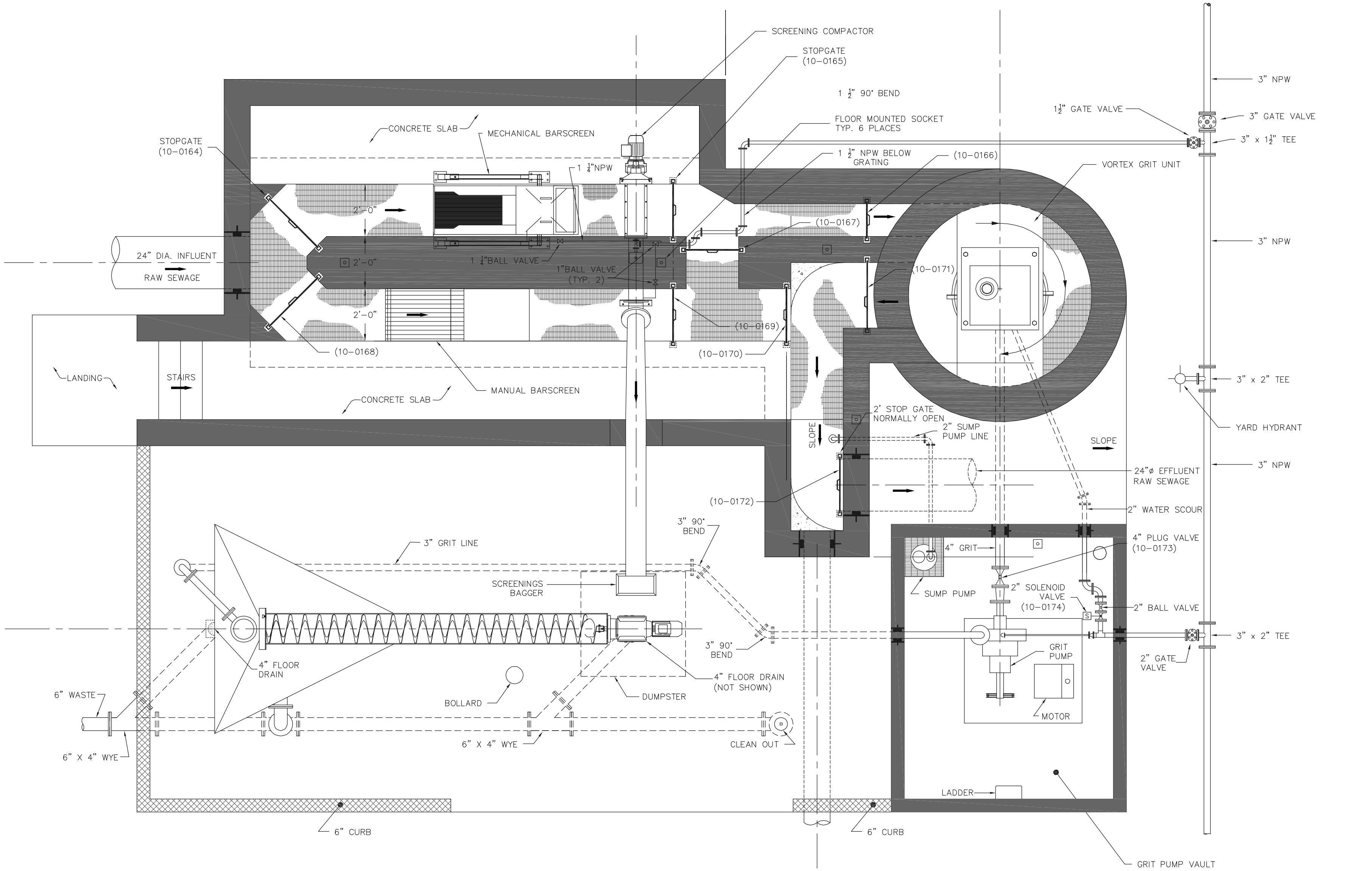
The headworks facility is located south of the oxidation ditch and west of the influent pump station. It is the first treatment step at the wastewater treatment plant and receives inflow directly from the Town of Amherst wastewater collection system through a 24-inch raw sewage influent pipe. Effluent from the headworks flows to the influent pump station.

<u>Normal Operations</u>

(Refer to Figure 3-1 "Headworks Plan," and Figure 1-1, "Process Flow Diagram".)

Under normal operation, influent enters the channel containing the mechanical step screen. At the current flow rate (between 0.3 – 0.4 mgd), the step screen is operated on a timer. However, it also has the capability to operate using a differential style level control system to activate the step process. Ultrasonic level sensors are located before and after the screen. Once the set water level differential is met, the screen will step until the differential drops below a selected level. The screenings press compacts the screenings after an adjustable number of screen steps. Solenoids for NPW equipment washing are activated whenever the respective piece of equipment is operating.

After leaving the mechanical screen channel, wastewater enters the circular vortex grit unit. The grit removal unit operates continuously in the "On" mode to remove suspended solids from the waste stream. Under the current flow conditions (0.3-0.4 mgd), the grit pump and grit classifier are operated by personnel once per day to clear grit from the collection pit. The three units operate as a synchronous system utilizing timers when all three are in the "Auto" position. The process starts by opening the 2-inch solenoid valve for the NPW scour. Once this timer has run out, the grit pump and grit classifier turn on to transfer the grit slurry from the collection pit and into the classifier for final separation and disposal into a dumpster. When this timer runs out, the



ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: HEADWORKS PLAN	FIGURE:	3-1
	APPROVED:	HFW		SCALE:	N.T.S.
				DATE:	12/2005

process stops and repeats after a user-specified time interval. Odors from the screenings and grit dumpster are controlled by hand applying lime daily.

Alternate Mode of Operation

The mechanical screen, screenings compactor, grit pump, and grit classifier can all be operated in continuous or "Hand" mode. Should the inflow exceed the mechanical step screen's hydraulic capacity, stopgates can be opened to allow flow through the manual bar screen. When the bar screen is in use, personnel must be present to monitor and clean the screenings. The manual bar screen may also be used when maintenance requires the mechanical step screen to be shutdown. The stopgates are configured so that either screen can bypass the vortex grit unit.

Operation and Control

Stopgates 10-0164, 10-0165, 10-0166, 10-0171, and 10-0172 are normally open to allow flow through the mechnical step screen and vortex grit unit. If the mechanical step screen needs to be taken out of service, close stopgates 10-0164 and 10-0165 and open stopgates 10-0168, 10-0169, and 10-0167. The vortex grit unit may be bypassed by closing stopgates 10-0166 and 10-0171 and opening stopgates 10-0169 and 10-0167 (if mechanical step screen is in use).

Operating Problems/Solutions

1. Screen does not work although trouble indication light is not lit.

   Causes:

   a. Main isolator is off.
   b. Operation selector switch is in position "0" or "backward".
   c. Emergency cut-off is pushed.
   d. Breaker tripped.
   e. PLC-CPU is stopped.

   Corrective Measures:

   a. Turn on main isolator.
   b. Turn selector switch to position "manual" or "automatic".
   c. Unlock emergency cut-off button and push "reset" button.
   d. Reset breaker.
   e. Turn switch to "run".

2. Trouble indication lamp is lit or trouble is indicated at the display.

Causes:

a. Motor protection switch has triggered.

b. Current relay was activated.

c. Phase breakdown.

Corrective Measures:

a. Switch off main isolator. Check if there are a lot of deposits in front of or between the lamellae and remove them. If there are any lamella which are bent, straighten or replace them. Turn on motor protection switch and push reset button. Turn on main isolator.

b. Switch off main isolator. Check if there are a lot of deposits in front of or between the lamellae and remove them. If there are any lamella which are bent, straighten or replace them. Turn on main isolator.

c. Check fuses in the control panel. Check preceding fuse.

3. Screenings are not transported or fall from the lamellae.

Causes:

a. Fixed and movable lamella do not correspond in zero position. Movable lamellae do not go far enough over fixed lamellae.

Corrective Measures:

a. Basic adjustment of the lamellae has changed, readjust.

4. Wash press does not start.

Causes:

a. Motor protection and/or current relays shows overload.

b. Wrong control.

Corrective Measures:

a. Adjust motor protection and/or current relays correctly.

b. Check electrical control.

5. Press motor rotates but compacting screw does not move.

Causes:

a. Gearbox is defective.

b. Auger is broken.

Corrective Measures:

a. Replace gearbox.

b. Weld or replace auger.

6. Screenings do not move forward in wash press.

Causes:

a. Screenings are too sludgy or too greasy.

b. Pressing zone or washing zone is clogged.

c. There are too many screenings per washing cycle in the inlet hopper.

d. Screenings are too dewatered casing blockages within the discharge pipe.

e. Screw and/or guide bars are worn.

Corrective Measures:

a. Remove the material by adding washed screenings.

b. Move screw slowly backwards by tapping manually and remove blockage by adding water.

c. The screenings volume must be adjusted to the conditions, re-adjust the wash water volume.

d. Adjust length of the discharge pipe to the conditions.

e. Replace compacting screw and/or guide bars if necessary.

7. Requested washing effect is not achieved.

Causes:

a. Wash water feeding is interrupted (no pressure).

b. A solenoid valve or the wash water pump are defective.

c. The regulating valves are closed.

d. Wash water feed line is too small.

e. Wash water is too dirty.

f. Water filter is dirty (if installed).

g. Water entrance openings are clogged.

Corrective Measures:

a. Check wash water feeding.

b. Check valve/pump.

c. Check settings.

d. Install large feed line.

e. Find out the cause, connect different sources.

f. Clean entrance openings.

8. Screenings are not dewatered.

Causes:

a. Water entrance openings in press body are dirty or greasy.

b. Wash water outlet in the tray is blocked.

Corrective Measures:

a. Clean with high pressure and remove water collecting tray to clean openings.

b. Clean the outlet.

Laboratory Controls

There are no laboratory controls for this process.

Safety and Fail-Safe Features

Should the screening facilities become hydraulically overloaded with no personnel present to open the secondary flow channel, inflow will overflow the inflow channel area and into the influent pump station wet well or into the 12-inch overflow that leads to the digesters if the wet well is full. Since the headworks facility is surrounded by a concrete wall, an emergency overflow event should be contained within the facility until personnel can take corrective action.

Start-Up Procedure

Check to make sure none of the machinery is clogged with debris. Check electrical components are working properly and that there are no malfunctions. Be sure that protective covers are attached and the screenings container is emptied. Grit sediments should be removed from the front of the screen. Check all solenoid valves and washing cycles for proper function.

Reference Drawings

- **DAA Record Drawings: July 22, 2004**

  Sheet No. 3 of 20, Drawing No. M-3 – Headworks Plan and Section.

  Sheet No. 4 of 20, Drawing No. M-4 – Headworks Sections.

  Sheet No. 7 of 13, Drawing No. E-7 – Headworks Plan - Electrical.

- **Headworks Operation and Maintenance Manual – Combs & Associates, Inc.**

INFLUENT PUMP STATION

Description

The influent pump station receives wastewater by gravity flow from the headworks facility via a 24-inch pipe. The influent pump station consists of three self-priming Gorman-Rupp suction lift wastewater pumps. The pumps are equipped with variable speed drives (VFDs) and 40 HP motors. Each pump is rated for 860 gpm at 88 ft TDH. Each pump is equipped with a 12 3/8-inch diameter impeller that operates at 1,500 RPM. The pump station wet well consists of a 12-foot by 10-foot rectangular concrete structure approximately 10 feet deep. An air bubbler system monitors the water level and transmits signals back to the influent pump station PLC. The PLC controls the lead/lag arrangement of the three pumps and communicates with the VFDs to increase or decrease pump speed based upon the water level signals from the air bubbler system. The use of VFDs allows consistent flow into the D-Ditch by attenuating influent spikes.

Major Components

- Pumps and Motors
- Pump Station Building and Wet Well
- Force Main
- Level Controls and Control Panel
- Variable Frequency Drive (VFD)

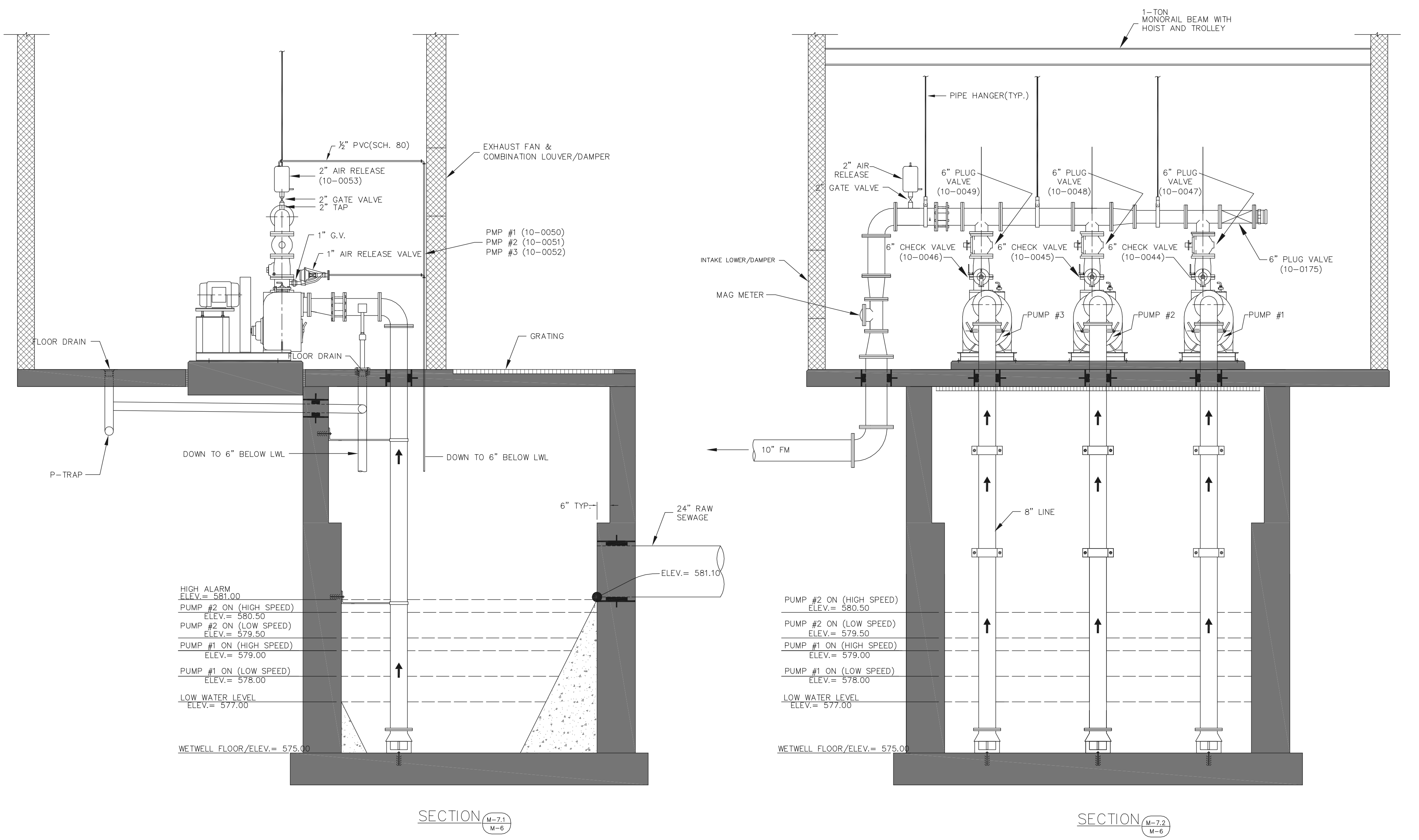
Relationship to Adjacent Units

The influent pump station is located east of the headworks unit. Plant flow enters the pump station from the headworks facility via a 24-inch pipe to the wet well and is pumped through a 10-inch force main to the influent distribution box.

Normal Operation

(Please see Figure 3-2, "Pump Station Sections")

Discharge plug valves 10-0047, 10-0048, and 10-049 should be open. Pumps are controlled by a bubbler type level control system and operate in a lead/lag mode. A ¼–inch stainless steel bubbler line in the wet well is connected to the control panel. Pressure in the bubbler system increases proportionally as the level in the wetwell increases. The pressure transmitter sends a 4-



WW ENGINEERS SURVEYORS PLANNERS ASSOCIATES

DRAWN:	EFA	TITLE: PUMP STATION SECTIONS		FIGURE:	3-2
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				DATE:	12/2005

20 ma signal to the PLC. The PLC can be programmed to control pump sequence and alternation as well as the wetwell levels at which the pumps will run. When the liquid level reaches the lead pump (pump #1) low speed start level at elevation 578.00 feet, the PLC sends a relay that calls the VFD (variable frequency drive) to run. The VFD will run at a speed based on the 4-20 ma signal from the PLC to maintain the desired wet well level or until the wetwell level reaches the pumps off level at 577.00 feet. The VFD ramps up to full/high speed at elevation of 579.00 feet. If the liquid level continues to rise then the lag pump (pump #2) VFD will start at low speed at elevation of 579.50 feet. The lag pump will ramp up to full speed at the elevation of 580.50 feet and both pumps will run until the wetwell reaches the desired level. At this point the lead pump will stop running and the lag pump will become the lead pump. The third pump will become the lag pump when the lag pump is next called to run. A pump duty selector switch allows the pumps to alternate as the lead and lag pumps automatically after each cycle.

If the wastewater level in the wet well rises to the high level float switch, an external high water level alarm light will turn on at an elevation of 581.00 feet and will stay on until the high level condition no longer exists. For emergency low level cutoff, a float switch is installed in the wetwell below the programmed low level set point in the PLC. If the PLC loses its signal from the pressure transmitter and the pumps continue to operate past the programmed stop pump level, the float switch will signal to the PLC to stop all pumps.

Alternate Mode of Operation

A backup float system is enabled when the PLC fails. When the liquid level reaches the elevation for the lead pump, a float switch will signal the VFD to run at full speed until the level drops below the emergency low level float switch. The lag pump will run at full speed should the liquid level continue to rise to the lag pump level. Both pumps will run at full speed until the level drops below the emergency low level float switch.

Should all the pumps fail in an emergency situation, the sludge transfer station portable pump may be used as a backup. First, open cam lock fitting and connect flexible hose that leads to the digesters. Open plug valve 10-0175 and allow wastewater in the force main to drain to the aerobic digesters. Afterwards, remove the flexible hose, connect the portable pump, and pump wastewater from the wet well into the force main.

Operation and Control

The automatic operation of the pumps is enabled by a bubbler system. A pressure transmitter senses the pressure in the level control system air piping to provide continuous wet well level signals. As the water rises in the wet well, the system monitors the liquid level and transmits a signal to start or stop the pumps at designated levels. Two additional settings are provided to sound alarms in the event that extreme low or high water levels occur.

The pumping sequence of the three suction lift centrifugal pumps is controlled by the influent pump station PLC. The three pumps operate in a lead/lag arrangement and the PLC is programmed to control the pump sequence. A pump duty selector switch is inputted to the PLC for pump alternation sequence. After completion of one pump cycle, the switch allows the pump arrangement to change when the pressure switch is next activated.

Operating Problems/Solutions

1. No pump discharge.

   Indicator:

   a. No discharge from pumping station.

   Monitoring, Analysis, and/or Inspection:

   a. Check to see if pump is primed.
   b. Check pump speed.
   c. Verify discharge valves are open and air release valves are functioning properly.
   d. Check to see if impeller is rotating in correct direction.
   e. Determine if motor is receiving full voltage.
   f. Verify if VFD is operational.

   Corrective Measures:

   a. Prime pump.
   b. Open discharge valves.

2. Insufficient pump discharge.

   Indicator:

   a. Low discharge from pumping station.

   Monitoring, Analysis, and/or Inspection:

   a. Check pump speed.
   b. Check for air lock.
   c. Determine if the suction check valve is stuck open or clogged.
   d. Check to see if suction opening is submerged enough.
   e. Check for possible clogging or damage of impeller.
   f. Determine if motor is receiving full voltage.

   Corrective Measure:

   a. Clean out debris, repair or replace impeller.
   b. Correct any voltage problem.
   c. Bleed air from discharge piping.

3. Insufficient pump pressure.

   Indicator:

   a. Little or no discharge from pumping station.

   Monitoring, Analysis, and/or Inspection:

   a. Check to see if pump speed is too low.
   b. Check for air or gases in liquid.
   c. Check for damaged impeller.
   d. Check for correct rotation of impeller.
   e. Check to see if impeller diameter is too small.

   Corrective Measures:

   a. Repair or replace impeller.
   b. Correct rotation of impeller.
   c. Replace with larger diameter impeller.

4. Pump will not start.

Indicator:

a. Blown fuses or tripped circuit breakers.
b. VFD default.

Monitoring, Analysis, and/or Inspection:

a. Switch (breakers) contacts corroded or shorted.
b. Motor shorted or burned out.
c. Rating of fuses or circuit breakers not correct.
d. Automatic control mechanism not functioning properly.
e. Wiring hookup or service not correct.
f. Shaft binding or sticking because of rubbing impeller, tight packing gland, or clogging of pump.

Corrective Measures:

a. Correct automatic control mechanism.
b. Overhaul motor.
c. Use correctly rated fuses or circuit breakers.
d. Adjust alignment on pump shaft.
e. Replace or adjust packing gland.

Laboratory Controls

There are no laboratory control tests required for the influent pump station.

Safety and Fail-Safe Features

Each of the three pump discharge lines is equipped with a suction check valve to prevent backflow of wastewater through the pump to the wet well. A high liquid level alarm light turns on to warn the operator of a dangerous operating condition when the wet well level rises to the high level float switch. An emergency low level float switch provides a "pumps off" signal should the pumps continue to run after the liquid level is below the pump cutoff elevation. The pumps are equipped with high pump temperature protection that shuts down the pump motors to protect the pump from damage. The pump overtemp switch is wired directly to the VFD and disables the VFD when high temperature conditions arise. The PLC will light an indicating light in this situation. The pump station building is also equipped with louvers, an exhaust fan and a heater.

Start-Up Procedure

Before start-up, check all plug valves for the correct operating position. The pumps should be inspected for proper installation, clearances, and alignment. Check the lubricant of each pump for proper level and condition. Refill or replace as necessary. "Bump" the pumps and check for proper rotation of the impeller. Refer to the manufacturers' instruction manual for more comprehensive start-up procedures. After starting the pumps, check frequently for noise, vibration, and overheating.

Reference Drawings

- **DAA Record Drawings: July 22, 2004**
  Sheet No. 6 of 20, Drawing No. M-6 – Pump Station Plan
  Sheet No. 7 of 20, Drawing No. M-7 – Pump Station Sections
  Sheet No. 8 of 13, Drawing No. E-8 – Influent Pump Station Plan – Electrical
- **Influent Pump Station Installation, Operation and Maintenance Manual – The Gorman-Rupp Company**

OXIDATION DITCH

Description

An oxidation ditch provides aeration and complete mixing of activated sludge and influent wastewater in an extended aeration process. This process maintains a low food-to-microorganism (F/M) ratio and long aeration time to maintain the activated sludge in an endogenous phase. The appropriate F/M ratio is accomplished by contacting influent wastewater with biological microorganisms called activated sludge. The activated sludge feeds on the organic constituents in the waste with the presence of dissolved oxygen supplied by the aeration equipment. During the endogenous phase, the amount of available food is at a minimum and microorganisms begin to feed on themselves.

The Rutledge Creek WWTP utilizes a variation of the oxidation ditch called the Double Ditch (D-Ditch). The D-Ditch is similar to conventional oxidation ditches except that it utilizes phased isolation ditch (PID) technology to achieve nitrification, denitrification, and clarification. The D-Ditch process employs an advanced user-customizable Supervisory Control And Data Acquisition (SCADA) system that automatically monitors and controls the phased operation. The user interface for the SCADA system is located in the lab control building. The following is an excerpt from the Kruger Double Ditch Process O&M Manual describing the D-Ditch process:

> A wastewater treatment plant employing the D-Ditch process resembles a conventional oxidation ditch system. The major components common to both conventional oxidation ditches and the D-Ditch process are the closed loop reactor basins where aeration or oxygenation of the mixed liquor takes place. A distinguishing feature of the D-Ditch process is that it does not require a separate clarifier for settling the mixed liquor or a return sludge pumping system. In addition, the D-Ditch plant follows a series flow pattern and alternates process conditions within the oxidation ditches to perform specific treatment objectives.

Although treatment and clarification are carried out in a batch-type operation, influent and effluent flows are continuous. The facility utilizes two interconnected ovalized oxidation channels with a volume of 300,000 gallons each. Both ditches are equipped with two horizontal brush aerators that provide adequate aeration and flow velocity during oxic (nitrification) phases.

Each ditch also contains a submersible mixer that provides mixing during anoxic (denitrification) phases when the brush aerators are turned off. Based on a design flow of 0.6 mgd, the hydraulic detention time is approximately 24 hours.

Each oxidation ditch is equipped with a telescoping valve that allows control of the waste activated sludge (WAS) flow. The WAS flow plays a critical process control role by helping keep the sludge age relatively constant. Wasted sludge from the oxidation ditches flows by gravity through a metering vault and then to the aerobic digesters

Major Components

- Influent Distributor
- Four 3.0-meter Horizontal Brush Aerators with 15 HP Motors
- Two 6.0 HP Submersible Mixers
- Two 5.0-meter Motor Actuated Effluent Weirs
- Two Manual Operated Rotating Scum Pipes
- Two Dissolved Oxygen Probes
- Two Ultrasonic Level Transmitters
- Programmable Logic Control (PLC) based Control Panel
- Telescoping Valves
- Magnetic Flow Meter

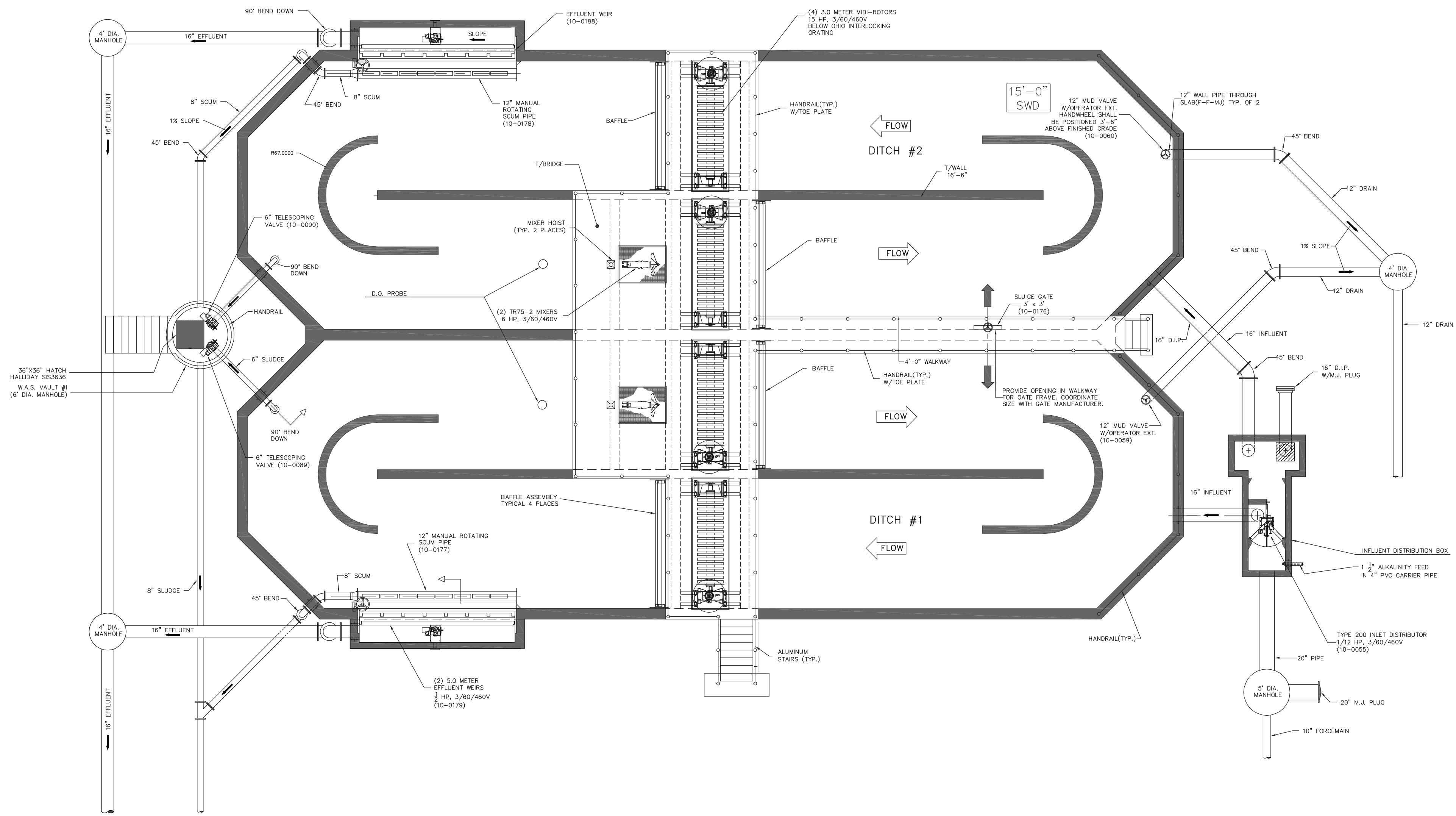
Relationship to Adjacent Units

The D-Ditch is west of the lab control building. It receives flow from the influent pump station via a 10-inch force main. Flow exits the D-Ditch through effluent weirs and flows to the effluent filter.

Normal Operation

(Refer to Figure 1-1, "Basic Wastewater Flow Diagram," and Figure 3-3, "Phased Oxidation Ditch - Plan.", Figure 3-4, “W.A.S. Vault Sections”).

The following is an excerpt from the Kruger Double Ditch Process O&M Manual describing the D-Ditch operation:



ENGINEERS SURVEYORS PLANNERS ASSOCIATES

DRAWN:	EFA	TITLE: PHASED OXIDATION DITCH – PLAN		FIGURE:	3–3
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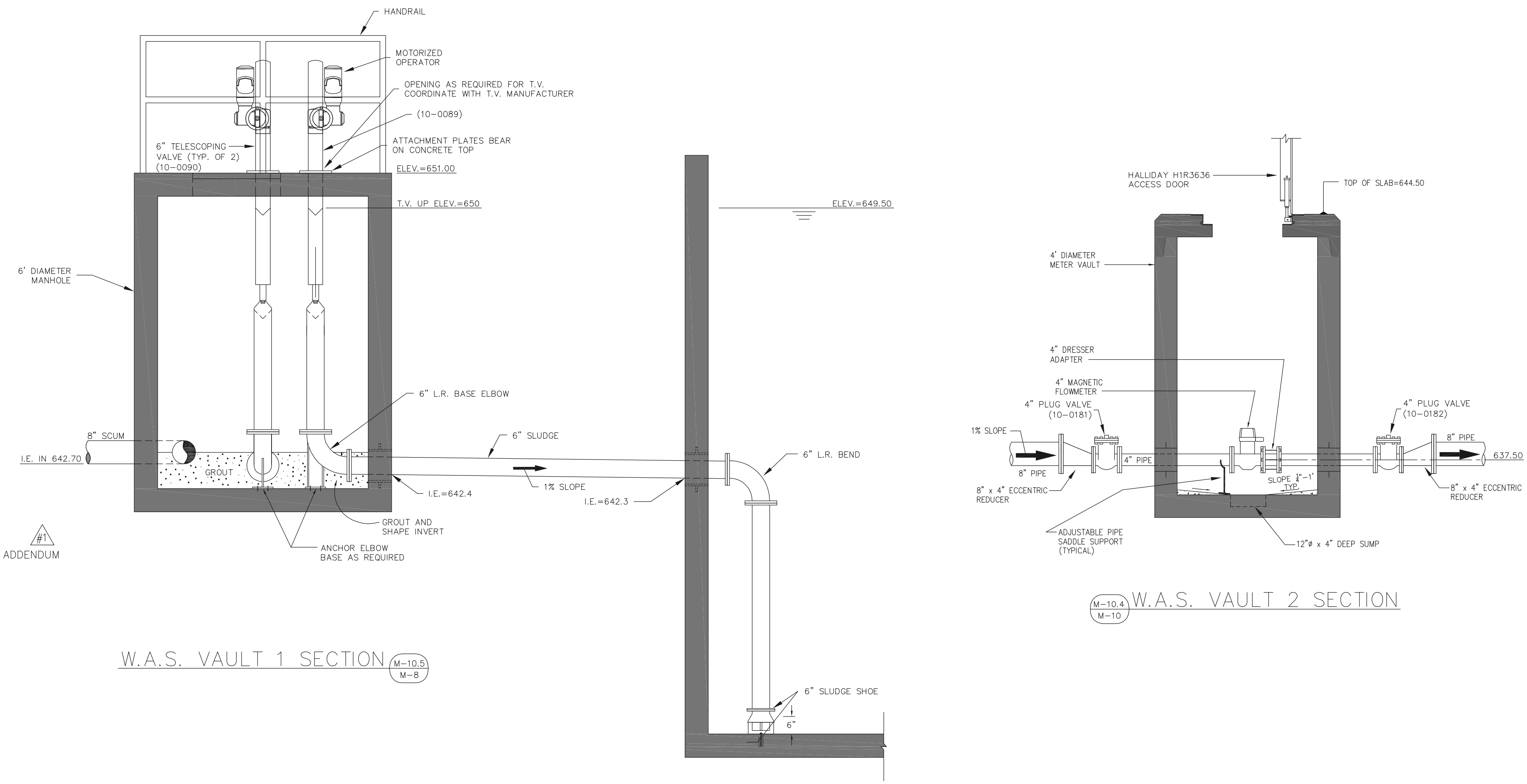


W/W ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: W.A.S. VAULT SECTIONS		FIGURE:	3-4
					SCALE:	N.T.S.
	APPROVED:	HFW			DATE:	12/2005

The influent distributor directs the influent mixture into Ditch 1 or Ditch 2 depending on the status of the process. The raw wastewater flow enters the oxidation ditch, and is immediately blended into the mixed liquor coursing around the ditch. The mixed liquor passes through the oxidation ditches in series in the D-Ditch process. The direction of flow alternates from Ditch 1 to Ditch 2, and from Ditch 2 to Ditch 1, depending on the phase of operation.

As the mixed liquor passes through the ditches, the ambient conditions are alternated between oxic, anoxic, and quiescent to accomplish nitrification, denitrification, and clarification without external clarifiers or returnactivated sludge (RAS) streams. The hydraulic capacity or volume in the oxidation ditches is large in comparison to the influent flow volume. Therefore, the concentrations of the pollutants are greatly diluted upon entering the ditches. This dilution of the influent wastewater helps to make the oxidation ditch processes very "forgiving". In other words, the plant is not easily upset by shock loadings of organics.

Operation of the MIDI-Rotors is determined both by the process phases and by the D.O. concentration in the ditches. Preprogrammed upper and lower D.O. concentrations are established and entered into a Programmable-Logic Controller (PLC). When the D.O. concentration in the mixed liquor reaches the upper level, the D.O. monitor signals the PLC to switch rotors off and switch the mixer on. Similarly, if the D.O. concentration drops to the lower level, a rotor(s) is turned back on and the mixer is turned off.

The D.O. setpoint and the deadband width are programmed into the control panel to establish the upper and lower D.O. concentrations. For example, consider a D.O. setpoint of 1.0 mg/l and a deadband width of 0.25 mg/l programmed into the PLC. In this case, when the D.O. concentration reaches 1.25 mg/l, one rotor in the aerating ditch would be turned off. Similarly, if the D.O. concentration fell to 0.75 mg/l, a rotor would be turned back on.

> The effluent weirs control the liquid level in the ditches, as well as the flow path through the ditches. The submergence of the rotor can be varied in increments from 4 to 11 inches. The level sensor in the ditch monitors the liquid depth and feeds that data to the PLC. The PLC processes the data and controls the operation of the weirs. If the level in the ditch increases, the weir is lowered to maintain the desired submergence. Similarly, if the level in the ditch decreases, the weir is raised to account for the change. The intention behind this feature is to operate the rotors at their most efficient submergence to reduce power consumption and maximize oxygen transfer. For the MIDI rotors this optimum submergence point is approximately 9.1 inches.

The D-Ditch is equipped with the capability to feed lime into the influent stream. This injection takes place inside the influent distributor just before wastewater flows into the ditches. The lime provides alkalinity control in the D-Ditch for maintaining the optimum pH to sustain the biological reaction. In addition to aiding in biological control, the lime allows control of the effluent hardness. The plant's VPDES permit requires a minimum hardness in order to control the toxicity of copper in the effluent. For proper control, alkalinity in the D-Ditch must be monitored regularly.

The following is an excerpt from the Kruger Double Ditch Process O&M Manual describing the D-Ditch phasing process:

> Phased Isolation Ditch Technology in the D-Ditch mode of operation can be best understood by following the process through one complete 8-hour cycle of operation. One complete cycle set forth in this example consists of eight phases. The phases are labeled B, D, E, F, H, J, K, and L. Please note that Phases H, J, K, and L are simply "mirror images" of Phases B, D, E, and F.

The cycle begins with Phase B followed by Phase D. Please note that these phases are exactly the same and in this example the total duration of both phases is 3 hours (1.5 hrs each). Please note if denitrification is desired additional anoxic phases will be incorporated into the system (refer to Table 3-1 phases A-D). In Phases B and D, the influent wastewater is directed to Ditch 1 (See Figure 3-5). Ditch 1 is in the aeration mode of operation. The rotors in Ditch 1 aerate the mixed liquor, resulting in the degradation of the influent BOD and nitrification of ammonia-nitrogen.

In Phases B and D, the influent enters Ditch 1, where the effluent weirs are raised producing a hydraulic gradient that forces the mixed liquor to Ditch 2, where the biosolids settle. The motorized effluent weirs are lowered in Ditch 2 to allow the treated and clarified effluent to continue on to further treatment, such as disinfection. The process will continue to operate in the mode for 3 hours, before advancing to Phases E and F.

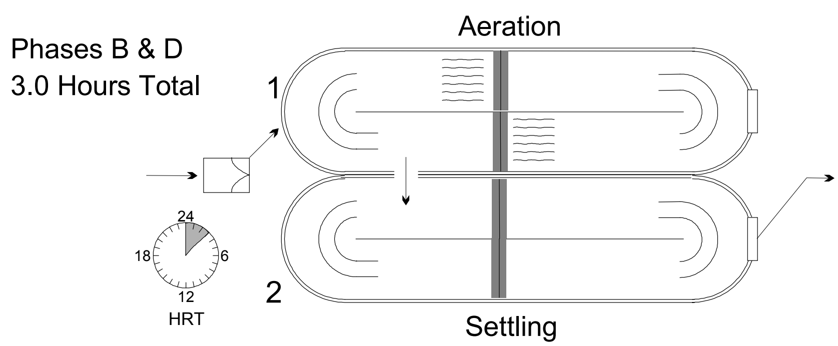


Figure 3-5 D-Ditch Process Phases B & D.

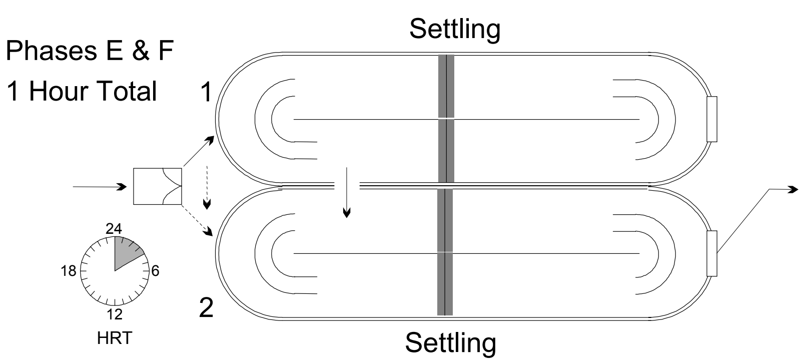


Figure 3-6 D-Ditch Process Phases E & F.

Phases E and F are intermediate phases with a total duration of 1.0 hour (0.5 hrs each), during which quiescent conditions are maintained in both ditches (See Figure 3-6). During these phases, Ditch 2 is still settling from the previous phase, and will continue settling throughout the duration of these phases. In addition, the effluent will continue to be discharged from Ditch 2 through both phases. After thirty minutes the system moves from Phase E to Phase F. The automated flap gate-type flow distributor in the distribution chamber, which was directing the influent to Ditch 1, switches position from the left to the right. This directs the influent to the inlet pipe discharging to Ditch 2, instead of Ditch 1. The purpose of Phase F is to completely isolate Ditch 1 from flow patterns to promote quiescent conditions. The distributor is operated automatically via PLC, however, the unit can also be operated manually in the event of an emergency.

In Phases H and J, the effluent weirs in Ditch 2 are raised and the effluent weirs in Ditch 1 are lowered. The hydraulic gradient is now shifted so that the flow direction is from Ditch 2 to Ditch 1, with Ditch 1 discharging effluent (See Figure 3-7). It must be noted that Phases H and J are exactly the same and that anoxic sub-cycles can be included into the phasing by turning all of the rotors off and turning the mixer on. (refer to Table 3-1 phases G-J).

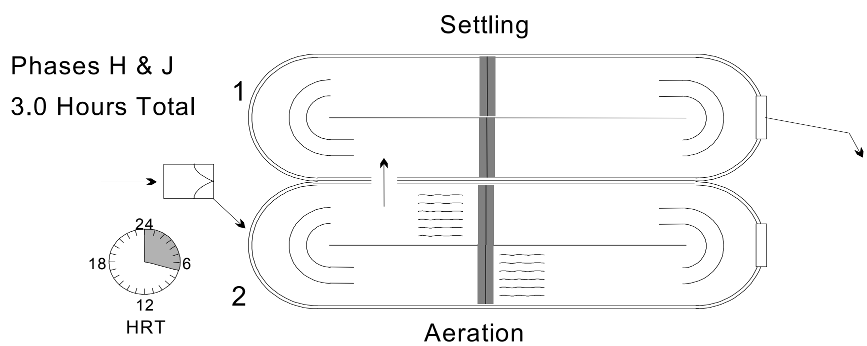


Figure 3-7: D-Ditch Process Phases H & J.

Ditch 1, which was quiescent in Phases E and F, will continue settling during Phases H and J. The rotors in Ditch 2 are turned on, and will maintain oxic conditions in Ditch 2 throughout Phases H & J (3.0 hours).

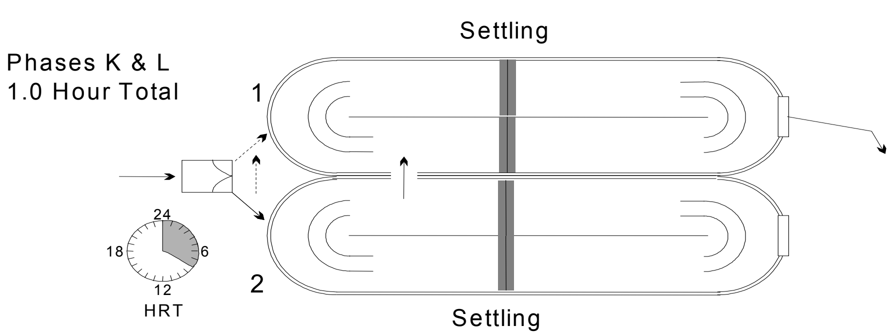
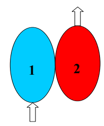
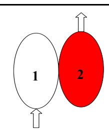
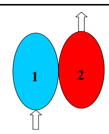
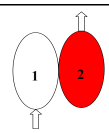
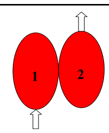
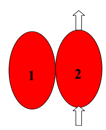
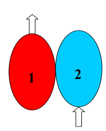
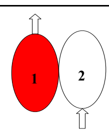
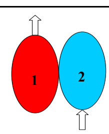
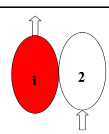
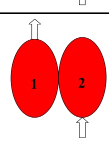
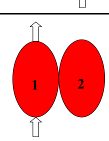


Figure 3-8 D-Ditch Process Phases K & L.

Table 3-1 Current D-Ditch process control.

Phase	Flow Pattern/ Process Conditions	Operator Input. Time (min)	Ditch 1	Ditch 2
A		Default: 0 Range: 0-60 **Currently: 0**	• Denitrification • Rotors off • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
B		Default: 90 Range: 0-180 **Currently: 90**	• Nitrification • Rotors on • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
C		Default: 0 Range: 0-60 **Currently: 15**	• Denitrification • Rotors off • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
D		Default: 90 Range: 0-180 Currently: 105	• Nitrification • Rotors on • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
E		Default: 30 Range: 0-60 **Currently: 15**	• Settling • Rotors off • Mixers off • Weir up	• Settling • Rotors off • Mixers off • Weir down
F		Default: 30 Range: 0-60 **Currently: 30**	• Settling • Rotors off • Mixers off • Weir up	• Settling • Rotors off • Mixers off • Weir down
G		Default: 0 Range: 0-60 **Currently: 0**	• Settling • Rotors off • Mixers off • Weir down	• Denitrification • Rotors off • Mixers on • Weir up
H		Default: 90 Range: 0-180 **Currently: 90**	• Settling • Rotors off • Mixers off • Weir down	• Nitrification • Rotors on • Mixers on • Weir up
I		Default: 0 Range: 0-60 **Currently: 15**	• Settling • Rotors off • Mixers off • Weir down	• Denitrification • Rotors off • Mixers on • Weir up
J		Default: 90 Range: 0-180 **Currently: 105**	• Settling • Rotors off • Mixers off • Weir down	• Nitrification • Rotors on • Mixers on • Weir up
K		Default: 30 Range: 0-60 **Currently: 15**	• Settling • Rotors off • Mixers off • Weir down	• Settling • Rotors off • Mixers off • Weir up
L		Default: 30 Range: 0-60 **Currently: 30**	• Settling • Rotors off • Mixers off • Weir down	• Settling • Rotors off • Mixers off • Weir up

Phases K and L are other intermediate phases with a total duration of 1.0 hour (0.5 hrs each). Phase K is initiated by discontinuing aeration in Ditch 2. Ditch 1 continues to discharge effluent (See Figure 3-8). At the end of Phase K, the influent flow distributor changes position to direct flow back into Ditch 1 signaling the start of Phase L. The purpose of Phase L is to completely isolate Ditch 2 from flow patterns to promote quiescent conditions. At the end of phase L, the entire cycle will have been completed. The weirs in Ditch 1 will be raised, while the weirs in Ditch 2 are lowered and another 8 hour cycle of operation will begin.

One should note that based on a Hydraulic Retention Time (HRT) of 24 hours, one complete 8 hour cycle accounts for 33% of the HRT. In addition, sludge can be wasted from the ditch under oxic conditions as mixed liquor or during settling phases as settled sludge.

A total of twelve (12) phases are programmed into the SCADA system. All twelve phases are illustrated in Table 3-1 along with both the default and current phase timing. Please note that if the time duration of a phase is set to zero, the system will skip the phase in sequence and move into the following phase. The example provided above illustrates how the system will run based on the default settings.

Sludge wasting can be accomplished by lowering the telescoping valves during the quiescent ditch phases. This operation is controlled manually through the SCADA system user interface in the lab building or at the local telescoping valve control panel. The two valves have 30-inches of vertical travel and draw settled sludge from the bottom of the ditches by utilizing the head differential that is created when the valves are lowered below the water level in the ditches. The sludge flows through the 6-inch suction lines and into the WAS Vault 1 where it drains into an 8-inch scum pipe that flows to WAS Vault 2 where it is metered by a magnetic flowmeter. After exiting WAS Vault 2, sludge flows down to the aerobic digesters.

Emergency/Alternate Mode of Operation

The following is an excerpt from the Kruger Double Ditch Process O&M Manual describing alternative and emergency operational schemes for the D-Ditch:

The following section should be used as a guide to aid the operators in running the activated sludge process during periods of emergency, start-up, or alternative process conditions. The term “emergency” is used to indicate that a piece of equipment, whether an influent distributor or rotor, is not in service. Although this section should be consulted during the emergency periods, ***Kruger personnel should also be contacted.*** In all cases, the piece of equipment should be repaired and put in service as quickly as possible.

Loss of Influent Distributor

Similar to losing an automatic effluent weir, the loss of an influent distributor will not allow the flow pattern to be automatically changed or the ditches to be automatically isolated. However, the process can still be operated for short periods by manually placing the influent distributor to send flow to one ditch and placing that Ditch in A-Ditch mode.

Loss of Effluent Weir in Oxidation Ditches

With loss of <u>one</u> automatic effluent weir, the ditch with the functioning weir can be operated in the A-Ditch mode for a very short period.

Loss of a Rotor

If one of the rotors is out of service, the D-Ditch system can still be operated in the AUTO mode for a short period of time (days). The system can continue with only one rotor available in a ditch. Depending on the organic load to the plant, the DO setpoint may not be achieved during aerobic phases but nitrification can still take place at low DO levels (<1.0 mg/L). Please note that if one rotor is taken out of service, the mixer should remain on throughout the duration of oxic phases to ensure the mixed liquor remains suspended.

Loss of a Mixer

If one of the mixers is out of service, the D-Ditch system can still be operated in the AUTO mode for a short period of time without a major impact upon overall effluent quality due to mixing imparted by flow velocity. The system will temporarily not be able to operate fully with the optional denitrification phases because the solids will settle during this phase.

Loss of Oxidation Ditch (A-Ditch Operation)

NOTE: Please contact Kruger before the system is placed into this mode of operation. If flow is greater than 50% of the design flow, the system may have trouble meeting permit limits. For this reason, this mode should only be used for very short durations.

If one (1) oxidation ditch is taken out of service, the other oxidation ditch can be used to create both oxic and quiescent conditions while taking the full influent load. This is called the A-Ditch mode of operation.

In order to initiate the A-Ditch mode of operation, the operating mode will have to be turned to either position 1 for Ditch 1 operation, or position 2 for Ditch 2 operation. In the A-Ditch mode of operation, influent is continuously directed to one ditch, and discharge is released from that same ditch on an intermittent basis. The water level in the ditch will fluctuate as a result of the A-Ditch method of operation.

At the beginning of the cycle, the water level will be at the minimum elevation. As influent enters the ditch, the water level will slowly rise. The Midi-Rotors aerate the mixed liquor during this filling of the ditch. Throughout this phase of the cycle, the motorized effluent weir remains in the raised position to prevent any discharge from the ditch. There is approximately 0.458 feet of difference between the minimum Side Water Depth (SWD, corresponding to 5” rotor submergence) at which the Midi-Rotors can operate and the maximum operational SWD (corresponding to 10.5” rotor submergence). There is approximately 0.33 feet of difference between the minimum SWD and the normal operation SWD (corresponding to 9” rotor submergence). The water levels are illustrated in Figure 3-9.

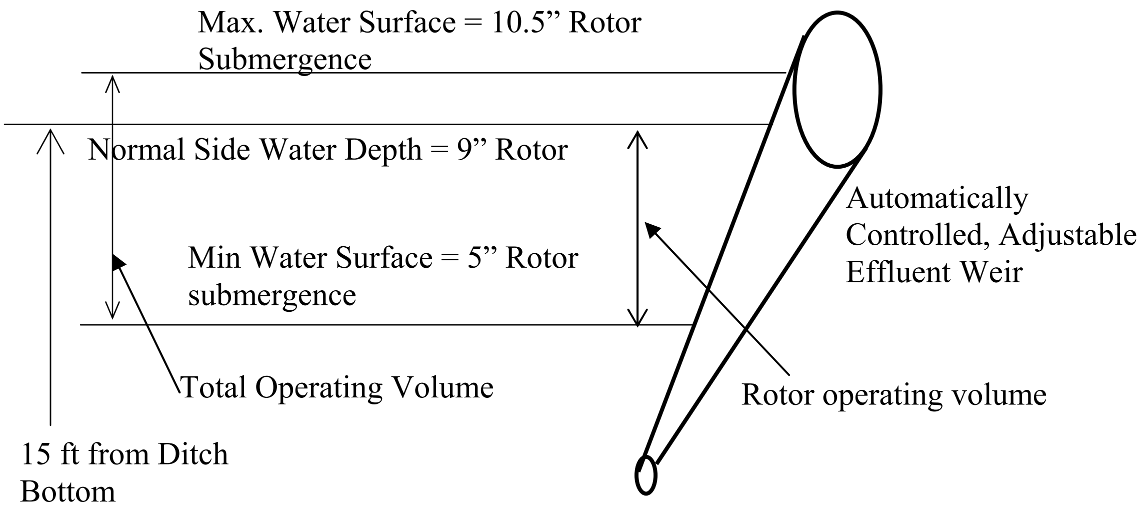
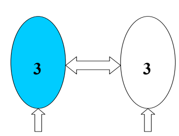
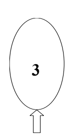
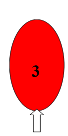
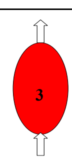


Figure 3-9 Operating Water Levels and Operating Volume

The four phases of the A-Ditch Process are illustrated in Table 3-2 below.

Table 3-2 A-Ditch Operational Phases

Phase	Flow Pattern/ Process Conditions	Operator Input. Time (min)	Ditch 1 or 2
AA		**Subphase DN:** Default: 0 Range: 0-30 **Subphase N:** Default: 54 Range: 0-90 **Max WL = 10”**	**Subphase DN:** • Rotors off • Mixers on • Weir up **Subphase N:** • Rotors on • Mixers on • Weir up
AB		Default: 10 Range: 0-20 **Max WL = 10.5”**	• Nitrification • Rotors on • Mixers on • Weir up
AC		Default: 30 Range: 0-60 **Max WL = 12”**	• Settling • Rotors off • Mixers off • Weir up
AD		Default: 50 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down

- Phases AA consists of a series of nitrification and denitrification subphases. The phases will Alternate until the main time duration runs out or the maximum water level is achieved
- Phase AB consists of a short aerated period, which is always put into operation before starting settling phases (Phase AC) to ensure aerobic conditions before settling. When the water level rises to the maximum, phase AA is interrupted, and phase AB is started.
- In phase AC, the sludge settles. This phase will continue until the time duration runs out or when the maximum water level is achieved.
- In phase AD, the weir is slowly lowered, and the treated wastewater leaves the tank.

<u>Operation and Control</u>

In order for the activated sludge process to function properly, it is imperative to maintain a biological sludge or MLSS with good physical characteristics. Most importantly, it must flocculate well and settle rapidly during the quiescent phases. The key to successful activated sludge treatment is the ability to control and maintain solids settling in the system while achieving the desired BOD removal. The activated sludge organisms will perform best when the proper amount of food is available. If they are overfed or underfed, upsets could occur that may result in a bulking sludge which is difficult to handle.

The wasting of sludge is an essential part of any activated sludge treatment process. If sludge is not removed from the activated sludge system, it could overflow the clarifiers' effluent weirs. Increasing the return sludge pumping rate without wasting a portion of the sludge does not solve the problem. Ultimate control of the system, no matter what intermediate operating decisions are made, will always be based on solids wasting. There are three common methods used by wastewater treatment plant operators to assist in the decision about the amount of sludge to be wasted. The three methods are as follows:

1. Control by maintenance of a constant sludge age.
2. Control by maintenance of a constant mixed liquor volatile suspended solids (MLVSS).
3. Control by maintenance of a constant food-to-microorganism (F/M) ratio.

Kruger recommends that the Rutledge Creek Wastewater Treatment Plant be controlled by maintenance of a constant sludge age. The term sludge age is also commonly termed the solids retention time (SRT) or the mean cell residence time of the activated sludge system. The following is an derived from the Kruger Double Ditch Process O&M Manual regarding the three ditch control methods:

Control by Maintenance of a Constant Sludge Age

Sludge Age or Solids Retention Time (SRT) or Mean Cell Residence Time, days =

$$\frac{\text{TSS in Aeration Tank}}{\text{Solids Wasted + Solids Lost in Effluent per day}}$$

Average sludge age will be simply the total amount of solids in the system divided by the amount leaving the system each day. If it takes 5 days to get rid of an amount of sludge equal to that contained in the system, then the sludge will be there an average of 5 days or will have a sludge age of 5 days. In equation form, sludge age would be represented as follows:

$$SRT = \frac{VaX}{Qw\,Xu + Qe\,Xe} \quad \textbf{(1)}$$

where:

SRT = sludge age, days

Va = volume of aeration tanks, gal

X = average active microbial solids concentration in the aeration tank, mg/l

Qw = flow rate of sludge being wasted, gpd

Xu = average concentration of activated sludge in final settling tank underflow, mg/l

Qe = flow rate of wastewater leaving plant, gpd

Xe = average solids concentration in the effluent, mg/l

Where the amount of solids in the effluent, Xe, is small, the term Qe Xe may be neglected. Considering these assumptions, Equation 1 is simplified as follows:

$$SRT = \frac{X \bullet Va}{Qw\,Xu} \qquad \textbf{(2)}$$

Solving for the amount to be wasted:

$$Qw = \frac{X \bullet Va}{SRT\,Xu} \qquad \textbf{(3)}$$

The operator can set the sludge age, SRT, that he/she feels will work well or has found to work well for the particular plant. Therefore, to calculate the wasting rate, Qw, the operator needs to know only the volume of the aeration basin (Va), the solids concentration of both the mixed liquor (X), and the settled sludge (Xu).

The only lab work involves determining the mixed liquor and settled sludge solids concentrations. The ratio X/Xu as it appears in Equation 3 also can be approximated very quickly by centrifuging samples of both the aeration mixed liquor and the settled sludge and looking at the relative solids concentrations. If normal settling tests are done, the X/Xu ratio also can be approximated by taking the solids heights in a 1L graduated cylinder after 30 min. settling and dividing that height by the initial solids height in the settling cylinder. The overriding advantage of this method of solids control is that it is inherently simple and requires a minimum of lab work.

Normally, the sludge age would be varied several times throughout the year to take into account changes in other operating variables such as temperature. For instance, in summer the reaction rates of the activated sludge system are greater, requiring fewer bacteria to do the job and consequently a lower sludge age than is required in winter.

In the double ditch process, mixed liquor is wasted directly from the oxidation ditches to thickeners or primary tanks. The mixed liquor can be wasted either during oxic or settling phases. If wasting occurs during settling phases, the WAS flow needs to be cycled on and off.

The pulse pattern is to prevent rat-holing in the sludge blanket. If wasting occurs during the aeration phase, the control system becomes even simpler. The concentration of the wasted solids, Xu, is the same as the concentration of the mixed liquor, X and so equation 3 becomes:

$$Qw = \frac{X \bullet Va}{X\,SRT} \qquad \textbf{(4)}$$

or

$$Qw = \frac{Va}{SRT} \qquad \textbf{(5)}$$

The operator needs to know only the volume of the aeration tank and the preferred sludge age. In other words, the wasting rate is a constant volume per day and is independent of solids concentration. This process of wasting mixed liquor rather than settled sludge is called hydraulic control of the activated sludge system.

The hydraulic control system is self-regulating. A constant volume of mixed liquor is wasted. As the concentration of the mixed liquor increases, the mass of solids wasted also increases, lowering the MLVSS concentration over a period of time. If the MLSS concentration decreases below the level dictated by the selected sludge age, the mass of solids wasted decreases, raising the MLVSS concentration over time. The hydraulic control system lends itself to automation readily and is the simplest system to control. This system may be adopted readily to simplify the control of any existing activated sludge plant. Sludge thickening or solids separation facilities must be available, however. The hydraulic system of sludge age control is effective and results in stable operation of the process because there will be less variation in the F:M ratio and sludge age than with other control methods. However, the operator must waste a larger volume of mixed liquor than of settled sludge, and the associated pumping costs will be higher.

Control by Maintenance of a Constant MLVSS

According to this method, the operator must maintain a constant mass of organisms to use the incoming food supply. More simply, if the operator finds that a MLVSS concentration of 2,000 mg/1 works effectively at the plant, then that level will be maintained. If the solids in the oxidation channels increase above 2,000 mg/1, the operator will waste more sludge until the

MLVSS level is again 2,000 mg/1. If the MLVSS drops below 2,000 mg/1, the operator will waste less and allow the solids concentration to increase. A graph should be kept, with readings from the analyzer taken two times per shift and recorded on the graph paper to give a visual indication of the rise or fall of the solids concentration.

This method has a rather severe limitation in that the F/M ratio is completely ignored. For example, suppose the BOD_5 of the incoming waste increases by 50 percent over a substantial period of time. This BOD_5 increase could be the result of seasonal loadings from local schools when they are in operation. The increased solids production from the BOD_5 load would be wasted to maintain the constant MLVSS. The result of this action, however, is that the F/M ratio is 50 percent higher than the previously maintained ratio, and the organic overload could easily lead to process inefficiency or failure. This limitation could be minimized if the operator has determined from experience when the MLVSS must be changed to match an anticipated change in the incoming load.

Control by Maintenance of a Constant F:M Ratio

The third method of control is by maintenance of a constant food-to-microorganism (F/M) ratio. The F/M ratio can be calculated by dividing the pounds of BOD_5 in the plant influent by the pounds of MLSS in the system. Using this method, the operator must maintain a constant F/M ratio by increasing or decreasing the MLSS (through the process of wasting) to match an increase or decrease in the BOD_5 entering the plant. Most plants of this type operate optimally with an F/M ratio between 0.02 and 0.10. If the optimum F/M ratio has been determined from experience and can be maintained, a good quality effluent may be produced with consistent plant operation. Example calculations for determining the F/M ratio and wasting rates for this method are provided in Appendix 10.

This method of control is probably the most difficult and would be acceptable only if the plant received a waste with very predictable variations. The successful use of this method requires a large amount of laboratory work because it is necessary to know the amount of food added to the system and the mass of organisms in the system. Additionally, if the influent does not exhibit predictable variations, using the BOD_5 or COD tests as indicators would be too slow to allow MLSS adjustment according to incoming waste strength.

An additional disadvantage of this method is that the suspended solids test is not an accurate measure of active mass of organisms in the biological system. For example, tissue paper and dead cells are registered in the suspended solids test. As a result, even a constant BOD_5/MLSS ratio does not assure that the F/M ratio is constant.

Relationship Between Control Methods

Solids accumulate from two sources: biological tissue formed from organics removed and accumulation of essentially nondegradable materials. Solids are decreased through microorganism decay, termed endogenous respiration, of the active mass. This solids accumulation may be put in the form of an equation:

Net accumulation of solids (to be wasted) =
Yield from BOD_5 removed
+ Accumulation of non-degradables
– Decrease in active mass caused by endogenous respiration **(6)**

Normally, the accumulation of nondegradables is neglected, and Equation 6 is written as

$$dX/dt = Y\,dF/dt - K_d X \qquad \textbf{(7)}$$

where:

dX/dt = TSS withdrawn from the system per day,

Y = cell yield coefficient,

dF/dt = change in food with time, or BOD_5 used per time unit by bacteria,

K_d = endogenous decay coefficient, and

X = TSS in the system.

In most activated sludge systems receiving a municipal type waste, Y is equal to 0.5 to 1.0, indicating that between 0.5 and 1.0 lb of solids will accumulate in the system/lb BOD_5 removed by the system (0.5 to 0.8 kg solids/kg BOD_5). K_d usually varies from 0.04 to 0.075, depending on temperature, the value of X, and other characteristics of the particular waste. Equation 6 may be used to calculate the expected accumulation of solids.

Dividing Equation 7 by X yields

$$\frac{dX/dt}{X} = \frac{Y\,dF/dt}{X} - K_d \qquad \textbf{(8)}$$

Using the expression for sludge age,

$$SRT = \frac{X}{dX/dt}$$

$$SRT = \frac{TSS\ within\ system}{TSS\ withdrawn\ per\ day}$$

Also, because

$$\frac{dF/dt}{X} = \frac{food\,removed\,per\,day}{TSS\,within\,the\,system} = U$$

and because F:M =

Mass of food added per day
TSS in the system

Equation 7 may be written as

$$\frac{1}{SRT} = Y\,U - K_d \qquad \textbf{(9)}$$

From Equation 9 two important things may be seen. First, the new growth of organisms per day in the activated sludge system is related to the F:M ratio and the sludge age. Second, and more importantly, if one of the two variables is controlled near a given level, the other will seek and find an associated level. Therefore, control of F:M implies control of the sludge age and vice versa. This is of great importance primarily because, in a practical sense, instantaneous changes in MLVSS concentrations cannot be made in response to changes in the strength of incoming wastewater. The operator can determine which F:M gives the best results at the treatment plant for a particular time of year or anticipated loading. Knowing this, he can calculate the associated sludge age. Because F:M is difficult to maintain at a constant value and sludge age is relatively easy to maintain at a constant value, the sludge age may be used as the control variable.

Many other control-through-wasting schemes have been and probably will be devised. They will all have one feature in common: the wasting procedure will affect the effectiveness of the activated sludge plant.

Influent/Effluent BOD and COD

Biochemical Oxygen Demand (BOD_5): The traditional measurement of BOD_5 of the plant influent, primary tank effluent, and final effluent gives the most common measure of treatment plant efficiency. The drop in BOD_5 from raw influent to final effluent is usually used in calculating the solids growth rate in the aeration tank. This test is too slow to provide timely information to the operator for control purposes. It can, however, provide the operator with the historic results of previous operating decisions. Tests for BOD_5 are to be made on composite samples daily. BOD tests run for at least 20 days should also be made on the effluent periodically to determine the oxygen requirements of the nitrogen compounds present in the effluent.

Chemical Oxygen Demand (COD): COD measurements are preferred for a mixed domestic-industrial wastewater or where a more rapid determination of the load is desired. The COD test will record the oxygen demand for certain industrial wastes that cannot be used readily as food by the treatment plant organisms. The COD test may be run in several hours, giving the operator a more timely measurement of what is entering the plant and how the plant is performing.

Solids Determinations

Laboratory determinations of SS in the influent, primary effluent, and final effluent are standard measurements used to indicate treatment plant efficiency. The SS measurements are used in calculating the SVI and SDI - both important control tools.

There is a distinction between TSS and TVSS. TSS measures both the active bacterial mass and the inert materials in the waste or mixed liquor. TVSS is a more accurate estimate of the mass of active microorganisms in the mixed liquor and is the parameter to be used in calculating the F:M ratio.

Traditionally, SS measurements have been made manually in the lab. New portable instruments are available that can monitor SS concentrations continuously. This capability allows the operator to monitor solids balance or variations in the treatment plant quickly.

Food/Microorganism Ratio (F/M)

The F/M ratio should be calculated at least weekly and related to the efficiency of treatment plant operation. During the start-up period of this plant, the food is calculated as the BOD_5 in the influent that enters the aeration tank. If 140 mg/l BOD_5 is the influent concentration at a flow rate of 0.6 MGD, the food available to the microorganisms would be:

$$F = 140\ mg/L \times 0.6\ MGD \times 8.34 = 701\ lb/day$$

The mass of microorganisms is the average MLVSS concentration in the aeration tanks. For example, if the ditch volume is 0.6 MG, and the average MLVSS concentration in the aeration tanks 2,800 mg/l (based on an MLVSS:MLSS ratio of 70% and assuming that MLSS = 4,000 mg/l), the estimated mass of organisms in the aeration tank would be:

$$M = 0.6\ MG \times 2{,}800\ mg/L \times 8.34 = 14{,}011\ lb\ MLSS$$

The F/M ratio then would be

$$\frac{701\ \text{lb BOD}_5\text{/day}}{14{,}011\ \text{lb MLVSS}}$$

$$= 0.05\ \text{lb BOD}_5\text{/day/lb MLVSS}$$

Sludge Age

Historically, sludge age has been calculated as the ratio of TSS under aeration to the weight of TSS in the influent. Sludge age has been given a new definition and is referred to both as the "Sludge Residence Time," or "Mean Cell Residence Time" (covered in the previous section "Normal Operation").

Sludge Density Index and Sludge Volume Index

To get some idea of what the settling characteristics of the sludge are, sludge indexes (Table 3-3) have been proposed. One of the most common is the Donaldson Index, SDI:

$$SDI = \frac{MLSS\ (\%)\ x\ 100}{\%\ Volume\ occupied\ by\ MLSS\ after\ 30\ \text{min}\ settling} \qquad \textbf{(10)}$$

The other commonly used index is the Mohlman Index, SVI:

$$SVI = \frac{\%\ MLSS\ by\ volume\ after\ 30\ \text{min}}{\%\ MLSS} = \frac{ml\ settled\ sludge\ x\ 1{,}000}{mg/l\ MLSS} \qquad \textbf{(11)}$$

Table 3-3 Sludge Density Index and Sludge Volume Index

	Interpretation of Index	
Index*	**Good Quality Sludge**	**Poor Quality Sludge**
Donaldson, SDI	1.0 to 2.5	< 0.5
Mohlman, SVI	40 to 150	> 200

* SVI = 100/SDI

The indexes relate the weight of sludge to the volume the sludge occupies. They show how well the liquid-solids separation part of the activated sludge system is performing its function on the biological floc that has been produced and is to be settled out and returned to the aeration tanks or wasted. The better the liquid-solids separation is, the smaller will be the volume occupied by the settled sludge and the lower the pumping rate required to keep the solids in circulation.

Sixty Minute Settling Test

The 60-minute settling test is a reasonable approximation of what is happening in the final settling tank. An MLSS sample is taken from the aeration tank, placed carefully into the settling cylinder, and allowed to settle undisturbed for 60 min. The volume occupied by the settled sludge is read and recorded at 5-min intervals for the first 30 min and at 10-min intervals for the second 30 min.

The first 5-min reading is one of the most important observations for this test. During the first 5 min the conscientious operator will observe how the sludge particles stick together in clumps while forming the blanket. During these first 5 min the experienced operator will be able to judge the sludge's character and quality. Experience will help relate the observation to present or predicted plant performance.

Visual Indicators

A good visual indication for the proper operation of the oxidation ditch is the color of the mixed liquor suspended solids. Under normal operation, the MLSS should be a chocolate-brown color.

Very dark brown NLSS indicates an excessively long mean cell residence time or sludge age. A light brown MLSS indicates an overly short mean cell residence time or sludge age. An experienced operator can recognize the proper color of the MLSS to determine fluctuations in the mean cell residence time or sludge age.

Example calculations for finding SRT, oxic sludge mass, and sludge wasting rate calculations are provided in Appendix 10.

Nitrification

In addition to BOD reduction, the oxidation ditch must help reduce organic and ammonia nitrogen in accordance with the current VPDES permit. Organic nitrogen and ammonia nitrogen concentrations are determined together and referred to as Total Kjeldahl Nitrogen (TKN). Therefore, TKN is considered the primary operational parameter for nitrogen. Biological nitrification in the wastewater treatment plant is accomplished primarily by two types of microorganisms—nitrosomonas and nitrobacter. These bacteria are autotrophic because they derive energy from inorganic compounds. Conversely, heterotrophic organisms derive energy from organic compounds.

Nitrification of ammonia is a two-step process. Nitrosomonas converts ammonium to nitrite in the first step. In the second step, Nitrobacter converts nitrite to nitrate. The complete process is shown in the following equations:

$$NH_4^{\ +} + \frac{3}{2}O_2 \longrightarrow 2H^+ + H_2O + NO_2^{\ -}$$

$$NO_2^{\ -} + \frac{1}{2}O_2 \longrightarrow NO_3^{\ -}$$

During nitrification, 7.14 mg of alkalinity as $CaCO_3$ is destroyed per mg of ammonia converted. In addition, 4.2 mg of O_2 per mg of ammonia are theoretically required for nitrification.

If too much alkalinity is destroyed, the pH of the wastewater will drop. During denitrification ditch phases, partial alkalinity recovery may occur. If the pH drops below 7.0 and the effluent

TKN rises above 3.0 mg/1, nitrification must be adjusted in the oxidation ditch by adding lime to raise the pH to 7.5 or higher.

Monitoring and Controlling Dissolved Oxygen

The dissolved oxygen (DO) concentration of the Oxidation ditch is critical for obtaining effective removal of organics. The activated sludge dissolved oxygen demand will vary proportionally to the strength of the incoming waste. As the strength of the incoming waste increases, the oxygen demand of the activated sludge microorganisms increases requiring more dissolved oxygen to be supplied by the aeration equipment. Conversely, when the incoming organic concentration decreases, the oxygen demand of the microorganisms decreases.

Operating Problems/Solutions

Tables 3-4 thru 3-8 are derived from the Kruger Double Ditch Process O&M Manual and describe common operating problems and solutions.

Table 3-4 Trouble-Shooting Plant Performance

Observation	Possible Explanation	Action
Elevated ammonia levels in effluent	Low SRT	• Calculate necessary oxic SRT[1] Compare with actual oxic SRT[2] • Increase MLSS by decreasing WAS pumping • Expand aerobic phase lengths
	Too little oxygen in aerobic phases	• Raise D.O. setpoint
Elevated suspended solids levels in effluent[3]	Too short settling time	• Check correct phase operation • Check SVI with design basis • Expand settling phase time (phases E, F, K, L)
	Too little oxygen supply	• Check D.O. probe for correct calibration • Raise D.O. setpoint
	Filamentous bacteria	• Perform microscopial examination • Raise D.O. level • Initiate detailed analysis of influent wastewater And plant operation

[1]Necessary oxic SRT may be estimated by $SRT_{ox} = 3.05 \times (1.127)^{20-1}$

[2]SRT_{ox} = oxic sludge mass/(WAS + $TSS_{effluent}$)

[3]To decrease TSS in effluent, alum can be added. However, this does not solve the essential problems. Call I. Krüger, Inc.

All numbers are in lbs/day and are average values over 15-30 days.

Table 3-5 - Solids Washout/Billowing Solids

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES
1. Localized clouds of homogenous sludge solids rising in the ditches. Mixed liquor in settleability test settles fairly well with a clear supernatant.	A. Equipment malfunction.	1. Check the following equipment for abnormal operation. a. Calibration of D.O. meters. b. Plugged or partially plugged WAS valves and transfer lines. 2. Check sludge removal rate.	1. Repair or replace abnormal operating equipment. 2. Adjust valve height position
	B. Solids washout due to hydraulic overloading.	1. Check sludge blanket level during the settling phase.	1. Increase WAS rate to maintain low sludge blanket depth in ditches.
2. Localized clouds of fluffy homogenous sludge rising in certain areas of the ditches. Mixed liquor in settleability test settles slowly, leaving stragglers in supernatant.	A. Overloaded aeration tank (low MLSS) resulting in a young, low-density sludge.	1. Check and monitor trend changes which occur in the following: a. Decrease in MLVSS, mg/l. b. Decrease in MCRT, Gould Sludge Age. c. Increase in F/M ratio. Lower operational time of the rotors to maintain D.O. level.	1. Decrease WAS rates by not more than 10% per day to bring process back to optimum parameters.

Table 3-6 – Bulking Sludge

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES
1. Clouds of billowing homogenous sludge rising and extending throughout the ditches. Mixed liquor settles slowly and compacts poorly in settleability test, but supernatant is fairly clear.	A. Improper organic loading or D.O. level.	1. Check and monitor trend changes which occur in the following: a. Decrease in MLVSS, mg/l. b. Decrease in MCRT, Gould Sludge Age. c. Increase in F/M ratio. d. Change in D.O. levels. e. Sudden SVI increase from normal, or decrease in SDI.	1. Decrease WAS rates by not more than 10% per day until process approaches normal operating parameters. 2. Maintain D.O. levels throughout aeration tank greater than 0.5 mg/l, preferably 1 to 2 mg/l.

Table 3-6 – Bulking Sludge (continued)

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES
	B. Filamentous organisms.	1. Perform microscopic examination of mixed liquor. If possible, try to identify type of filamentous organisms, either fungal or bacteria. 2. If fungal is identified check industries for wastes, which may cause problems. 3. If bacteria are identified, check influent wastewater and in-plant side stream flows returning to process for massive filamentous organisms.	1. Enforce Industrial Waste Ordinance to eliminate wastes. 2. Optimized operational performance or upgrading of other in-plant unit processes will be required if filamentous organisms are found in side stream flows.
	C. Wastewater nutrient deficiencies.	1. Check nutrient levels in influent wastewater. The BOD to nutrient ratios should be 100 parts BOD to 5 parts total nitrogen to 1 part phosphorus to 0.5 iron. 2. Perform hourly ML settleability tests.	1. If nutrient levels are less than average ratio, field tests should be performed on the influent wastewater for addition of nitrogen in the form of anhydrous ammonia, phosphorus in the form of trisodium phosphate and/or iron in the form of ferric chloride. 2. Observe tests for improvement in sludge settling characteristics with the addition of nutrients.
	D. Low D.O. in aeration tank.	1. Check D.O. at various locations throughout the tank.	1. If average D.O. is less than 0.5 mg/l, increase until the D.O. level increases to between 1 and 2 mg/l throughout the tank.

Table 3-6 – Bulking Sludge (continued)

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES
	E. pH in aeration tank is less than 6.5.	1. Monitor plant influent pH.	1. If pH is less than 6.5, conduct industrial survey to identify source. If possible, stop or neutralize discharge at source. 2. If the above is not possible raise pH by adding an alkaline agent such as caustic soda or lime to the aeration influent.

Table 3-7 – Cloudy Secondary Effluent

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES
1. Secondary effluent from ditches is cloudy and contains suspended matter. Mixed liquor in settleability test settles poorly, leaving a cloudy supernatant.	A. MLSS in aeration tank low due to process start-up.		1. Reduce WAS rate.
	B. Increase in organic loading.	1. Perform microscopic examinations on mixed liquor. Check for presence of protozoa. 2. Check organic loading on process. 3. Check D.O. level in aeration tank.	1. If no protozoa are present, possible shock organic loading has occurred. 2. Reduce WAS rate by not more than 10% per day to bring process back to proper loading parameters. 3. Adjust aerobic phase length.
	C. Toxic shock loading.	1. Perform microscopic examination on mixed liquor. Check for presence of inactive protozoa.	1. If protozoa are inactive, possibility of recent toxic load on process.
	D. Overaeration causing mixed liquor floc to shear.	1. Perform microscopic examination on mixed liquor. Check for dispersed or fragmented floc and presence of active protozoa.	1. Reduce D.O. setpoint.
	E. Improper D.O. levels maintained in aeration tank.	1. Calibrate D.O. meter. 2. Adjust D.O. setpoint, as necessary.	1. Optimize D.O. setpoint.

Table 3-8 – Ashing and Pinpoint/Straggler Floc

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES
1. Fine dispersed floc (about the size of a pinhead) extending throughout the ditches with little islands of sludge accumulated on the surface and discharging over the weirs. Mixed liquor in settleability test, settles fairly well. Sludge is dense at bottom with fine particles of floc suspended in fairly clear supernatant.	A. Aeration tank approaching underloaded conditions (High MLSS) because of old sludge in system.	1. Check and monitor trend changes which occur in the following: a. Increase in MLVSS mg/l. b. Increase in Sludge Age. c. Decrease in F/M ratio. d. D.O. levels maintained with increasing aeration rates. e. Decrease in WAS rates. f. Decrease in organic loading (BOD/COD in primary effluent). 2. Stir floating floc on surface of 30-minute settling test.	1. Increase WAS rates by not more than 10% per day to bring process back to optimum control parameters for average organic loading.
2. Small particles of ash-like material floating on ditch surface.	A. Excessive amount of grease in mixed liquor.	1. Perform a grease analysis on MLSS, and check scum baffles in grit/grease unit. 2. Check grease content in raw wastewater.	1. If the grease content exceeds 15% by weight of the MLSS, repair or replace scum baffles as needed. 2. If grease content is excessive, implement an industrial waste monitoring and enforcement program.

Table 3-8 – Ashing and Pinpoint/Straggler Floc (continued)

OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	REMEDIES
3. Particles of straggler floc about ¼" or larger, extending throughout the ditches and discharging over the weirs. Mixed liquor in settleability test settles fairly well. Sludge does not compact well at the bottom with chunks of floc suspended in fairly clear supernatant.	A. Aeration tank slightly underloaded (low MLSS) due to organic load change.	1. Check and monitor trend changes which occur in the following: a. Decrease in MLVSS mg/l. b. Decrease in MCRT, Gould Sludge Age. c. Increase in F/M ratio. d. Less aeration rate used to maintain D.O. e. Increase in WAS rate. f. Increase or decrease in organic loading (BOD/COD in primary effluent). 2. Check for foaming in aeration tanks.	1. Decrease WAS rates by not more than 10% per day to bring process back to optimum control parameters for average organic loading. 2. Decrease aeration rates to maintain minimum D.O. of only 1.0 mg/l in aeration tank.

Laboratory Controls

The following is the recommended monitoring schedule for the Kruger D-Ditch:

	Influent	Oxidation Ditches (in aerobic phase)	Secondary Effluent	Waste Sludge
Organic				
CBOD – total	W	---	W	---
Solids				
TSS	DC	DG	DC	O
VSS	--	O	---	---
Nitrogen				
TKN	DC	---	DC	---
Ammonia	DC	---	DC	---
NO_X	---	---	DC	---
Operational Indicators				
pH	DG	W	DG	---
Alkalinity	DG	W	---	---
Temperature	DG	---	---	---
Mixed Liquor				
Sludge Volume (30 Minutes)	---	DG	---	---
N Content of Sludge	---	---	---	O

Where:

- DC: Daily Composite Sample
- DG: Daily Grab Sample
- W: Weekly (twice/week)
- O: Occasionally (once every 1 – 2 months)

Safety and Fail-Safe Features

In the event of a power failure, the emergency power generator will engage and the D-Ditch will continue to operate. If power is lost to the plant, the hydraulic flow of the plant can be routed into the digesters until power is restored and the influent pump station can resume operation. Under this condition, no washout of the mixed liquor suspended solids should occur. A power failure to the aerators will result in the activated sludge settling to the bottom of the tanks and remaining there until treatment is resumed after power has been restored. The *Emergency/Alternative Mode of Operation* section discusses the recommended procedures during the temporary loss of oxidation ditch equipment operation.

Start-Up Procedure

Prior to start-up of the D-Ditch, each channel should be inspected to ensure that it is free of foreign matter or obstructions. The sluice gate, effluent weirs, and influent distributor should be inspected to ensure that they are set properly. In addition, lubrication requirements should be checked for every piece of equipment.

After starting the D-Ditch for the first time, an adjustment time will be required for the ditch to reach the appropriate mixed liquor suspended solids concentration. No sludge wasting should be attempted until the desired food-to-microorganism ratio is obtained in the secondary treatment system.

A more detailed description of the start-up of secondary treatment units can be found in EPA Manual, Contract No. 68-01-0341, December 1973, Start-Up of Municipal Wastewater Treatment Facilities.

Reference Drawings

- **DAA Record Drawings: July 22, 2004**

  Sheet No. 8 of 20, Drawing No. M-8 – Phased Oxidation Ditch—Plan.

  Sheet No. 9 of 20, Drawing No. M-9 – Phased Oxidation Ditch—Sections.

  Sheet No. 10 of 20, Drawing No. M-10 – Phased Oxidation Ditch—Influent.

  Sheet No. 11 of 20, Drawing No. M-11 – Phased Oxidation Ditch—Effluent.
- Standard Methods for the Examination of Water and Wastewater
- Double Ditch Process O&M Manual, I. Kruger Inc. Dated August 2004.

  Start-Up of Municipal Wastewater Treatment Facilities, EPA Contract No. 68-01-0341, December 1973.

Example calculations for finding SRT, oxic sludge mass, and sludge wasting rate calculations are provided in Appendix 10.

EFFLUENT FILTER

Description

Effluent from the D-Ditch flows by gravity to a Kruger Hydrotech Disc Filter. The Disc Filter is used as a polishing process to enhance TSS and BOD removal. The unit is mounted in a 22-ft. 8-in. square concrete structure with future expansion capability. The structure features an inlet channel, filtered water channel, and emergency bypass channel.

Water flows into the center of the drum of the unit and fills the filter segments, which are partially submerged. The head of the D-Ditch effluent forces the water through the woven cloth filter elements where solids are trapped. Filtered water passes through the disc to the outside of the filter elements. The filter elements are static until a maximum pre-determined head level is reached. When the head increases to 11.8-inches, the unit initiates a backwash cycle. The filter elements are spun while simultaneously receiving countercurrent backwash from high-pressure spray nozzles. The backwash flow enters the waste channel and is sent to the headworks.

Major Components

- Drive Motor
- Backwash Pumps
- Woven Cloth Filter Elements
- Nozzles
- Control Panel
- Emergency Overflow Weir
- Emergency Bypass Channel
- Filtered Water Channel
- Mud Valves
- Inlet Channel

Relationship to Adjacent Units

The effluent filter is located west of the D-Ditch and north of the UV disinfection channel. It receives flow by gravity from the D-Ditch through a 20-inch pipe. Flow exits the effluent filter by gravity at its southwestern corner through a 20-inch pipe and flows to the UV disinfection channel.

Normal Operation

(Please see Figure 3-10, "Effluent Filtration-Plan & Section")

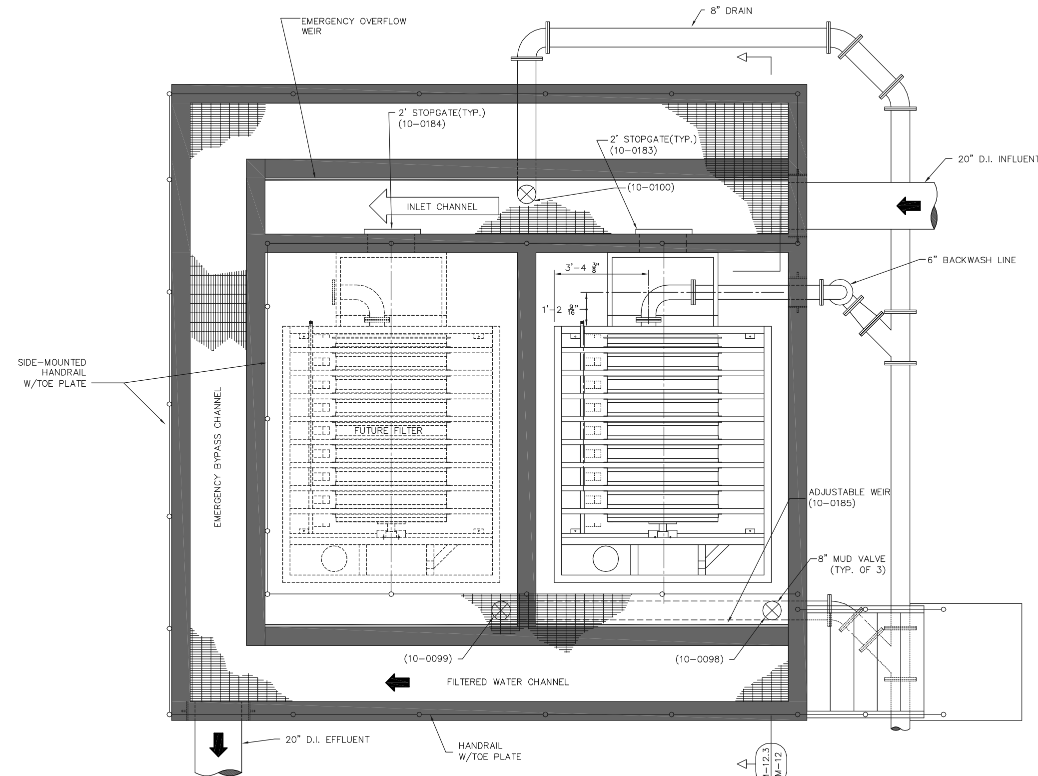
During normal operation, the filtering process is controlled automatically by the effluent filter PLC. Effluent enters the filter's inlet drum through a stopgate and disperses through the filter elements into the effluent reservoir. The head difference between the inlet drum and the effluent reservoir is monitored by sensor probes. Once the head reaches 11.8-inches, the backwash cycle is initiated and the inlet drum rotates the filters while the backwash nozzles spray the outside of the filter elements. The pressurized water disperses solids that have collected on the inside of the filter elements. Backwash liquid drains into a collection trough that transports it to an 8-inch pipe that flows by gravity back to the headworks facility. Filtered wastewater in the effluent reservoir flows over a weir and into the filtered water channel. The channel transports effluent to a 20-inch pipe that leads to the UV disinfection channel.

Alternate Mode of Operation

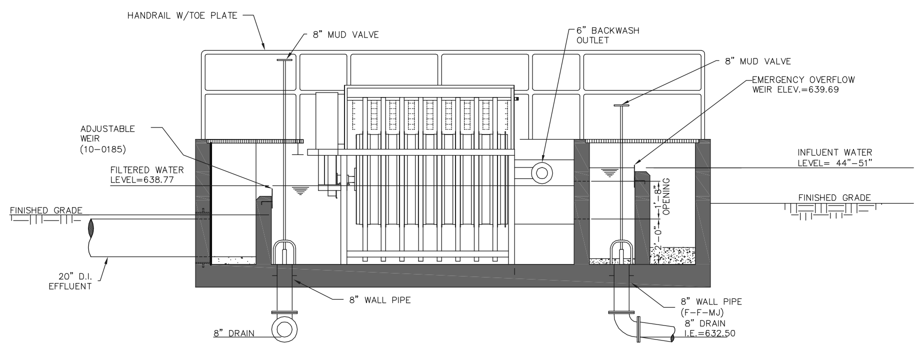
The effluent filter can be operated in continuous HAND mode. This mode operates the rotation and backwash continuously keeping the water level within the inlet drum constant. The level sensors and automatic control system are not used in this mode. This mode is useful for checking proper operation of the nozzle and rotation systems.

Operation and Control

During normal operation, Stopgate 10-0183 is open to allow flow into the filter. It may be desirable to lower the stopgate slightly below the water level to trap floating debris in the inlet channel. The inlet channel should be checked daily and cleaned if necessary. The control panel for the filter should be set to the AUTO position. The level probe should be placed 2"- 4" below the emergency-overflow weir, depending on the turbulence of the water surface. The time delay relay that controls the backwash process after the water has cropped below the probe (time delay TD2) should be set equal to the time it takes the drum to rotate approximately ¾ of a revolution. This relay is adjustable from 0.1 to 30 seconds. The dial should be set at 15 seconds approximately 50%). Verify the degree of drum rotation during the cycle and adjust the dial setting as needed to set the rotation at ¾ revolution during the backwash cycle.



PLAN



SECTION M-12.3 / M-12

ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: EFFLUENT FILTRATION – PLAN & SECTION	FIGURE:	3–10
	APPROVED:	HFW		SCALE:	N.T.S.
				DATE:	12/2005

The sensitivity of the level sensor can be adjusted by the relay LR1. The sensitivity setting of LR1 should be adjusted if the backwash cycle does not initiate upon the water level reaching the level sensor. In this case, more sensitivity is needed. However, in the event that splashing or water droplets initiated the backwash cycle, then the sensitivity must be lowered. If it is not possible to set the necessary sensitivity at the existing water conditions, consider changing the setting to a different sensitivity range. Adjust sensitivity based on the system's water conductivity.

Once the water level rises to a point where LR1 is engaged, then time delay relay TD1 is activated. This relay sets the amount of time that the water must be in contact with the sensor before the backwash cycle is initiated. This feature is also intended to prevent splashing of water droplets from initiating the cycle. The relay is adjustable from 0.1 to 10 seconds. Set the relay dial at 1 second (approximately 10%). The delay may be adjusted to a higher setting if needed to prevent backwash initiation due to splashing.

Once TD1 has reached the specified time limit, then the backwash pump motor is started and time delay relay 2 (TD3) is activated. This relay is adjustable from 0.1 to 10 seconds and determines the amount of time that the backwash pump motor will run before the drum drive started is activated. The intent of this feature is to make certain that the backwash water is fully flowing from all nozzles prior to the drum turning (and thus prevents uncleaned portions of the filter panels). The relay dial for TD3 should be set at ½ second (approximately 5%). Verify that full flow is achieved from the backwash nozzles prior to the drum turning during a backwash cycle. If not, increase the setting on the dial to the point where full flow is achieved prior to the drum turning. The standard control system includes a frequency converter to achieve soft starts and stops.

<u>Operating Problems/Solutions</u>

1. Disc/drum unit does not rotate, and the backwash does not operate.

    Causes:

    a. No power to the Discfilter.
    b. Master Power switch is on and the selector switch is set to "Auto" or "Hand". No power to the Discfilter.

Corrective Measures:

a. Turn Master Power switch to on and selector switch to “Auto” or “Hand”.

b. Open control panel and check or reset contactor. Ensure that motor proctor is set to the on position. Turn Master Power switch to on and selector switch to “Auto” or “Hand”.

2. Discfilter backwash does not start, although the water level inside the inlet drum has reached the level probe.

Causes:

a. The water is “very clean” i.e. has a low conductivity.

b. The sensor is not correctly grounded. For detection, the water has to “connect” the probe with the drum frame. A wire from the level relay is screwed (“grounded”) to the drum frame.

c. The level relay is defective. The red diode lamp on the level relay and on the time relay TD1 should be lit as long as the water level is in contact with the probe. The green diode lamp should always be lit (when there is power to the relay).

Corrective Measures:

a. Increase the sensitivity by turning the sensitivity knob towards MAX setting. If this does not help, you could change the sensitivity range selectable by a switch on the front of the relay to a more sensitive setting.

b. Check that all wires are undamaged and that the screw that is screwed into the filter frame is secured.

c. Replace the defective level relay.

3. The Discfilter backwash does not stop after the time set on the time relay.

Causes:

a. There is permanent contact between the level probe and the filter tank.

b. The level relay is too sensitive.

c. The time relay is defective. When the red diode lamp on the level relay is lit, the red diode lamp on the time relay should be lit as long as the water level is in contact with the level probe, plus the time set on the time relay. The green diode lamp on the time relay should always be lit when there is power to the relay.

Corrective Measures:

a. Remove any object that could connect the sensor to the filter tank (e.g. biological growth)
b. Lower the sensitivity by turning the sensitivity knob. If this does not help, you could change the sensitivity range selectable by a switch on the front of the relay to a less sensitive setting.
c. Replace the defective time relay.
d. Replace the defective level relay.

4. The disc/drum rotates, but the backwash does not operate.

Causes:

a. No power to the pump.
b. Backwash pump feed line ball valve closed.
c. Vapor lock in hose.

Corrective Measures:

a. Open control panel and check or reset contactor.
b. Open ball valve.
c. Bleed air out of backwash piping.

5. Backwash spray pattern is disrupted or uneven.

Causes:

a. Spray nozzle fouled.
b. Spray nozzles display loss of pressure.

Corrective Measures:

a. Clean spray nozzle according to manufacturer recommendations.
b. Possible biological growth in rinse piping. Clean piping according to manufacturer recommendations.

<u>Laboratory Controls</u>

There are no laboratory controls for this process.

<u>Safety and Fail-Safe Features</u>

The effluent filter system is equipped with an emergency overflow weir. If the flow rate into the filter exceeds its hydraulic design capacity or if power to the filter is lost, water will back up into the inlet channel, overflow the emergency weir, and flow directly to the UV channel, bypassing the filter completely. This feature also prevents excessive pressure buildup on the filter cloth media.

The filter facility is equipped with three 8-inch mud valves that allow accumulated sediment to be removed from the effluent reservoirs and inlet channel.

Start-Up Procedure

Ensure that the power transmission guard and cover are firm and correctly mounted before starting the filter. Run the filter and backwash system, even if the water level is below the level sensor. Place the selector switch to manual operation ("Hand") on the control panel and run backwash system for 10 minutes before switching to "Auto". Check that the spray distribution of the nozzles is 60 degrees.

Reference Drawings

- **DAA Record Drawings: July 22, 2004**
  Sheet No. 12 of 20, Drawing No. M-12 – Filtration Plan and Sections.
- **Operations and Maintenance Manual for Discfilter (Model HSF2108-2F), I. Kruger, Inc.**

ULTRAVIOLET (UV) DISINFECTION CHANNEL

Description

Ultraviolet light is used to destroy pathogenic bacteria and viruses in the water before it is discharged by gravity to the post aeration unit. The UV unit is an Infilco Degremont Model 2X30 LH and provides a minimum dosage of 52,000 microwatt-seconds per square centimeter ($\mu Ws/cm^2$) at the peak flow at 80% lamp life (8,760 hours) with no fouling of the quartz jackets. The dosage listed shall reduce the fecal coliform count to less than 200/100 ml geometric mean for any 30 day period at peak flow, at 80% lamp output, 65% UV transmittance, through 1 cm of effluent with no fouling of the lamp jackets.

Major Components

- Master Control Panel
- Power Distribution Center
- UV Lamp Modules
- UV Lamps
- Disinfection Channel
- Serpentine Weir

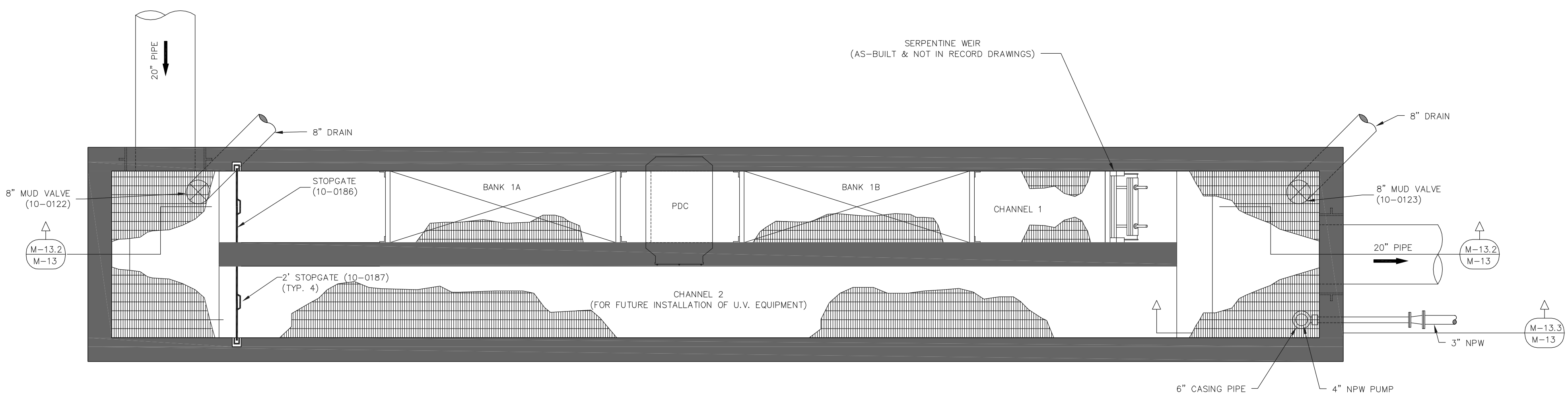
Relationship to Adjacent Units

The disinfection chamber is located south of the effluent filter. It receives filter wastewater from the effluent filter and discharges to the post-aeration unit.

Normal Operation

(Refer to Figure 3-11, "UV Disinfection-Plan")

Wastewater from the effluent filter enters the disinfection chamber through a 20-inch gravity line. Stopgate 10-0186 remains open while stopgate 10-0187 remains closed. Wastewater passes through the channel to the UV lamp modules where it is exposed to UV light that destroys pathogenic bacteria and viruses. The two UV lamp module banks are arranged in series, and can operate together or individually. The effluent flow level in the disinfection channel is held constant by a serpentine weir. Effluent spills over the weir into a 20-inch gravity fed pipe leading to the parshall flume/post aeration facility. A submersible UV sensor (photocell)



ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: UV DISINFECTION – PLAN		FIGURE:	3–11
	APPROVED:	HFW			SCALE:	N.T.S.
					DATE:	12/2005

continuously monitors the UV intensity produced in each bank. If the measured UV intensity is too low, a status alarm is transmitted to the master control panel.

Alternate Mode of Operation

There are two UV units in the disinfection channel. Normally one is in operation, however, two can be run if flow is exceptionally high or if maintenance is required. Two 8-inch mud valves and 8-inch drains, one near the 20-inch influent pipe and one near the 20-inch effluent pipe, are provided for cleaning out accumulated sediment.

Operation and Control

The UV disinfection system consists of two banks of UV lamps that are manually controlled at the local monitoring system for each UV bank. The ON-OFF selector switch should be in the "ON" position and the ballast enclosure LED's should be lit while receiving flow. Daily observations of the LED's in the ballast enclosure and the UV intensity in the control panel by the plant operators is recommended for any alarm indicators that may arise.

Operating Problems/Solutions

1. Reduction in transmitted light.

   Indicators:

   a. UV output drop as indicated by the intensity meter.
   b. High fecal count in effluent.

   Monitoring, Analysis, and/or Inspection:

   a. Examine quartz sleeve/jacket for coating and/or water leaks.
   b. Check for turbid effluent.
   c. Lamp being monitored may be faulty or there is electrode degradation in the lamp ends. Replace lamp.
   d. Intensity probe (photocell) may be fouled.
   e. Master controller has failed or has turned off the bank of lamps.
   f. Check for water leaks in or around the flexible multi-conductor cable or strain reliefs. Leaks may be due to loose sealing fittings or damaged module conduit fitting.

Corrective Measures:

a. Clean quartz sleeve once a month or as needed. Use proper cleaning compound listed in user's manual. Improper cleaners may leave a film on the surface and inhibit disinfection.
b. For water leaks of quartz jacket, check the seal around the quartz jacket to see if it is seated properly and adjust accordingly or replace the damaged module seal.
c. Replace defective UV photocell with a new photocell.
d. Have master controller turn the bank of lamps on. If the master controller has failed then replace the master controller printed circuit board.
e. Electrode degradation increases with frequency of ON-OFF cycles. A shorter ON-OFF cycle can reduce the operating life of the lamp. It is recommended when a lamp or group of lamps are switched on that they remain on for a minimum of 8 hours. Lamps should be replaced after 8,760 hours of operation or about one year.

2. Electrical Malfunction

Indicators:

a. Lamp indicator does not light

Monitoring, Analysis, and/or Inspection:

a. UV lamp failed.
b. Lamp indicator burned out.
c. ELCI tripped.
d. Ballast failed.
e. Open wire connection.
f. Lamp monitor control board

Corrective Measures:

a. Replace failed UV lamp.
b. Replace lamp indicator.
c. Reset ELCI located on back of ballast enclosures.
d. Test ballast by measuring voltage.

3. Lamp Out Warning System Malfunctions

Indicators:

a. Remote lamp out indicator is on and all UV lamp indicators are also on.

b. UV lamp indicator off but remote lamp out indicator is on

Monitoring, Analysis, and/or Inspection:

a. Defective lamp module control board.
b. UV lamp indicator not working.
c. Failed lamp module control board.

Corrective Measures:

a. Replace lamp module control board in the ballast enclosure.
b. Replace the burned out UV lamp indicator.
c. Replace the lamp module control board.

4. Master Controller Communications Malfunctions

Indicators:

a. Bank module status if FAIL.
b. Bank module status if TRBL (TROUBLE)

Monitoring, Analysis, and/or Inspection:

a. No communication between the master controller and ballast enclosure.
b. There is no power to the ballast enclosure/lamp module.
c. Check ECLI.
d. Check power connections
e. Check ballast enclosure fuses.
f. Check power distribution center/breaker panel.

Corrective Measures:

a. Tighten/attach as necessary the communication cable connections going in and out of the ballast enclosure.
b. Confirm the next module in series of communications shows as OK on the display. If so, then replace lamp module control board in the ballast enclosure indicated as FAIL.
c. Replace the lamp module control board.
d. Reset ELCI as necessary.
e. Tighten/attach power connections as necessary.
f. Replace ballast enclosure fuses as necessary.

Laboratory Controls

Regular fecal coliform testing should be performed to ensure that the UV disinfection channel is working properly and that the limit is not being exceeded.

Safety and Fail-Safe Features

Each lamp in the UV modules is a powerful source of ultraviolet light. UV light can cause serious damage to unprotected skin and eyes, but it is harmless if the proper precautions are taken. The best protection is simply to prevent exposure to UV light. The UV modules pose no health threat when they are submerged in their support racks, but they should be turned off while removing them from the racks to prevent exposure to UV light. If it becomes necessary to work or perform maintenance while UV lamps are burning, it recommended to wear gloves, protective long clothing, and a UV face shield. Ordinary eyeglasses and safety glasses with plastic lenses are not adequate protection. Burning UV lamps can cause severe damage to unprotected eyes and skin, and no part of the body should be directly exposed to UV light. Follow user's manual for quartz sleeve cleaner instructions.

Start-Up Procedure

Before allowing flow into the UV channel, verify: 1) the switch on the master control panel is in the "ON" position and there are no alarm readings, 2) a satisfactory UV intensity reading for both banks, 3) all red ballast enclosure lights are illuminated, and 4) the equipment leakage circuit interrupter (ELCI) is set and in operation. Check the UV modules in the channel and the connections to the receptacles on the side of the distribution center. The channel should be filled slowly to prevent damage to the quartz jackets.

Reference Drawings

- **DAA Record Drawings: July 22, 2005**
  Sheet No. 13 of 20, Drawing No. M-13 – UV Disinfection Plan and Sections

PARSHALL FLUME

Description

The Parshall Flume utilizes the Venturi principal to measure open channel flow. The premise is that a restriction with a specific shape and form placed across a channel will result in a predictable rise of the upstream liquid level as it travels through the restricted section. The effluent Parshall Flume has a 6-inch throat and can measure flows from 0.036 mgd to 2.52 mgd. The electronic flow transmitter senses the liquid level by means of bubbler flow meter which transmits a signal to a receiver and flow indicator located in the Lab Building. A refrigerated automatic composite wastewater sampler is located near the influent end and retrieves effluent samples.

Major Components

- Parshall Flume
- Bubbler Flow Meter
- Receiver, Indicator, Recorder, Totalizer (Parshall Flume Control Panel)

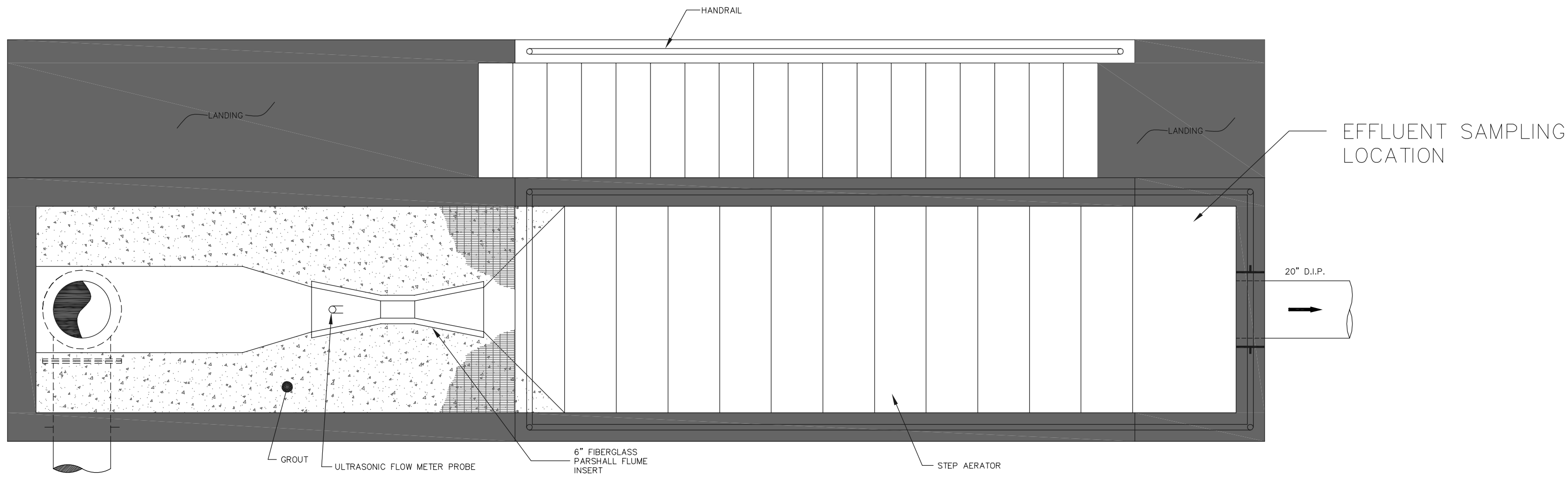
Relationship to Adjacent Units

The Parshall flume is located at the top of the cascade aerator, downstream of the UV channel.

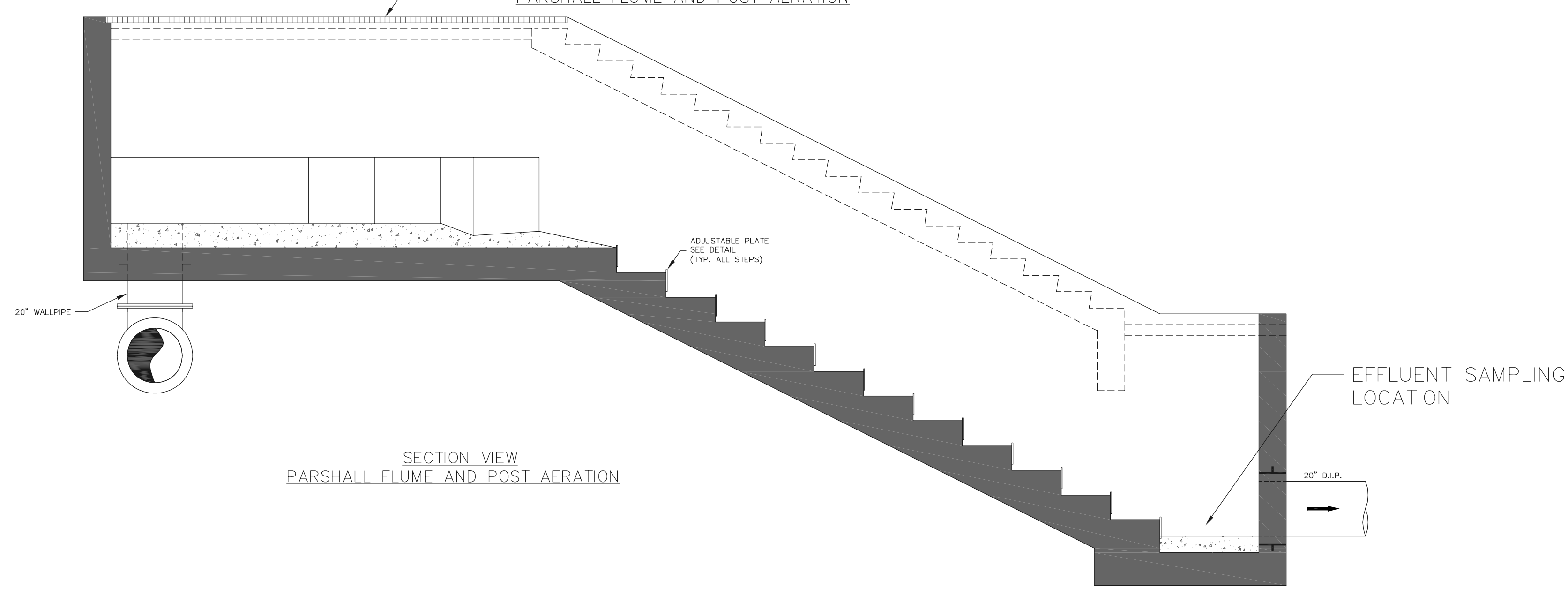
Normal Operations

(Refer to Figure 3-12, “Flow Monitoring & Cascade Aerator")

Flow enters the Parshall Flume through a 20-inch pipe from the UV disinfection channel. Liquid level is measured by a bubbler flow meter. A bubbler tube is submerged in the channel and an internal air compressor forces a metered amount of air through the bubbler tube. Water level is measured by the amount of pressure needed to force air out of the tube. The flow meter, located in the control panel by the flume, converts the measured water level to a corresponding flow rate. The Parshall flume discharges by gravity to the cascade aerator.



PLAN VIEW
PARSHALL FLUME AND POST AERATION



SECTION VIEW
PARSHALL FLUME AND POST AERATION

W W ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: FLOW MONITORING & CASCADE AERATOR	FIGURE:	3-12
	APPROVED:	HFW		SCALE:	N.T.S.
				DATE:	9/2006

Alternate Mode of Operation

The flow in the Parshall flume can be measured manually using a measuring rule and Parshall flume flow tables.

Operation and Control

Inspect the Parshall Flume daily and clean out any debris or obstructions. Read and inspect all flow meters daily to insure they are operating properly.

Operating Problems/Solutions

1. Unreliable Metering

   Indicators:

   a. Unusually erratic flow readings.

   b. Overly uniform flow readings.

   Monitoring, Analysis, and/or Inspection:

   a. Check the height of flow in the flume at different time intervals, and using the flume characteristic formulas or tables, calculate the flow and compare calculations with flow meter readings.

   b. Check bubbler line for kinks, frays, cuts, damage, etc.

   c. Bubbler line is clogged.

   Corrective Measures:

   a. Consult manufacturer's instructions concerning problems associated with operation of the transmitter, and make necessary adjustments and/or repairs or have manufacturer's representative correct the problem.

   b. Replace bubbler line and recalibrate the level.

   c. Clean out bubbler line and/or increase frequency of PURGE.

Laboratory Controls

Maintain records of flows through Parshall Flume.

Safety and Fail-Safe Features

The effluent Parshall flume is covered with grating to aid in the safety of personnel working in this area.

Start-Up Procedure

Refer to manufacturer's operation manual for bubbler flow meter start-up procedure.

Reference Drawings

- **DAA Record Drawings: July 22, 2005**

  Sheet No. 14 of 20, Drawing No. M-14 – Flow Monitoring and Post Aeration

CASCADE AERATOR (POST AERATION)

Description

The cascade aerator provides a non-mechanical means of introducing dissolved oxygen into the effluent stream before it is discharged into Rutledge Creek. Wastewater enters the aerator after leaving the parshall flume and flows by gravity down twelve steps to exit via a 20-inch gravity pipe.

Major Components

- Adjustable Step Plates
- Refrigerated Composite Sampler

Relationship to Adjacent Units

The cascade aerator is located with the Parshall flume as a unit downstream of the UV disinfection channel and upstream of the outfall at Rutledge Creek.

Normal Operation

(Refer to Figure 3-12, "Flow Monitoring & Cascade Aerator")

Under normal operating conditions, the cascade aerator receives effluent via the Parshall flume. The effluent exits the parshall flume/cascade aerator unit through a 20-inch pipe. The automatic sampler program can be set to take composite effluent samples at specified time intervals or water levels.

Operation and Control

See the composite sampler manufacturer information/owner's manual for sample programming.

Operating Problems/Solutions

1. High levels of flow

   Monitoring, Analysis, and/or Inspection:

   a. Check to see if the entrance to 20-inch effluent pipe is obstructed with debris.

   Corrective Measures:

   a. Clean out any debris/obstruction at entrance of effluent pipe.

2. Sampler malfunction.

   Indicator:

   a. No samples taken by sampler.

   Monitoring, Analysis, and/or Inspection:

   a. Check to see if the sample tube is clogged.
   b. Check electricity source.
   c. Check program for accuracy.

   Corrective Measures:

   a. Repair or replace clogged sample tube.
   b. Repair or replace faulty wiring.
   c. Reset or reprogram sampler.

3. Refrigerator will not cool

   Monitoring, Analysis, and/or Inspection:

   a. Check compressor.
   b. Check fan.
   c. Check refrigerant.

   Corrective Measures:

   a. Check circuit board for malfunction.
   b. Replace fan.
   c. Replace fan/compression relay.

4. Samples are freezing

   Monitoring, Analysis, and/or Inspection:

   a. Check compressor.
   b. Check fan.
   c. Check heater wiring.

   Corrective Measures:

   a. Check circuit board for malfunction.
   b. Replace fan.
   c. Replace fan/compression relay.

Laboratory Controls

Wastewater samples should be retrieved as soon as possible after the sampler's program is complete. Samples should then be either tested immediately or refrigerated in coordination with laboratory protocols.

Safety and Fail-Safe Features

Walkways should be kept clean.

Start-Up Procedures

There are no start-up procedures for the cascade aerator.

Reference Drawings

- **DAA Record Drawings: July 22, 2005**
  Sheet No. 14 of 20, Drawing No. M-14 – Flow Monitoring and Post Aeration

NONPOTABLE WATER SYSTEM

Description

The plant's nonpotable water pump is located in a wet well at the downstream end of the UV disinfection channel. A diaphragm tank in the nonpotable water building is used to store and pressurize the nonpotable water system. The tank supplies water to the headworks facility, alkalinity feed building, and various yard hydrants. Non-potable water is disinfected by sodium hypochlorite, which is injected into the 3-inch NPW line just before the NPW diaphragm tank.

Major Components

- Diaphragm Tank (115.9 gal)
- Sodium Hypochlorite Tank (55-gal)
- Chemical Feed Pump
- Yard Hydrants
- Submersible Pump

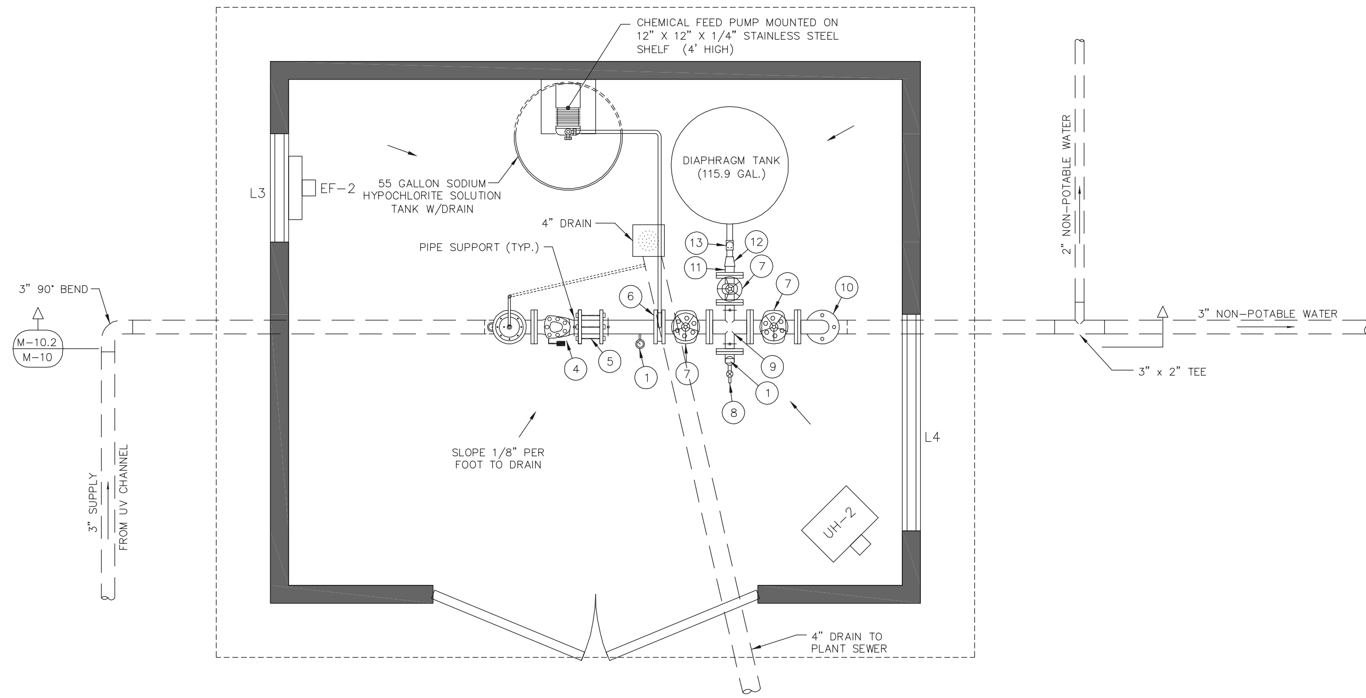
Relationship to Adjacent Units

The NPW building is located between the effluent filters and the oxidation ditch. The NPW pump and wet well are located at the downstream end of the UV channel.

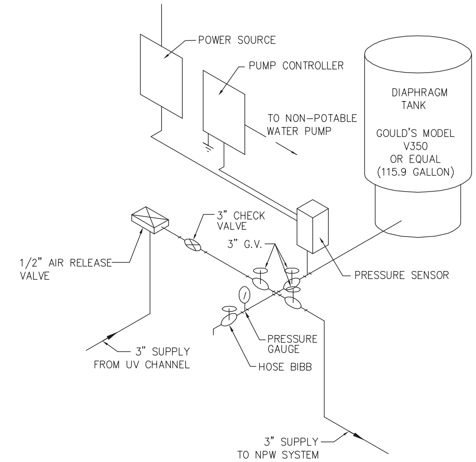
Normal Operation

(Refer to Figure 3-13, "Non-Potable Water System")

A diaphragm tank in the NPW building stores water that is supplied by a submersible pump located in a wet well within the UV disinfection channel. As water enters the tank, its internal bladder expands and the system pressure rises until the "pumps-off" pressure is reached. The non-potable water is stored in the diaphragm tank until it is dispersed as needed for yard hydrants and unit processes. When there is a demand for water, the pressure in the tank forces water into the system without running the pump. As water exits the tank, the tank pressure drops until it reaches the "pumps-on" pressure. The pump will start up at the pumps-on pressure and feed the tank (or current water demand) until the pressure in the system again reaches the "pumps-off" pressure. Water is pumped from the UV channel to the NPW building through a 3-



M-10.1 / M-10 BUILDING PLAN VIEW



M-10.3 / M-10 NON-POTABLE WATER SUPPLY SCHEMATIC

NPW DISINFECTION BUILDING FITTINGS		
	DESCRIPTION	TOTAL QUANTITY
1	PRESSURE GAUGE	3
2	3" X 3" TEE	1
3	1/2" AIR RELEASE VALVE	1
4	3" CHECK VALVE	1
5	3" COUPLING	1
6	3" STATIC MIXER (WAFER TYPE)	1
7	3" GATE VALVE	3
8	3/4" HOSE BIBB	2
9	3" X 2" CROSS	1
10	3" 90° BEND	1
11	2" FLANGE TO THREADED UNION	1
12	2" X 1-1/4" REDUCER	1
13	1-1/4" 90° BEND	2

NOTE: RECORD DRAWINGS DIFFERENT FROM AS BUILT

ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN: EFA	TITLE: NON-POTABLE WATER SYSTEM	FIGURE:	3-13
	APPROVED: HFW		SCALE:	N.T.S.
			DATE:	12/2005

inch supply line. When the 4-inch submersible pump starts up, a chemical feed pump in the NPW building (capable of delivering 44 GPD at 100 psi) pumps a sodium hypochlorite mixture from a 55-gallon drum to a 3-inch static injection mixer which mixes the sodium hypochlorite into the 3-inch supply line.

Operation and Control

The 4-inch submersible pump is controlled by signals from a variable frequency drive transmitter on the diaphragm tank in the NPW Building. The control panel for the NPW system is located on the west wall of the building. When the system is in the "Auto" position, the chemical feed pump automatically starts when the submersible pump starts. The chemical feed rate and pressure gauges associated with the NPW system should be regularly inspected to ensure proper operation. Monitor the solution level of sodium hypochlorite solution in the 55-gallon tank daily. When the level is low, fill the tank with nonpotable water using the hose within the NPW building. Add about 10 HTH tablets to every 5 gallons of water. The tank mixer mixes the HTH tablets with the water to form the sodium hypochlorite solution.

Operating Problems/Solutions

1. No pump discharge.

   Indicators:

   a. No discharge from pump in UV channel.

   Monitoring, Analysis, and/or Inspection:

   a. Check pump speed.
   b. Verify valves are open.
   c. Check to see if impeller is rotating in right direction.
   d. Determine if motor is receiving full voltage.

   Correction Measure:

   a. Open valves.

2. Insufficient pump discharge.

   Indicator:

   a. Low discharge from pump in UV channel.

   Monitoring, Analysis, and/or Inspection:

a. Check pump speed.

b. Check to see if suction opening is submerged enough.

c. Check for possible damage to impeller.

d. Determine if motor is receiving full voltage.

e. Check diaphragm tank.

f. Excessive pump wear.

g. Pump bound by foreign matter.

Corrective Measures:

a. Repair or replace impeller.

b. Check for leaks in diaphragm tank and/or replace diaphragm tank.

c. Repair pump as required.

d. Pull pump, clean, and adjust set depth as required.

3. Insufficient pump pressure.

Indicator:

a. Little or no discharge from pump.

Monitoring, Analysis, and/or Inspection:

a. Check to see if pump speed is too low.

b. Check for air or gases in liquid.

c. Check for damaged impeller.

d. Check for correct rotation of impeller.

Corrective Measures:

a. Repair or replace impeller.

b. Correct rotation of impeller.

4. Pump will not start.

Indicator:

a. Blown fuses or tripped circuit breakers.

Monitoring, Analysis, and/or Inspection:

a. Switch (breakers) contacts corroded or shorted.

b. Motor shorted or burned out.

c. Rating of fuses or circuit breakers not correct.

d. Automatic control mechanism not functioning properly.

e. Wiring hookup or service not correct.

f. Shaft binding or sticking because of rubbing impeller, tight packing gland, or clogging of pump.

Corrective Measures:

a. Correct automatic control mechanism.

b. Overhaul motor.

c. Use correctly rated fuses or circuit breakers.

d. Adjust alignment on pump shaft.

e. Replace or adjust packing gland.

5. Chemical deficiency/excess in water supply

Monitoring, Analysis, and/or Inspection:

a. Pump setting too low/high

b. Check solution level in drum

Corrective Measures:

a. Adjust pump setting accordingly.

b. Refill tank with sodium hypochlorite solution. Solution must be above foot valve.

6. Chemical feed pump failure

Monitoring, Analysis, and/or Inspection:

a. Leak in suction side of pump

b. Valve seats not sealing.

c. Diaphragm ruptured.

d. Pumphead cracked or broken.

e. Pumphead contains air or gas.

f. Breakdown or disconnection of wiring

g. Voltage drop.

h. Malfunction of electronic control board.

Corrective Measures:

a. Examine and replace suction tubing.

b. Clean valve seats or replace if there is deterioration.

c. Replace diaphragm. Note: chemical incompatibility with diaphragm material can cause rupture and leakage around pumphead.
d. Replace pumphead. Fittings are handtight only.
e. Bleed pumphead.
f. Check fuse or circuit breaker. Connect wiring properly.

Laboratory Controls

There are no laboratory controls associated with the NPW system.

Safety and Fail-Safe Features

The submersible pump is equipped with a check valve to prevent the backflow of NPW water through the pump to the UV Disinfection Channel. The NPW line in the building also has a 3" check valve to prevent backflow to the UV channel. To ensure the system is operating under normal pressure ranges, pressure gauges are placed in a couple of places on the NPW line. An alarm status will be transmitted to the SCADA system for pump failure for both the chemical feed pump and submersible pump.

Start-Up Procedures

The submersible NPW pump should be inspected for proper installation, clearances, and alignment. Check the lubricant of the pump for proper level and condition. Refill or replace as necessary. "Bump" the pump and check for proper rotation of the impeller. Refer to the manufacturers' instruction manual for more comprehensive start-up procedures. After starting the NPW and sodium hypochlorite pumps, check frequently for noise, vibration, and overheating.

Reference Drawings

- **DAA Record Drawings: July 22, 2005**
  Sheet No. 13 of 20, Drawing No. M-13 – UV Disinfection Plan & Section
  Sheet No. 13A of 20, Drawing No. M-13A – Non-Potable Water Disinfection System
  Sheet No. 6 of 13, Drawing No. E-6 – Filter and UV Disinfection, Effluent Flowmeter, and WAS Vault
  Sheet No. 12 of 13, Drawing No. E-12 – NPW Building-Electrical

AEROBIC DIGESTERS

Description

The aerobic digesters are designed to hold, aerate, mix, and stabilize waste sludge and scum prior to being transferred to the sludge drying beds. The two concrete digester basins are an inverted truncated pyramid shape and have been converted from use as aeration basins. The top and bottom of the digesters are 79-feet squared and 37-feet squared, respectively. Each digester has a capacity of 219,000 gallons. Provision for drawing off supernatant (liquid standing above denser sludge) to the headworks unit is controlled by two Flygt Model FS3068.180 submersible pumps located in the center of each basin. The digesters are provided with two Roots Model 68 URAI positive displacement blowers and 6-inch air lines to maintain the sludge in an aerobic state, reducing the volatile solids concentration and odor issues. The blowers are equipped with 20 HP motors and a V-Belt drive assembly. The blowers deliver 353 SCFM at a discharge pressure of 6.5 psig. The digesters also feature two torque-tube mixers that are used to keep sludge suspended. When necessary, a Godwin CD150M Dri-Prime® portable pump can be used to pump stabilized sludge from the bottom of the digesters to the sludge drying beds.

Major Components

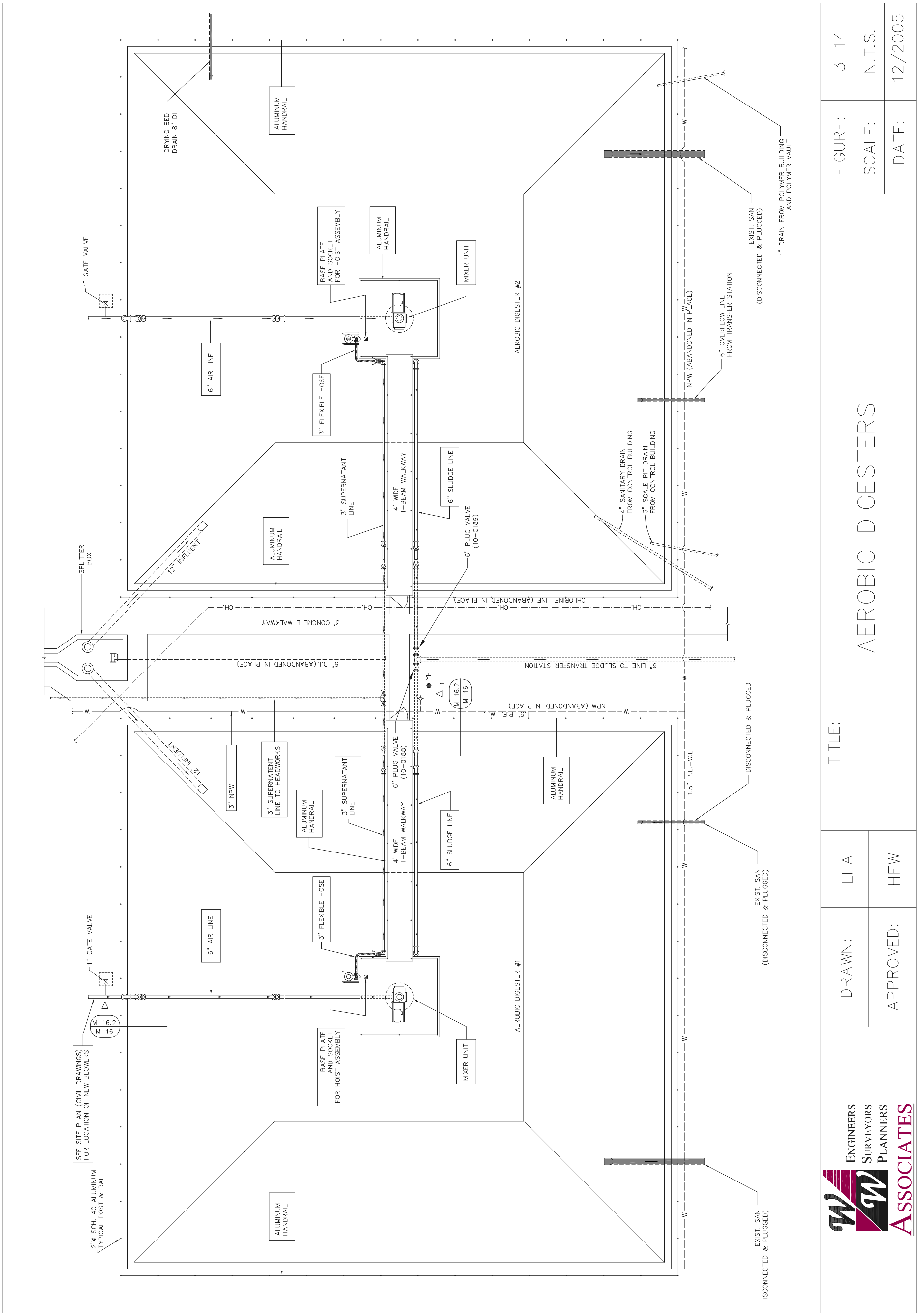
- Aerobic Digester
- Blowers & 6-inch air lines
- Submersible Decant Pumps & Adjustable Hoists
- Mixing Units
- Septage Receiving Station

Relationship to Adjacent Units

The aerobic digesters are located south of the headworks unit. Waste sludge and scum from the oxidation ditches are drained out of the oxidation ditches and flow by gravity to the digesters. Digested sludge from the digesters is pumped to the sludge drying beds. Supernatant from the digesters is pumped back to the headworks unit via submersible pumps.

Normal Operation

(Refer to Figure 3-14, “Aerobic Digesters,” Figure 3-15, “Section of Aerobic Digesters”, Figure 3-16, “Digester Basin Blower Pad Plan and Schematic”, and Figure 3-17, “Septage Receiving Station-Plan/Section”)


AEROBIC DIGESTERS
FIGURE: 3-14
SCALE: N.T.S.
DATE: 12/2005
TITLE:
DRAWN: EFA
APPROVED: HFW
ENGINEERS SURVEYORS PLANNERS ASSOCIATES
AEROBIC DIGESTER #2
AEROBIC DIGESTER #1
ALUMINUM HANDRAIL
DRYING BED DRAIN 8" DI
1" GATE VALVE
BASE PLATE AND SOCKET FOR HOIST ASSEMBLY
MIXER UNIT
6" AIR LINE
3" FLEXIBLE HOSE
3" SUPERNATANT LINE
4' WIDE T-BEAM WALKWAY
6" SLUDGE LINE
6" PLUG VALVE (10-0189)
6" PLUG VALVE (10-0188)
SPLITTER BOX
12" INFLUENT
3' CONCRETE WALKWAY
CHLORINE LINE (ABANDONED IN PLACE)
6" D.I. (ABANDONED IN PLACE)
6" LINE TO SLUDGE TRANSFER STATION
NPW (ABANDONED IN PLACE)
1.5" P.E.-W.L.
YH
M-16.2
M-16
3" NPW
3" SUPERNATENT LINE TO HEADWORKS
SEE SITE PLAN (CIVIL DRAWINGS) FOR LOCATION OF NEW BLOWERS
2"φ SCH. 40 ALUMINUM TYPICAL POST & RAIL
EXIST. SAN (DISCONNECTED & PLUGGED)
1" DRAIN FROM POLYMER BUILDING AND POLYMER VAULT
6" OVERFLOW LINE FROM TRANSFER STATION
4" SANITARY DRAIN FROM CONTROL BUILDING
3" SCALE PIT DRAIN FROM CONTROL BUILDING
DISCONNECTED & PLUGGED
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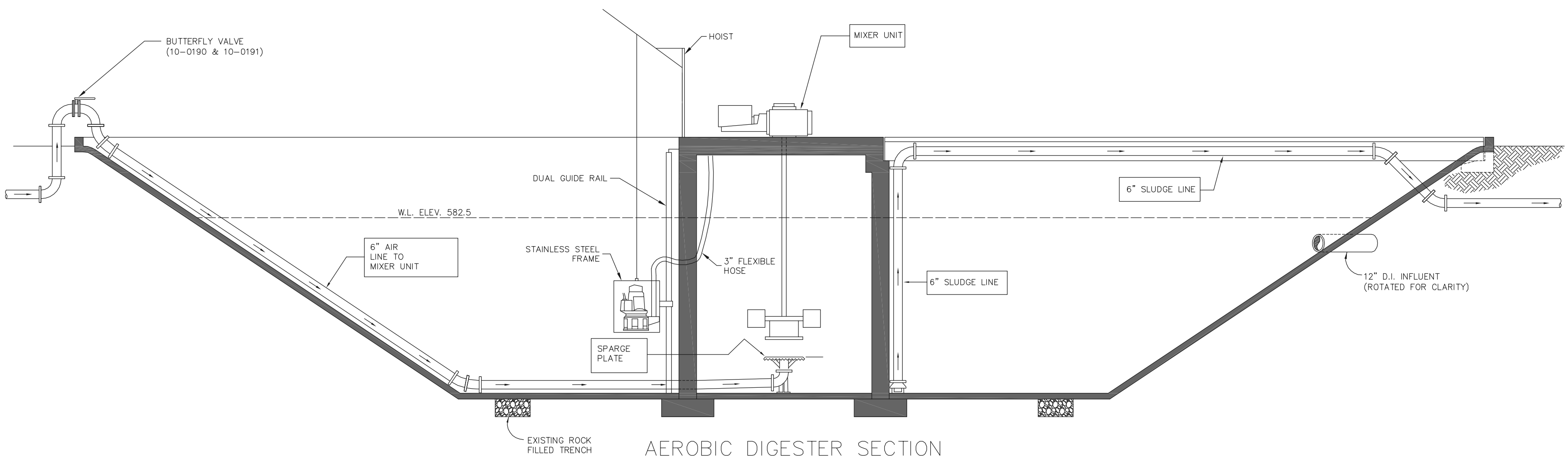
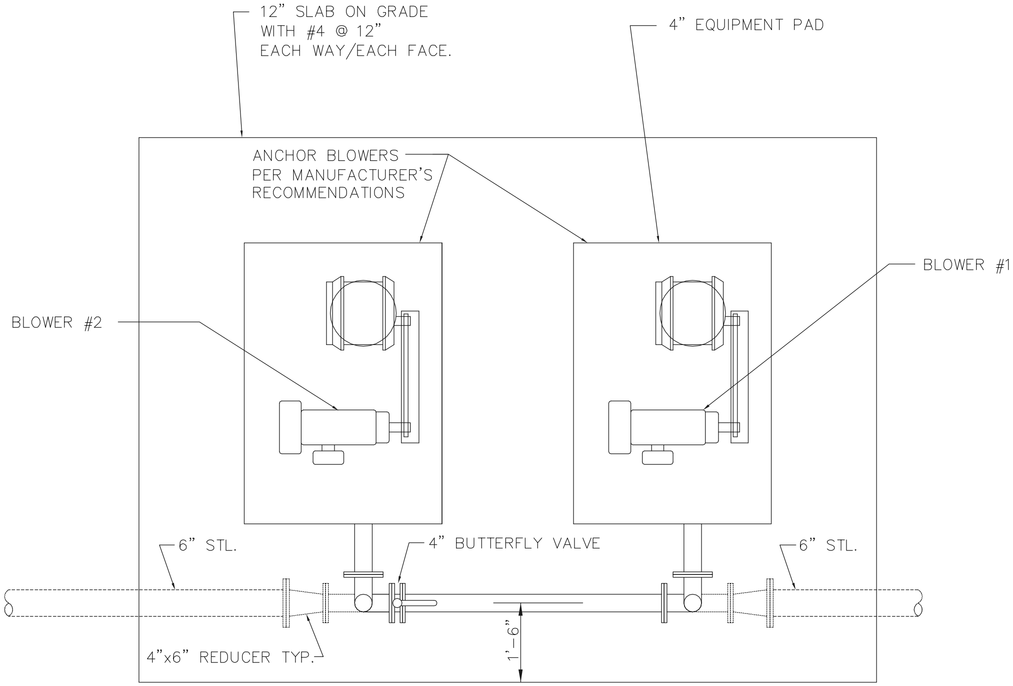


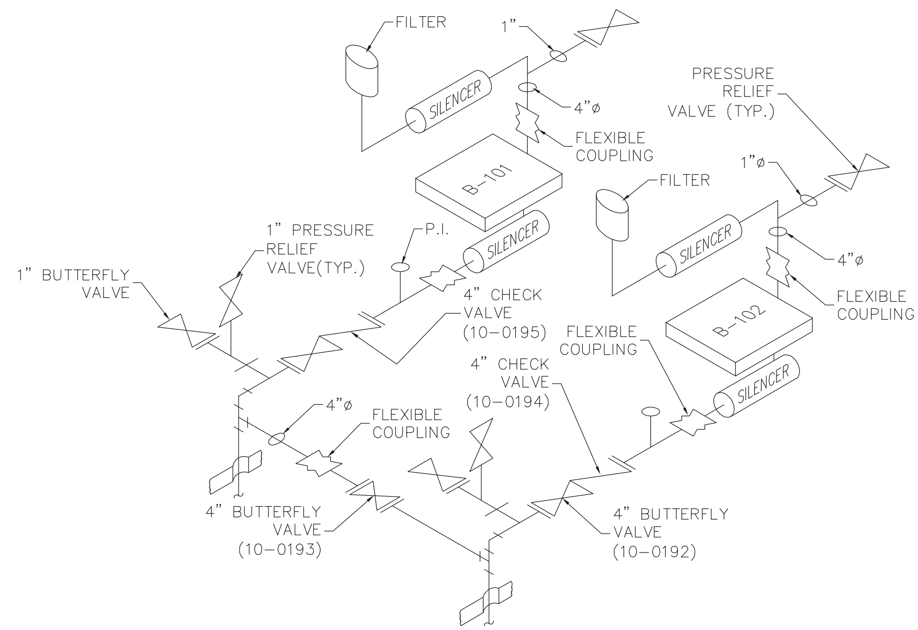
AEROBIC DIGESTER SECTION

NOTE: MIRROR SECTION FOR AEROBIC DIGESTER #2

W W ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: SECTION OF AEROBIC DIGESTERS		FIGURE:	3–15
	APPROVED:	HFW			SCALE:	N.T.S.
					DATE:	12/2005

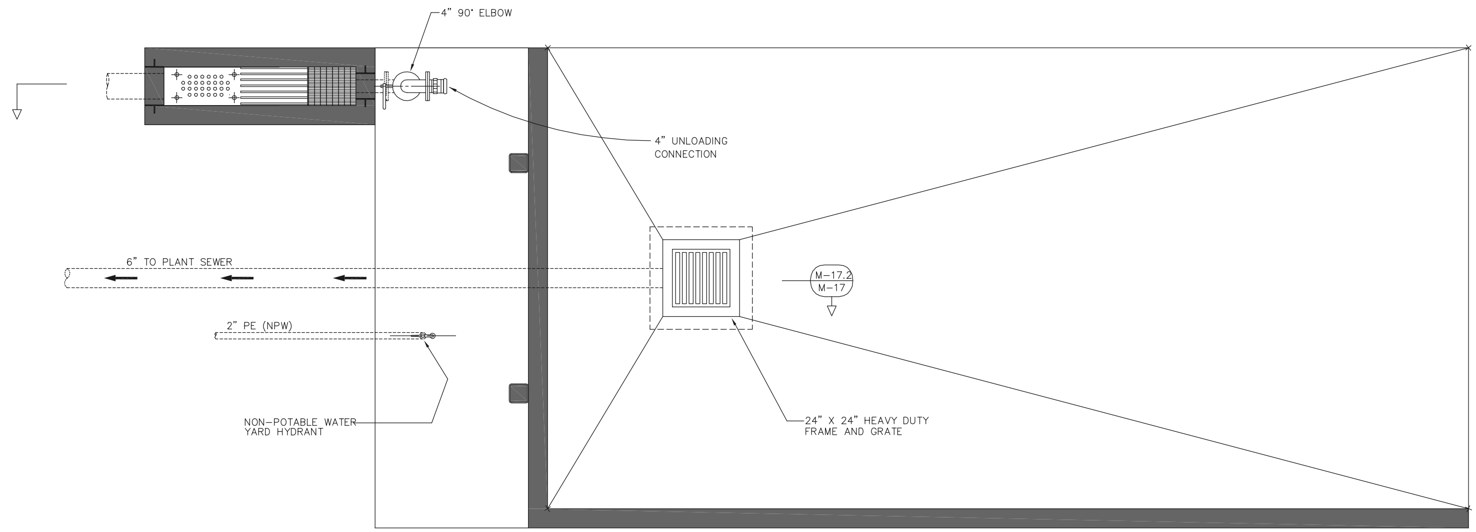


BLOWER PAD PLAN

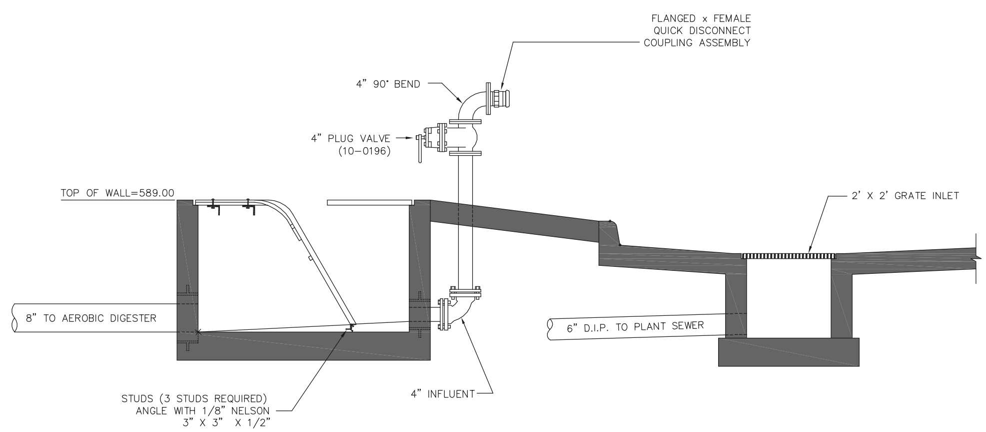


BLOWER PIPING SCHEMATIC

ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: DIGESTER BASIN BLOWER PAD PLAN AND SCHEMATIC	FIGURE:	3-16
	APPROVED:	HFW		SCALE:	N.T.S.
				DATE:	12/2005



SEPTAGE RECEIVING STATION–PLAN



SECTION

WW Engineers Surveyors Planners Associates	DRAWN:	EFA	TITLE: SEPTAGE RECEIVING STATION – PLAN/SECTION	FIGURE:	3–17
				SCALE:	N.T.S.
	APPROVED:	HFW		DATE:	12/2005

Waste sludge and scum from the oxidation ditch flows to the aerobic digesters via the telescoping valves in WAS Vault #1. Plug valves 10-0181 and 10-0182 (WAS Vault #2) and one or both of the splitter box stopgates (10-0210 and 10-0211) are normally open to allow waste sludge to enter the digesters. Upon entering the digesters through 12-inch influent lines, waste sludge is mixed and aerated to promote volatile solids reduction. The air discharge header is equipped with manual butterfly valves (10-0190 to 10-0193) to allow aeration of one or both digester basins. A cross connection exists so that each blower can aerate either basin. The mixing units in the digesters operate continuously and can be set to the "On" or "Off" position at the control panel located on the platform of the respective digester. Blowers can be set to the "On", "Off", or "Auto" position. In the "Auto" position, the blowers operate on a timer. If a blower failure is sensed from an auxiliary contact in the blower motor starter, an alarm light for the blower will be activated at the local control panel, and a status alarm will be transmitted to the SCADA system. Mixer units and blowers are turned off before decanting and wasting sludge. The submersible decant pumps are lowered to the sludge-water interface to decant supernatant.

Following digestion, stabilized sludge is pumped to the portable pump located at the sludge transfer station south of the digesters. Using the plant's portable pump, sludge is transferred to the sludge drying beds for dewatering and removal from the site.

The aerobic digesters also receive sludge from the septage receiving station located north of Digester #1. A coupling assembly is furnished to receive influent from septic trucks. Plug valve 10-0196 is normally open and the sludge flows down into a rectangular concrete structure that contains a manual bar screen to remove large solids from the septage. The sludge flows by gravity through an 8-inch pipe to a splitter box where it is diverted to the digesters. Any spillage flows down the 2-foot by 2-foot grate inlet into a 6-inch pipe to the beginning of the plant process.

Alternate Mode of Operation

To isolate one of the digester basins, close either stopgate 10-0210 or 10-0211 depending on which digester is to be taken out of service. This will divert waste sludge flow to the operational digester basin. Should one of the blowers need repair, the other blower can be used to aerate one of digester at a time. Blowers normally run on timers, but may also be operated in continuous "Hand" mode. The digesters are used to control inflow and infiltration (I/I) by storing overflow from the influent pump station during large rainfall events. Afterwards, the supernatant pumps can be used to pump stored sewage back into the system via introduction into the headworks.

Operation and Control

The blower and mixer controls are located on a control panel adjacent to the headworks facility. The mixer units have "Hand" and "Off" modes while the blowers also have an "Auto" position in which they can be operated on timers that are adjustable through the SCADA system. To allow sludge to settle, the mixers and blowers are turned off prior to wasting sludge to the sludge drying beds.

The oxygen uptake rate (OUR) is a good indicator of sludge stability if the sludge temperature is above 20 degrees C (68 degrees F). It is measured as milligrams of oxygen used per hour per gram of volatile suspended solids (mg 0_2/hour/g VSS). An OUR of 1 mg 0_2/hour/g VSS or lower

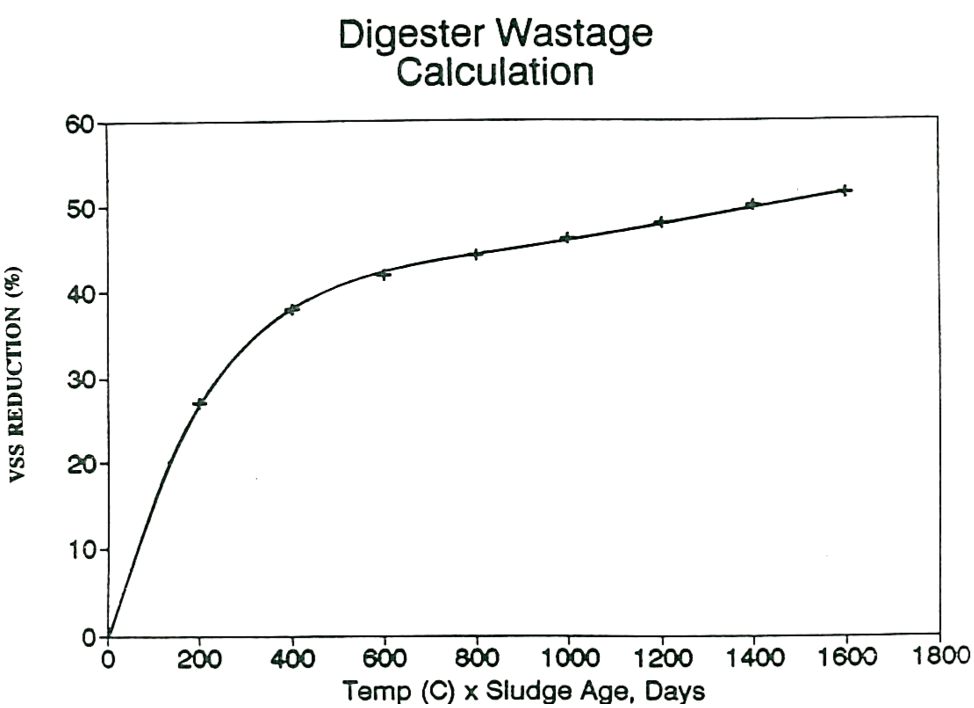


FIGURE 3-18

indicates a stable sludge. Temperatures below 20 degrees C cause the OUR to be lower due to decreased biological activity. Another non-temperature dependent indicator of stable sludge is when 40 percent VSS reduction has occurred. Since VSS destruction is a function of sludge temperature and sludge age, a graph can be developed and used to determine sludge stability. To calculate VSS reduction without laboratory analysis, Figure 3-18 may be used. Multiply the sludge age (MCRT) by the average temperature for the past number of days equal to the sludge age. To achieve a VSS reduction of 40 percent, this number will be approximately 485.

<u>Operating Problems/Solutions</u>

Blowers/Mixers

1. Odor Source in Aerobic Digester or Drying Beds.

   Indicators:

   a. Hydrogen sulfide odor.

   Monitoring, Analysis, and/or Inspection:

   a. Check volatile solids content of sludge.

   Corrective Measures:

   a. Increase aeration of sludge.

   b. Increase dewatered sludge production.

2. Clogged Air Lines

   Indicators:

   a. Blower Noise

   Corrective Measures:

   a. Hook up portable air compressor to blower unit.

3. Motor Fails to Start

   Causes:

   a. No voltage supply.

   b. Low voltage supply.

   c. Wrong control connections.

   d. Loose connection at some terminal lug.

   e. Overload

   f. Brushes

   Corrective Measures:

   a. Check feed connections to control system and from this to motor.

b. Check voltage supply and ascertain that voltage remains within 10% of the rated voltage shown on the motor nameplate.
c. Compare connections with the wiring diagram on the motor nameplate.
d. Tighten all connections.
e. Start motor under no-load conditions. If it starts, there may be an overload condition or a blocking of the starting mechanism. Reduce load to rated load level and increase torque.
f. Brushes may be worn, dirty or incorrectly fitted.

4. High Noise Level

Causes:

a. Imbalance.
b. Distorted shaft.
c. Incorrect alignment.
d. Uneven air gap.
e. Dirt in the air gap.
f. Extraneous matter stuck between fan and motor casing.
g. Loose motor foundation.
h. Worn bearings.

Corrective Measures:

a. Vibrations can be eliminated by balancing rotor. If load is coupled directly to motor shaft, the load can be unbalanced.
b. Shaft can be bent; check rotor balance and eccentricity.
c. Check motor alignment with machine running.
d. Check shaft for warping or bearing wear.
e. Dismantle motor and remove dirt or dust with jet of dry air.
f. Dismantle motor and clean. Remove trash and debris from motor vicinity.
g. Tighten all foundation studs. If necessary, realign motor.
h. Check lubrication. Replace bearing if noise is excessive and continuous.

5. Overheating of Bearings

Causes:

a. Excessive grease.
b. Excessive axial or radial strain on belt.
c. Deformed shaft.
d. Rough bearing surface.
e. Loose or poorly fitted motor end shields.
f. Lack of grease.
g. Hardened grease cause locking of balls.
h. Foreign material in grease.

Corrective Measures:

a. Remove grease bleeder plug and run motor until excess grease is expelled.
b. Reduce belt tension.
c. Have shaft straightened and check rotor balance.
d. Replace bearings before they damage shaft.
e. Check end shields for close fit around circumference and tightness.
f. Add grease to bearing
g. Replace bearings.
h. Flush out housings and relubricate.

6. Intense Bearing Vibration

Causes:

a. Unbalanced rotor.
b. Dirty or worn bearing.
c. Bearing rings too tight on shaft and/or bearing housing.
d. Extraneous solid particles in bearing.

Corrective Measures:

a. Balance rotor statically and dynamically.
b. If bearing rings are in perfect condition, clean and relubricate the bearing, otherwise, replace bearing.
c. Before altering shaft of housing dimensions, it is advisable to ascertain that bearing dimensions correspond to manufacturer's specifications.

d. Take bearing apart and clean. Reassemble only if rotating and support surfaces are unharmed.

7. Overheating of Motor

   Causes:

   a. Obstructed cooling system.
   b. Overload.
   c. Incorrect voltages and frequencies.
   d. Frequent inversions.
   e. Rotor dragging on stator.
   f. Unbalanced electrical load (burnt fuse, incorrect control).

   Corrective Measures:

   a. Clean and dry motor; inspect air vents and windings periodically.
   b. Check application, measuring voltage and current under normal running conditions.
   c. Compare values on motor nameplate with those of mains supply. Also check voltage at motor terminals under full load.
   d. Exchange motor for another that meets needs.
   e. Check bearing wear and shaft curvature.
   f. Check for unbalanced voltages or operation under single-phase condition.

8. Slip Ring Motor Operating at Low Speed with External Resistance Disconnected

   Causes:

   a. Control circuit conductors too light.
   b. Control too far from motor.
   c. Open circuit on rotor circuits (including connections with control apparatus).
   d. Dirt between brush and slip ring.
   e. Brushes grip on brush holders.
   f. Incorrect pressure on brushes.
   g. Rough surfaces on slip rings.
   h. Eccentric rings.
   i. High current density on brushes.
   j. Poorly set brushes.

Corrective Measures:

a. Install heavier conductors on control circuit.

b. Bring control closer to motor.

c. Test circuit with a magneto, or other means, and undertake necessary repairs.

d. Clean slip rings and insulation assembly.

e. Select brushes of correct size.

f. Check pressure on each brush and adjust it accordingly.

g. File, sand and polish.

h. Machine on lathe or with portable tool without removing from machine.

i. Reduce load or replace brushes.

j. Reset brushes correctly.

9. Brush Sparking

Causes:

a. Poorly set brushes with insufficient pressure.

b. Overload.

c. Slip rings in poor condition.

d. Oval slip rings. Rough surfaces and scored rings.

e. Excess of vibration.

Corrective Measures:

a. Check brush setting; adjust for correct pressure.

b. Reduce load or install motor with higher capacity.

c. Clean rings and reset brushes.

d. Polish the slip rings with an emery and machine the same on lathe.

e. Balance the rotor, check the brushes for free movement within holders.

10. Excessive Humming.

Causes:

a. High voltage.

b. Eccentric air gap.

Corrective Measures:

a. Check input line connections.

b. Have motor serviced .

11. Growling or Whining.

Causes:

a. Bad bearing.

Corrective Measures:

a. Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately ¾ filled.

Supernatant Pumps

1. Submersible Pump Fails to Start

Causes:

a. Impeller stuck.
b. No voltage supply.
c. Fault in level equipment (start level regulator).
d. Fault in control equipment.
e. Stator temperature is high.
f. Fault in thermistors/thermal contacts.

Corrective Measures:

a. Clean impeller.
b. Check that there is control voltage to starter equipment and its fuses are intact.
c. Check that there is voltage in each phase of supply line.
d. Check that all fuses are tight and have continuity.
e. Reset overload protection.
f. Check for breaks in motor cable.
g. Clean or replace level equipment.
h. Check relay and contactor coils.
i. Check that all connections are intact.
j. Check that impeller rotates freely.

2. Submersible Pump Starts but Motor Protection Trips.

   Causes:

   a. Motor protection set too low.
   b. Impeller won't rotate by hand.
   c. Installation not receiving full voltage on all three phases.
   d. Insulation between the phases and earth (ground) in stator defective.
   e. Density of pumped liquid too high.
   f. Fault on overload protection.

   Corrective Measures:

   a. Adjust motor protection.
   b. Clean impeller and check that it is properly trimmed.
   c. Check motor fuses. Call electrician.
   d. Use insulation tester. With a 1000 V-DC megger, insulation between the phases and between any phase and earth should be > 5 MΩ.
   e. Dilute liquid.
   f. Replace overload protection.

3. Submersible Pump Does Not Stop (when level control is used).

   Causes:

   a. Stop level set too low.
   b. Fault in level sensing equipment.
   c. Impeller clogged.
   d. Leakage in pipe and/or discharge connection.

   Corrective Measures:

   a. Raise stop level.
   b. Clean/replace level regulators.
   c. Check contactor and control circuit and replace if defective.
   d. Check impeller and clean.
   e. Check pipes, etc.
   f. Check non-return valve.

4. Pump Starts-stops-starts in Rapid Sequence.

   Causes:

   a. Contactor's self holding function breaks.

   Corrective Measures:

   a. Check contactor connections, functioning of stop level regulator, voltage in control circuit in relation to rated voltages in coil.
   b. Check that the distance between start and stop levels is not too small.

5. Pump Runs but Delivers too Little or No Fluid.

   Corrective Measures:

   a. Check rotation of pump.
   b. Check that the valves are open and intact.
   c. Check for clogged pipes and impeller.
   d. Check for impeller rotation.
   e. Check that suction lift has not been altered.
   f. Check for leakage in pump installation.
   g. Check for impeller, pump, and casing/flange wear.

Laboratory Controls

Regularly monitor VSS for stabilized sludge condition. Periodically monitor suspended solids of sludge going into digesters and of supernatant being withdrawn from the digesters.

Safety and Fail-Safe Features

All alarm condition relays are linked with the SCADA system to enable monitoring from the lab control building.

Start-Up Procedure

Make sure basin is clear of any debris. Check all valves for proper operation and position. Run water through digesters and check operation of all valves.

Reference Drawings

- **DAA Record Drawings: July 22, 2005**

  Sheet No. 15 of 20, Drawing No. M-15 – Aerobic Digester Modifications, Existing Conditions and Demolition Plan.

  Sheet No. 16 of 20, Drawing No. M-16 – Aerobic Digester Modifications, Proposed Piping and Equipment Layout.

  Sheet No. 7 of 13, Drawing No. E-7 – Headworks Plan - Electrical

  Sheet No. 9 of 13, Drawing No. E-9 – Aerobic Digester - Electrical

SLUDGE DRYING BEDS

Description

Following treatment in the digesters, stabilized sludge is transferred to the sludge drying beds. The plant has a total of eight square sludge drying beds that each measure approximately 22-ft x 22-ft. The drying beds are covered open-walled structures to facilitate evaporation. The beds have layers of sand, grit, gravel, and stone with a perforated underdrain system that captures liquid as it drains from the sludge slurry. The excess liquid is directed back to the digesters through an 8-inch drain pipe.

Major Components

- Sludge Drying Beds
- Stopgates
- Sheargates
- Plug Valves
- Portable Pump
- Polymer Feed Pump
- Static Mixers
- Sludge Transfer Station
- Static Mixer Vault

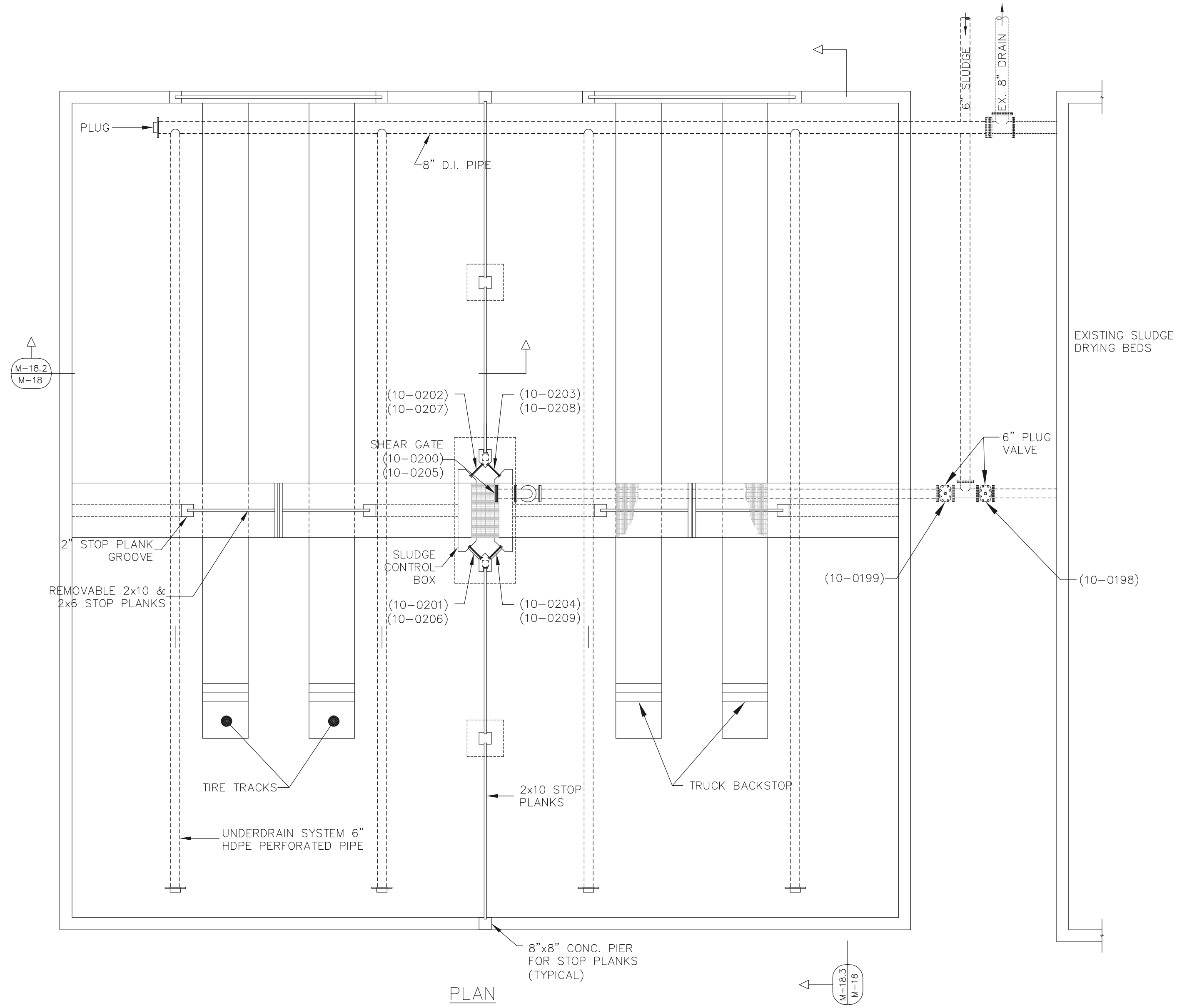
Relationship to Adjacent Units

The sludge drying beds are located east of the aerobic digesters. The beds receive digested sludge flow from the aerobic digesters and then return the liquid portion back to the digesters.

Normal Operations

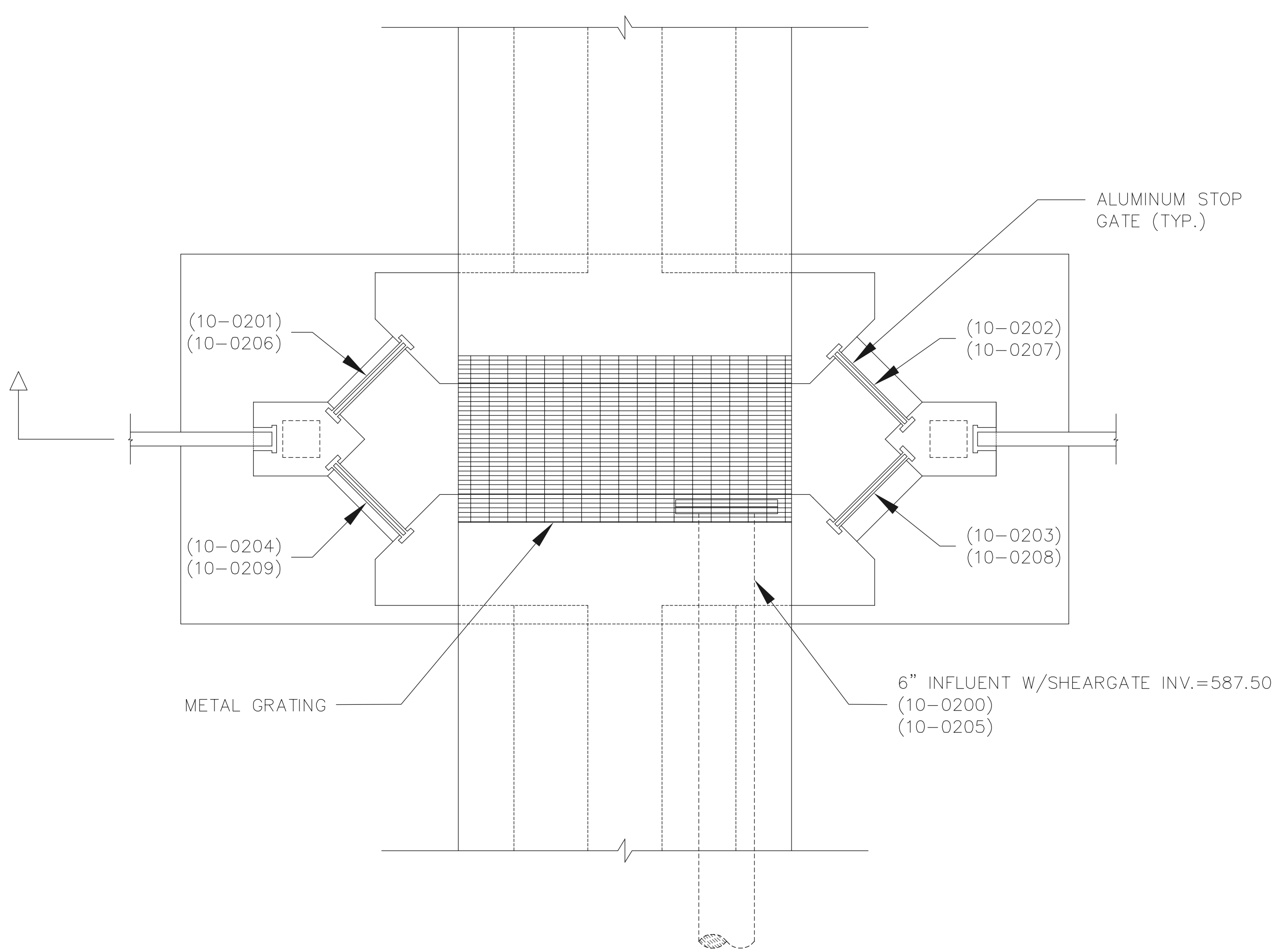
(Refer to Figure 3-19 “Sludge Drying Bed—Plan,” Figure 3-20 “Sludge Control Box—Plan”.), and Figure 3-21, “Sludge Transfer Station—Plan/Section”)

The plant’s portable pump is used to convey sludge from the digesters, though a 6-inch sludge transfer pipe, and into the drying beds. As sludge flows through the pipe, a polymer is mixed with the sludge flow to enhance the dewatering process. The polymer is controlled by a chemical



PLAN

W W ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: SLUDGE DRYING BED – PLAN	FIGURE:	3–19
				SCALE:	N.T.S.
	APPROVED:	HFW		DATE:	12/2005



PLAN–SLUDGE CONTROL BOX

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					SCALE:	N.T.S.
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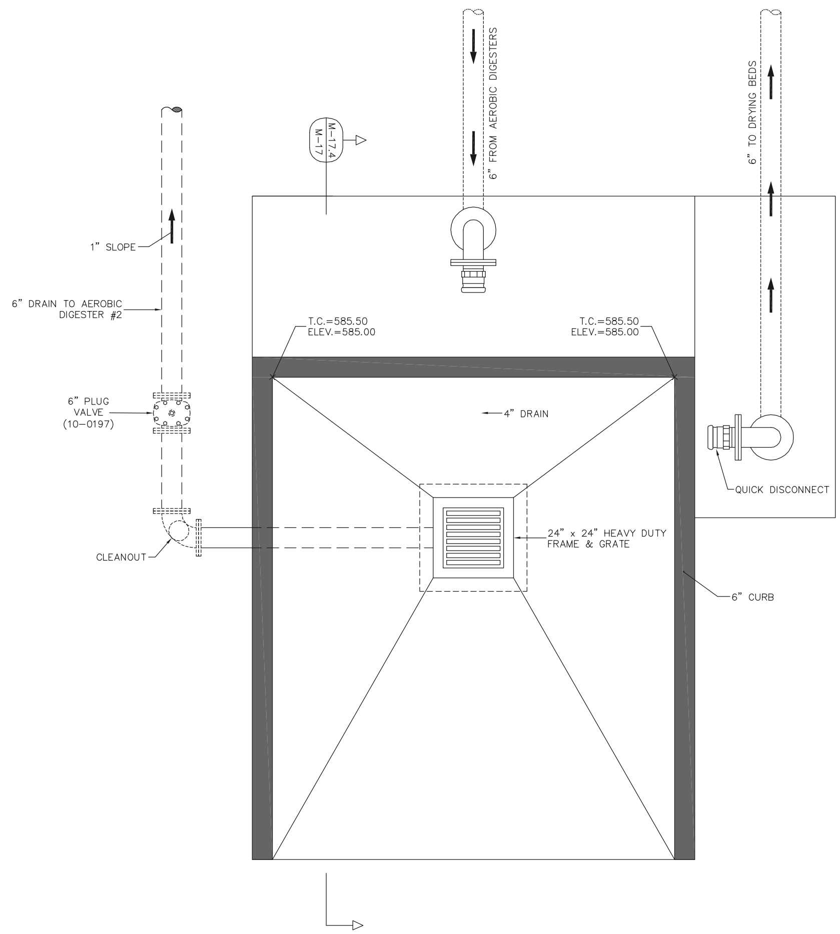
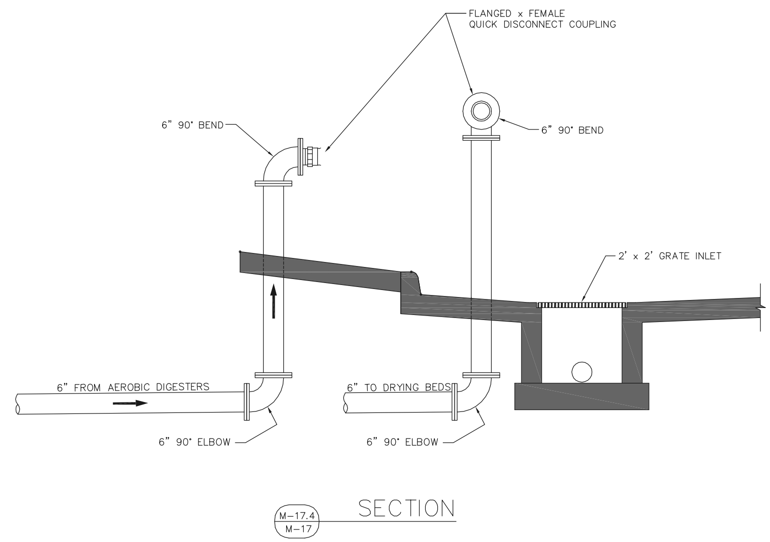


SLUDGE TRANSFER STATION



SECTION

WW Engineers Surveyors Planners Associates	DRAWN:	EFA	TITLE: SLUDGE TRANSFER STATION – PLAN/SECTION		FIGURE:	3–21
	APPROVED:	HFW			SCALE:	N.T.S.
					DATE:	12/2005

feed pump and mixed with potable water by a static mixer before it is injected into the 6-inch sludge transfer pipe and mixed with the sludge flow by a second static mixer. Sludge is directed into the chosen drying bed by opening the appropriate plug valves, shear gates, and hand lift stopgates. As sludge flows into the drying beds, workers evenly distribute the sludge around the bed using rakes. Dried sludge is removed and hauled to the Amherst County Landfill for final disposal.

<u>Alternate Mode of Operation</u>

Dried sludge is normally transported to the Amherst County Landfill. During emergencies, however, it may be necessary to transport sludge to the City of Lynchburg Landfill.

<u>Operation and Control</u>

To prepare for the sludge wasting operation open one of the two 6-inch plug valves (10-0199 or 10-0198) to allow flow to one of the two covered drying bed areas. The valves are located at a pipe tee between the two covered drying bed areas. Open the corresponding shear gate at the end of the 6-inch influent pipe and then chose the stopgate(s) to open. Ensure that the plug valve (10-0188 or 10-0189) corresponding to the correct digester has been opened before starting pumps. Also ensure that the digester blowers and mixers have been turned off for a sufficient amount of time to let the sludge settle. Turn on the potable water supply and polymer feed pump before starting the portable pump. Adjust the pumping rates accordingly to achieve the desired sludge texture at the drying beds.

<u>Operating Problems/Solutions</u>

1. Sludge too “wet” or “dry”.

    Causes:

    a. Incorrect sludge to polymer ratio.

    Corrective Measures:

    a. Increase or decrease the polymer feed rate. Increase or decrease the sludge pumping rate.

2. No sludge flow

    Causes:

a. Plug valves closed.

b. Portable pump damaged.

c. Suction hose collapsed.

d. Compressor pipe leaking.

e. Pump ejector ball stuck.

Corrective Measures:

a. Open plug valves.

b. Stop and inspect portable pump.

c. Replace hose.

d. Check connections, replace.

e. Disassemble, remove obstruction.

Laboratory Controls

There are no laboratory controls for this process.

Safety and Fail-Safe Features

The portable pump contains a check valve to avoid backflow and damage to the pump. The potable water supply is equipped with a reduced pressure zone backflow preventer to prevent polymer contamination of the potable water supply.

Start-Up Procedure

See Operation and Control section above.

Reference Drawings

- **DA Associates Record Drawings: July 22, 2005**

  Sheet No. 16 of 20, Drawing No. M-16 – Aerobic Digester Modifications-Proposed Piping and Equipment Layout.

  Sheet No. 17 of 20, Drawing No. M-17 – Septage Receiving Station and Sludge Transfer Station.

  Sheet No. 18 of 20, Drawing No. M-18 – Sludge Drying Beds

- **Operation and Maintenance Manual for Portable Pump—Godwin Pumps**

CHEMICAL FEED SYSTEM

Description

Three types of chemical feed systems are used: polymer, sodium hypochlorite, and lime. Chemical feed rates will vary depending on the wastewater and sludge characteristics. Some chemicals are mixed with non-potable water (NPW) prior to injection into the process stream. The NPW is used as a transporting agent because it makes flow rate control easier at low flow rates.

Polymer is used as a dewatering aid for sludge. A polymer solution is fed from the polymer solution building into a 6-inch sludge transfer pipe that runs from the sludge transfer station to the sludge drying beds. A chemical metering pump pumps polymer solution from 5-gallon buckets into the 6-inch sludge transfer pipe. The polymer solution is first mixed with potable water by a static mixer and then mixed with the sludge flow by a second static mixer located in a vault just outside the polymer feed building.

Wastewater pH is vital in the role of promoting nitrification in the oxidation ditch. The nitrification process consumes much of the natural alkalinity of the wastewater. Should the wastewater alkalinity become too low, the wastewater pH will decrease until the nitrifying bacteria are inhibited. The lime solution maintains the oxidation ditch alkalinity above the nitrification inhibition level. In addition to its important role in nitrification, lime also helps control the hardness of the effluent. Keeping a minimum hardness is a requirement of the plant's VPDES permit because it plays an important role in reducing the bioavailability of copper in the effluent. Lime solution is educted from a 50-gallon stainless steel dissolving tank in the alkalinity feed building by a ¾ -inch eductor through a 1-1/2 inch PVC pipe to the influent distribution box. The lime is mixed with non-potable water by a stainless steel mixer driven by a 900 RPM motor in the dissolving tank. The lime feed rate is sufficient to maintain the minimum plant effluent hardness specified in the VPDES permit.

A sodium hypochlorite solution is injected into nonpotable water that is pumped from the UV disinfection channel wet well to the diaphragm tank in the nonpotable water building. One PULSAtron Series MP, Model LME4 chemical meter pump rated at 44 GPD @ 100 psi feeds the prepared sodium hypochlorite solution out of a 55-gallon drum in the non-potable water line.

Major Components

- Feed Pumps
- Piping and Controls
- Bulk Chemical Storage

Relationship to Adjacent Units

The alkalinity feed building is located east of the oxidation ditches adjacent to the influent distribution box. The nonpotable water building is located east of the effluent filtration unit and the polymer solution building is located southeast of the aerobic digesters.

Normal Operation

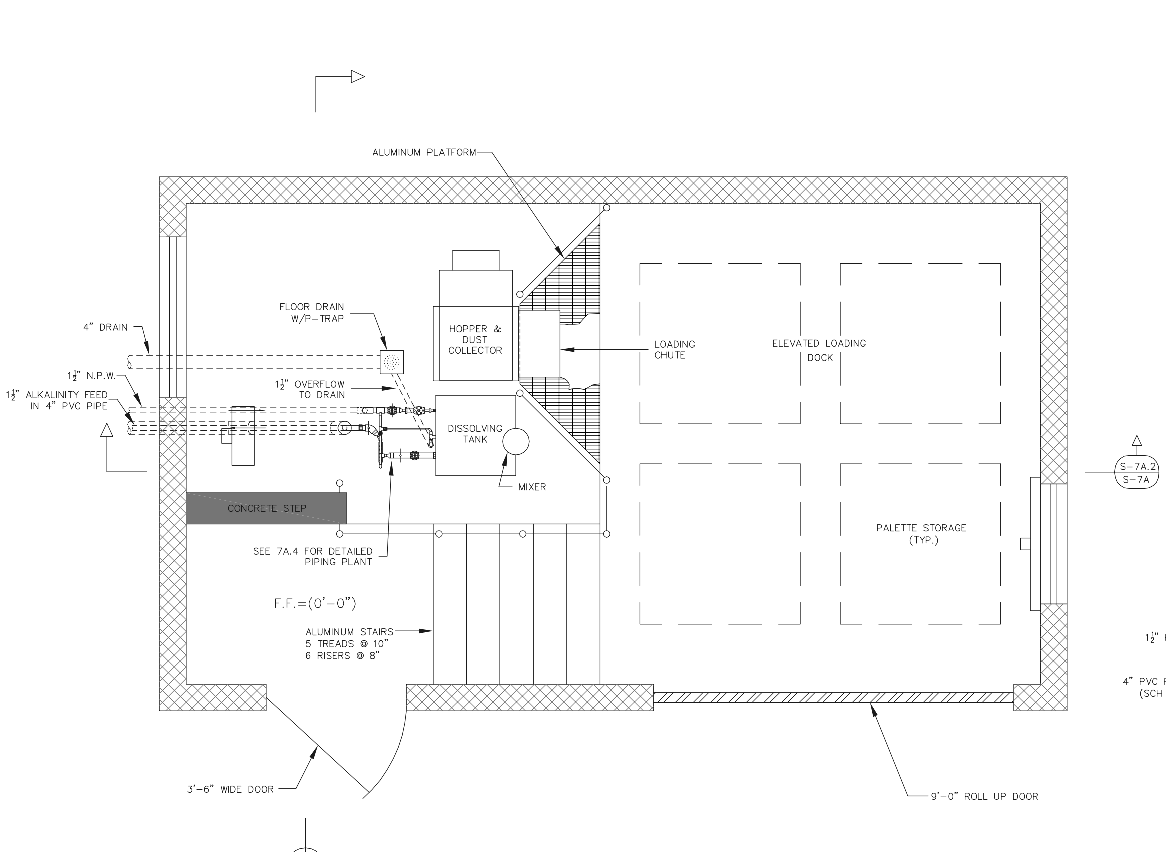
(Please see Figure 3-13, "Non-Potable Water system", Figure 3-22 and Figure 3-23, "Alkalinity Feed Building.")

Polymer:

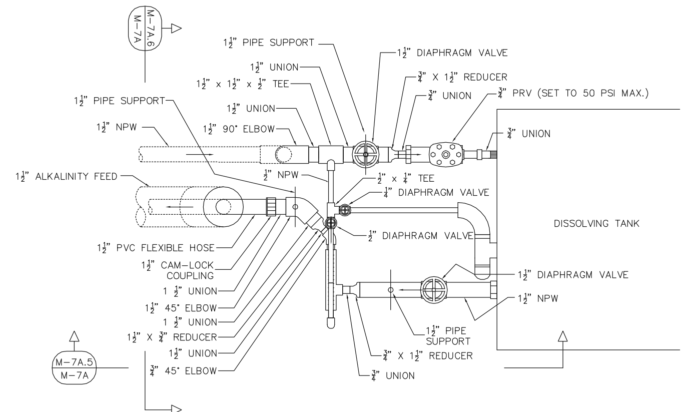
Potable water and chemical metering pump are turned on and desired flow rate is set. Flexible hose from the chemical metering pump is placed in the 5-gallon bucket of polymer solution. All valves should be open. Turn portable pump on at the septage transfer station.

Lime:

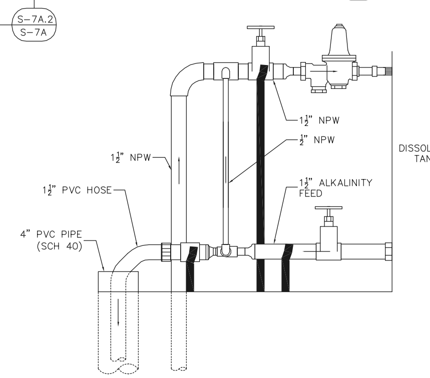
The lime feeder in the alkalinity feed building should be turned on and the desired feed rate set. Lime is fed through the loading chute of the hopper and dust collector and fed to the dissolving tank by the dry chemical feeder. A 1 ½-inch NPW line is fed into the dissolving tank where it is mixed and a lime slurry is created. All valves for the NPW line and the feed line should be open prior to this process beginning. An eductor located in the alkalinity feed building educts the lime slurry through a 1 ½-inch line to the influent distribution box where it is then fed to the oxidation ditches. A solenoid valve controls water inflow to the dissolving tank and the eductor.



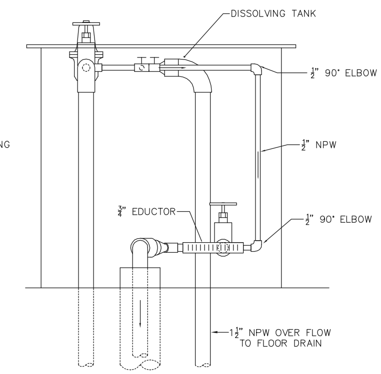
M-7A.1 M-7A FLOOR PLAN



M-7A.4 M-7A PIPING PLAN



M-7A.5 M-7A PIPING SECTION



M-7A.6 M-7A PIPING SECTION

ENGINEERS SURVEYORS PLANNERS ASSOCIATES

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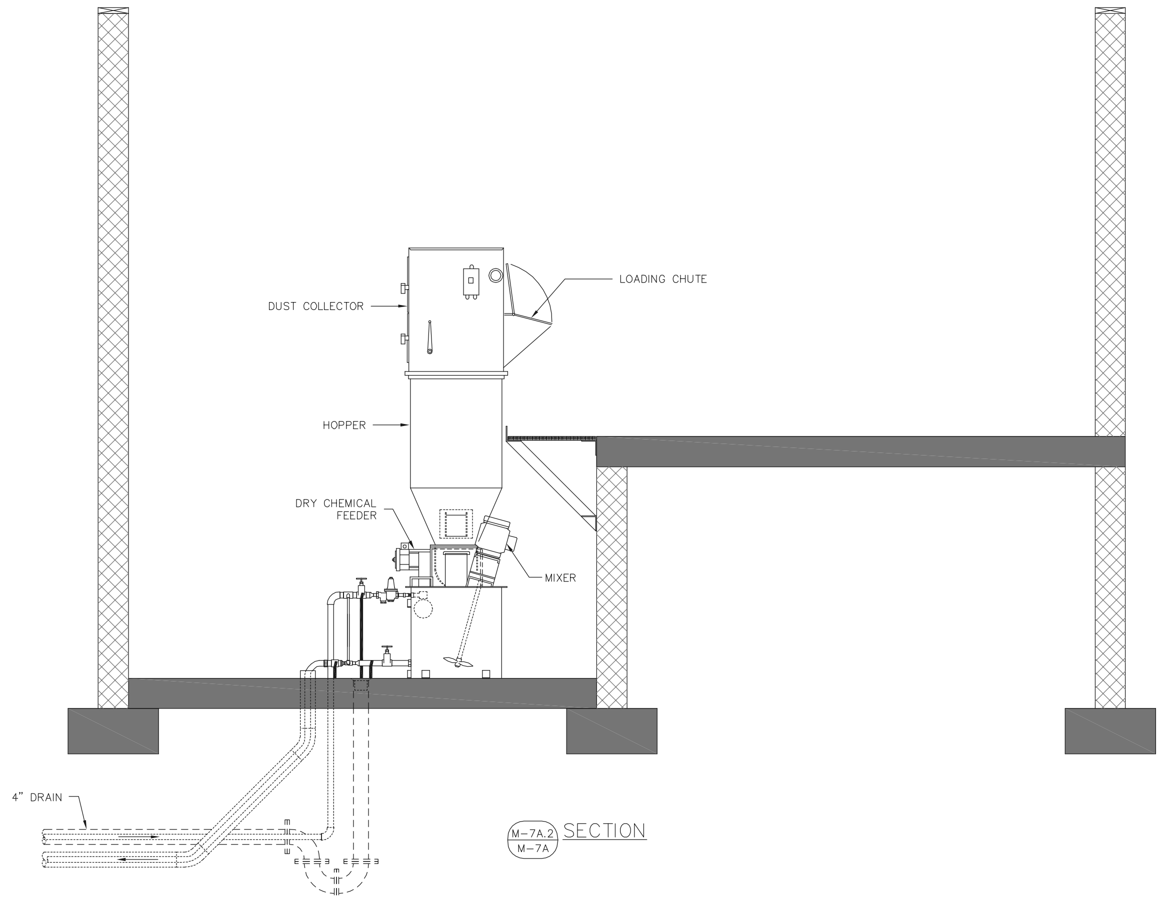
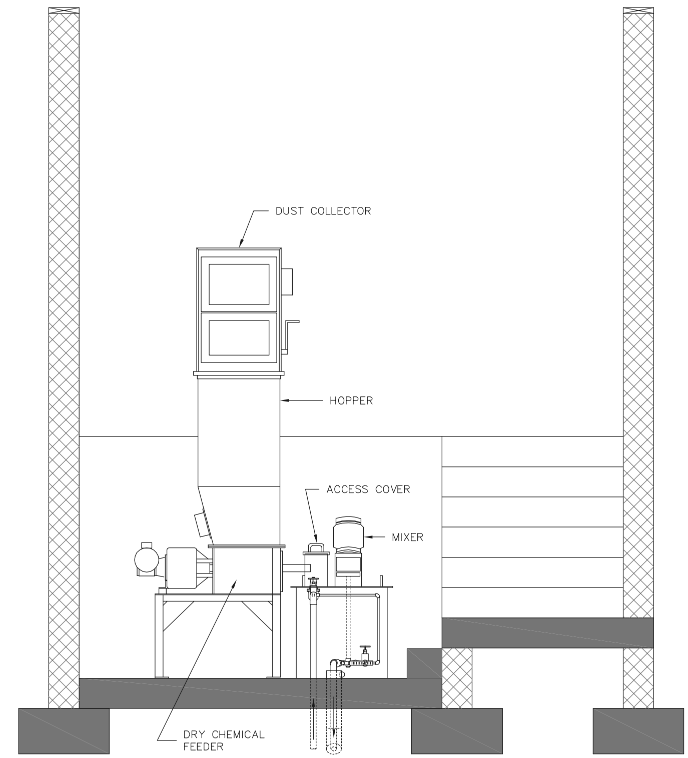


M-7A.2 / M-7A SECTION



M-7A.3 / M-7A PIPING SECTION

W W ENGINEERS SURVEYORS PLANNERS ASSOCIATES	DRAWN:	EFA	TITLE: ALKALINITY FEED BUILDING	FIGURE:	3–23
	APPROVED:	HFW		SCALE:	N.T.S.
				DATE:	12/2005

Sodium Hypochlorite:

The 55-gallon tank in the NPW building is filled with water and HTH tablets are added to the water in the tank (10 tablets per 5 gallons of water). The tank mixer mixes the HTH tablets and the water to form a sodium hypochlorite solution. When the control panel is in the “Auto” position, the chemical feed pump automatically starts when the NPW pump in the UV channel starts.

Alternate Mode of Operation

The sodium hypochlorite feed system can be operated manually or automatically (“Hand” or “Auto”). The alkalinity feed system and the polymer feed system are operated manually (“On” or “OFF”). Should the alkalinity feed system go down, lime can be fed directly to the oxidation ditches at a total rate of 2.0 lbs lime/100,000 gallons per hour (influent rate).

Operation and Control

All chemical feed systems at the Rutledge Creek WWTP should monitored carefully and adjusted as needed. Chemical feed rates may vary with influent wastewater characteristics and seasonal weather variations. Careful monitoring of pH, chlorine, flocculation/settling characteristics and filamentous growth throughout the treatment system can help to determine the process efficiency and chemical feed requirements.

Operating Problems/Solutions

Most problems encountered with the chemical feed system will be electrical and mechanical in nature and manufacturers' manuals should always be consulted. Leakages should always be repaired immediately and pumps should be inspected regularly for proper operation.

Laboratory Controls

Alkalinity and hardness in the oxidation ditch should be regularly monitored and controlled as necessary with lime.

Safety and Fail-safe Features

The sodium hypochlorite and lime feed systems have alarm features that can be monitored from the lab control building.

General Health Hazard Data:

Effects of Process Chemical Exposure:

Skin: Contact with concentrated chemical solutions may cause serious burns to human tissue.

Inhalation: Chemical mist or dust may cause injury to entire respiratory tract.

Eyes: May cause severe to permanent injury.

Ingestion: Damages throat area and gastro-respiratory tract.

Emergency First Aid:

Skin: Remove contaminated clothing and wash with water.

Inhalation: Remove from exposure. Get prompt medical assistance.

Eyes: Flush with water for 15 minutes including under the eyelids.

Ingestion: Drink plenty of water or fruit juice. Do not induce vomiting. Get prompt medical assistance.

Start-Up Procedure

Check all units for proper installation and alignment. Check clearance of all moving parts. Check chemical feed lines for any debris. Check all valves for correct setting. Run water through the system before adding chemicals and check pumps, valves, and piping for leaks. Start metering pumps for flow.

Process Chemical Minimum Quantities

The Rutledge Creek Wastewater Treatment Plant should have the following quantities of process chemicals on hand at all times:

Polymer Solution:	(5) – 5 gallon buckets
Sodium Hypochlorite Solution:	(5) – 50 tablet buckets
Lime:	(90) – 50 pound bags

Reference Drawings

- **DAA Record Drawings: July 22, 2005**

  Sheet No. 13 of 20, Drawing No. M-13 – UV Disinfection Plan & Section.

  Sheet No. 6 of 13, Drawing No. E-6 – Filter and UV Disinfection, Effluent Flowmeter, and WAS Vault 2 - Electrical

SLUDGE MANAGEMENT

Description

Sludge, grit and screenings are handled per the current approved Rutledge Creek WWTP Sludge Management Plan (see "Sludge Drying Beds" p. 3-91 for sludge wasting procedure). Sludge, grit, and screenings are transferred to the Amherst County Landfill from the Rutledge Creek WWTP via Town of Amherst truck and maintenance personnel. As per the plant's agreement with the County landfill, the paint filter test is applied to sludge, screenings, and grit prior to hauling.

Haul Route

The haul route description is as follows: WWTP site behind Zane Snead Industrial Park to Industrial Drive (SR 731) to Zane Snead Drive (SR 731) to Boxwood Farm Road (SR739) to N. Main Street (US Route 29 Business) to S. Amherst Highway (US Route 29 Bypass) to Coolwell Road (SR 663) to Izaak Walton Road (SR 663) to Kentmoor Farm Road (SR 613).

Landfill Contact Information

Amherst County Landfill
Conctact: Teresa Nuchols, Solid Waste Administrator
(434) 846-3324

Mailing address:
PO Box 779
Madison Heights, VA 24572

Landfill location:
715 Kentmoor Farm Road
Madison Heights, VA 24572

CONTENTS
CHAPTER 4 - PERSONNEL

CHAPTER 4
PERSONNEL

GENERAL

The personnel of the Rutledge Creek Wastewater Treatment Plant for the Town of Amherst ultimately determine the effectiveness of the facility. All personnel should have practical experience and current training in operation and maintenance.

This chapter is intended to present personnel requirements for the operation and maintenance of the WWTP, suggested staffing, and the recommended qualifications of the personnel.

STAFF REQUIREMENTS

The treatment plant is manned a minimum of 10-hours per day 7-days per week by a minimum Class III operator under the supervision of a Class II operator. The plant is also monitored 24-hours a day 7-days a week by a 24-hour dialer that notifies the plant superintendent of all alarm conditions. Qualifications for certification of a Class II and Class III operator are listed under the "Qualifications" section presented in this chapter. A copy of the Rules and Regulations for certification is presented in Appendix 6.

Maintenance at the WWTP will be performed by the Town of Amherst. Personnel from the Town of Amherst should be familiar with the plant and trained to perform maintenance duties required. The following is a description of job schedule requirements:

Job Schedule Requirements

- Water and Wastewater Superintendent

  Regular 16 hours per week devoted to Wastewater Treatment Plant, day shift, Monday through Friday, on call 24 hours per day for emergency situations. The Superintendent will be designated by the Town of Amherst.

- Class II/Class III Operator

  Regular 40 hours per week, alternating shift basis, Monday through Sunday - alternating days off per week, on call 24 hours per day for emergency situations.

- Maintenance Personnel

  No full time maintenance personnel are currently employed at the WWTP. Maintenance will be the responsibility of the Town of Amherst.

A reasonable allocation of work among the two employees might be as follows:

Work Allocations

- Water and Wastewater Superintendent

  - 20 Percent Wastewater Treatment Plant Administration
  - 10 Percent Pretreatment program, Grease Control Program
  - 5 Percent Distribution System
  - 5 Percent Operation

- Class II Operator

  - 50 Percent Operation
  - 20 Percent Maintenance
  - 20 Percent Laboratory
  - 7 Percent Records and Reporting Plant
  - 3 Percent Records and Reporting Pretreatment

QUALIFICATIONS
WASTEWATER SUPERINTENDENT

PERSONNEL REQUIRED

One

JOB DESCRIPTION

Responsible for administration of the Rutledge Creek Wastewater Treatment Plant located in The Town of Amherst. Exercises authority over all plant functions and personnel. Inspects plants regularly and initiates or recommends new or improved practices. Organizes training programs. Coordinates data and prepares or reviews and approves operational reports and budget requests. Controls expenditure of budgeted funds and requests approval of major expenditures, if required. Maintains effective communications and working relationships with employees, government officials, and general public. Performs some operational functions in emergencies.

QUALIFICATIONS PROFILE

1. Formal Education
   a. Graduation from a high school and preferably community college with an associate degree in civil or sanitary engineering technology or any equivalent combination of experience and training which provides the required knowledge, skills, and abilities.

2. General Requirements
   a. Knowledge of processes and equipment involved in wastewater treatment.
   b. Ability to direct and evaluate operation of plant.
   c. Ability to handle emergencies.
   d. Ability to train and supervise plant operators.
   e. Ability to prepare routine operations reports and maintenance records.
   f. Possession of a Class II Wastewater Treatment operator Certificate issued by the State of Virginia. Qualifications for Class II operators are presented in their respective sections later in this chapter.

3. Specific Vocational Preparation and Training

a. Completion of operator training course or equivalent in training and experience.

b. Two to 6 years experience in wastewater treatment plant operation supervisory experience highly desirable.

4. Physical Demands:

Light work, may occasionally engage in medium work during emergencies.

5. Working Conditions:

Both inside and outside - exposed to weather, fumes, odors, dust, and risk of bodily injury. May be exposed to toxic conditions.

QUALIFICATIONS
OPERATOR (CLASS II)

PERSONNEL RECOMMENDED

One

JOB DESCRIPTION

Operates treatment facilities to control flow and processing of wastewater, sludge, and effluent. Monitors gauges, meters, and control panels. Observes variations in operating conditions and interprets meter and gauge readings and test results to determine processing requirements. Operates valves and gates either manually or by remote control. Starts and stops pumps and reactor equipment to control and adjust flow treatment processes. Maintains shift log and records meter and gauge readings. Obtains samples and performs routine laboratory tests and analyses when necessary.

QUALIFICATIONS PROFILE

1. Formal Education:
   High school graduate or equivalent training and experience.

2. General Requirements:
   a. Ability to learn operation of plant processes and equipment.
   b. Ability to maintain and evaluate all records and keep superintendent apprised of any problems or issues.
   c. Ability to maintain a working relationship with other shift workers.
   d. Possession of a Class II Wastewater Treatment Operator Certificate issued by the State of Virginia. See 18 VAC 160-20-90 B.5 for requirements (Appendix 6).

3. Specific Vocational Preparation and Training:
   a. On the job training from date of employment.
   b. Completion of required operator training course.

c. Three to twelve months experience in a wastewater treatment plant depending upon formal training and prior experience.
d. Course work in biology and chemistry and practical laboratory experience helpful.
e. Or any equivalent combination of experience and training which provides the required knowledge, skills, and abilities.

4. Physical Demands:

   Work involving medium physical exertion such as climbing, balancing, and lifting. Must have sense perception such as hearing, visual acuity, color vision, etc.

5. Working Conditions:

   Both inside and outside - exposed to weather, fumes, odors, and dust. May be exposed to toxic conditions. Possible risk of bodily injury.

QUALIFICATIONS
OPERATOR (CLASS III)

PERSONNEL REQUIRED

One

JOB DESCRIPTION

Operates treatment facilities to control flow and processing of wastewater, sludge, and effluent. Monitors gages, meters, and control panels. Observes variations in operating conditions and interprets meter and gage readings and test results to determine processing requirements. Operates valves and gates either manually or by remote control. Starts and stops pumps and reactor equipment to control and adjust flow treatment processes. Maintains shift log and records meter and gage readings. Obtains samples and performs routine laboratory tests and analyses when necessary.

QUALIFICATIONS PROFILE

1. Formal Education:
   High school graduate or equivalent training and experience.

2. General Requirements:
   a. Ability to learn operation of plant processes and equipment.
   b. Ability to maintain and evaluate simple records.
   c. Ability to maintain a working relationship with other shift workers.
   d. Possession of a Class III Wastewater Treatment Operator Certificate issued by the State of Virginia. See 18 VAC 160-20-90 B.4 for requirements (Appendix 6).

3. Specific Vocational Preparation and Training:
   a. On the job training from date of employment.
   b. Completion of required operator training course.
   c. Three to twelve months experience in a wastewater treatment plant depending upon formal training and prior experience.

d. Course work in biology and chemistry and practical laboratory experience helpful.
e. Or any equivalent combination of experience and training which provides the required knowledge, skills, and abilities.

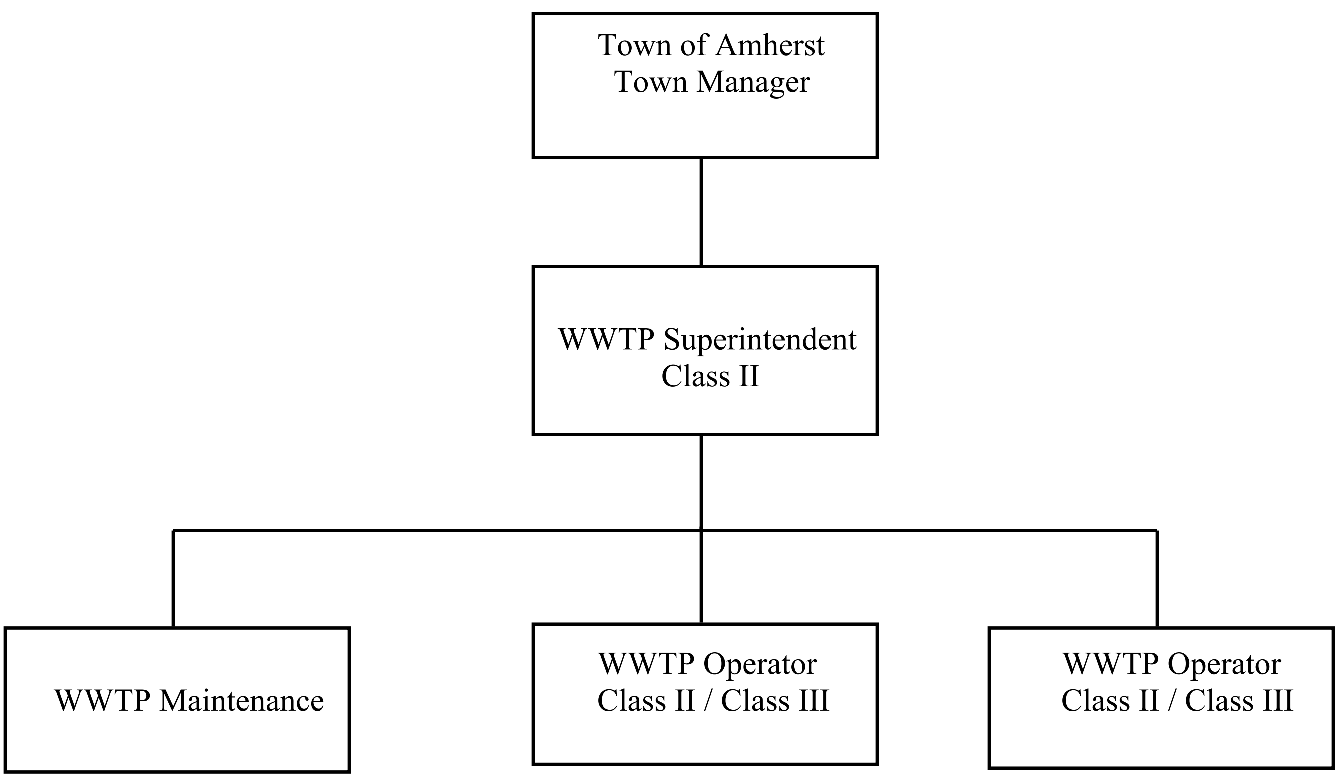
4. Physical Demands:
   Work involving medium physical exertion such as climbing, balancing, and lifting. Must have sense perception such as hearing, visual acuity, color vision, etc.

5. Working Conditions:
   Both inside and outside - exposed to weather, fumes, odors, and dust. May be exposed to toxic conditions. Possible risk of bodily injury.

STAFF ORGANIZATION CHART

The current staff organization chart for the Rutledge Creek WWTP is presented in Figure 4-1.

FIGURE 4-1
STAFF ORGANIZATION CHART – RUTLEDGE CREEK WWTP



CONTENTS
CHAPTER 5 – QUALITY CONTROL TESTING

CHAPTER 5
QUALITY CONTROL TESTING

PURPOSE

The purpose of laboratory testing is to evaluate overall wastewater treatment plant efficiency and to monitor the performance of the plant's individual processes. Results of laboratory testing provide information regarding required corrective actions to increase unit efficiencies and provide a record of plant operation. This data is required by State and Federal regulatory agencies to ensure that the plant is in compliance with provisions of the current Virginia Pollutant Discharge Elimination System (VPDES) permit, presented in Appendix 1. The data is also important to design engineers when plant expansion or improvements become necessary. For these reasons, proper and adequate testing is essential. In addition to the information found in this chapter, it is recommended that plant personnel responsible for sampling and lab procedures become familiar with "Section 1020, Quality Assurance" of *Standard Methods for the Examination of Water and Wastewater*.

Laboratory records are discussed in Chapter 6, "Records." The current VPDES sampling schedule can be found in Table 5-1. Figure 5-2 shows the current effluent sampling location.

SAMPLING

Laboratory tests and results are only as good as the sample obtained. There are three types of samples taken for laboratory analysis:

- <u>Flow Proportioned Samples</u> - A series of samples taken in proportion to flow over a 24-hour period to minimize the effect of the variability of the individual samples.

- <u>Grab Sample</u> - A single individual sample taken at neither a set time nor set flow.

- <u>8-Hour Grab Composite</u> - A flow weighted average sample taken over a period of eight hours.

The following is a list of general guidelines for sampling wastewater:

1. Samples should be taken at locations where the wastewater is as completely mixed as possible.

2. Particles greater than 1/4-inch in diameter should be excluded from samples.

3. Any floating materials and growths, which may have collected at a sampling location, should not be included when sampling.

4. If samples are to be kept for an hour or more prior to testing, they should be immersed in ice water to retard bacterial action.

5. Proper sampling equipment should be provided and safety precautions should be exercised during all sampling.

6. Consideration should be given to the relationship between the plant's daily flow variation and detention time through the units so that influent samples relate to the same waste.

7. Consideration should be given to the volume of sample required for a particular test. Sample volume will depend on the number and types of tests to be performed. Experience is the best guide.

Refer to Appendix 7 for a discussion of sample preservation from 40 CFR Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants.

LABORATORY TESTS AND GENERAL APPLICATIONS

The following is a list of recommended and required laboratory tests with definitions and explanations of the general application of each test to the wastewater plant processes. Worksheets presented in Appendix 11 can be used to aid in lab tests.

1. <u>Alkalinity</u> - Alkalinity is the total concentration of bases in water. Controlling alkalinity is key for optimizing the biological treatment process and plays a key role in reducing the toxicity of copper.

2. Ammonia - Ammonia is a form of oxidizable nitrogen. In the nitrification process, ammonia is broken down into nitrate and nitrite.

3. 5-Day Biochemical Oxygen Demand (BOD_5) - The BOD_5 test is used to determine the relative oxygen requirements to biologically stabilize the organic matter present in the wastewater. The BOD_5 test results are usually reported in milligrams per liter (mg/1) of oxygen consumed in a 5-day test period.

4. Chemical Oxygen Demand (COD) - The COD test provides a measure of the oxygen equivalent of that portion of the organic matter that is susceptible to oxidation by a strong chemical oxidant. The COD value will be greater than the BOD_5 value because more organic substances can be chemically oxidized than biologically oxidized. For many types of waste, the BOD_5 and COD results can be correlated. The COD data is used in the same manner as the BOD_5 test, but since it takes only 3 to 5 hours to obtain COD test results compared to 5 days for test results, the data is more readily available for use for treatment plant control and operation. The COD test results are usually reported in mg/l of oxygen consumed.

5. Dissolved Oxygen (DO) - The DO test indicates the amount of oxygen in solution in a liquid. The solubility of oxygen decreases with an increase in temperature. The solubility of oxygen in fresh water ranges from 14.6 mg/l at 0 degree C to about 7 mg/l at 35 degree C. The DO test is used to monitor aerobic conditions in streams and to control treatment processes.

6. *Escherichia coli* (E. coli) - E. coli bacteria is a type of coliform bacteria used as an indicator for the possible presence of pathenogenic organisms in water. E. coli is of entirely of fecal origin, therefore making it a good indicator of the presence of human feces and possible pathogens in water.

7. Fecal Coliform - Fecal coliform bacteria are a group of bacteria that are passed through the fecal excrement of humans, livestock and wildlife. It indicates the

presence of untreated sewage and the possible presence of other pathogenic organisms.

8. Hydrogen Ion Concentration (pH) - The pH value is an expression of the intensity of the acid or alkaline condition of a solution.

9. Orthophosphate - Orthophosphates are also know as reactive phosphates. These forms of phosphate are measurable in the lab without preliminary hydrolysis or oxidative digestion. Orthophosphates are the most biologically available form of phosphorous.

10. Suspended Solids - Suspended solids are those solids, which can be filtered from the sample. The suspended solids concentration also includes the settleable solids. This test indicates the quantity of sludge that will develop during sedimentation.

11. Temperature - The temperature of the wastewater affects the solubility of oxygen and the rate at which chemical reactions occur. Additionally, temperature affects microbiological activity. High temperatures promote microbiological activity while low temperature decreases microbiological activity.

12. Total Hardness - Total hardness is the sum of calcium and magnesium concentrations and is expressed as the equivalent quantity of calcium carbonate. Monitoring total hardness at the Rutledge Creek WWTP is required by the VPDES permit in order to control the toxicity of copper.

13. Total Kjehldahl Nitrogen (TKN) - TKN is the organically bound nitrogen in wastewater and must be released from the organic matter by a process of digestion prior to analysis. This form of nitrogen is usually much higher on influent (untreated waste) samples than effluent samples. In domestic wastewater facilities the biological activity breaks down the organic matter releasing and or consuming the nitrogen as energy in the process.

14. Total Nitrogen - Total nitrogen is a measure of all the various forms of nitrogen that are found in a water sample. Nitrogen is a necessary nutrient for the growth of aquatic plants and algae. Controlling total nitrogen helps prevent eutrophication in receiving waters.

15. Total Phosphorus - Total phosphorus is the measure of all the orthophosphates and condensed phosphates, both soluble and insoluble, organic and inorganic. Controlling total phosphorus in the effluent is key for preventing eutrophication in receiving waters.

16. Total Solids - The solids test is used to indicate the amount of solids that enter the treatment plant. Analytically, the total solids content is defined as all matter that remains as residue upon evaporation at 103 degrees C. Total solids include suspended solids, settleable solids, and dissolved solids.

17. Volatile Solids - The volatile solids test is used to distinguish between the inorganic and organic compounds in the total solids. Only inorganic compounds remain after the solids are fired at 600 degrees C. The term "volatile" can be applied to suspended as well as total solids. Volatile solids are usually expressed in mg/1 of volatile solids.

18. Turbidity - The turbidity of water indicates the amount of suspended solids in the water that interfere with the passage of light through the water. Measuring the turbidity of the effluent indicates the efficiency of the settling process.

19. Microscopic Examination of Activated Sludge - (From "Microbiology for Sanitary Engineers" by R. E. McKinney)

    Since the microorganisms follow definite patterns in all of the activated sludge systems, it is possible to determine the operating characteristics of the various systems by making routine microscopic examinations of the activated sludges.

The microorganisms act as instantaneous biochemical indicators and eliminate the need for complex chemical tests, especially in small systems.

Activated sludge floc does not have a definite size or shape, but rather is a heterogeneous agglomeration of microorganisms. A good activated sludge will flocculate readily and produce an effluent that is free of dispersed bacteria. The absence of dispersed bacteria is usually accompanied by a relatively active population of stalked ciliated protozoa such as Vorticella and an occasional rotifer or the free-swimming ciliate, Stylonichia.

While it is important to recognize a good activated sludge under the microscope, it is also important to recognize the symptoms of a poor activated sludge and what is responsible for the problem. A sudden loss of protozoa can result from anaerobic conditions or toxic materials. If the lack of oxygen has killed the protozoa, it will be noted that the number of free swimming bacteria has suddenly jumped. With toxic materials there will usually be no sudden increase in free-swimming bacteria, but rather a decrease. An activated sludge fed a toxic material will often look perfect and will have a clear effluent for a short period.

The growth of filamentous microorganisms such as actinomycetes or fungi is readily observable under the microscope. The filamentous microorganisms keep the floc from being compact. Filamentous forms usually result in nutritional deficiencies such as nitrogen and phosphorus, low PH levels, and low oxygen levels. The most critical factor for normal activated sludge systems is the low oxygen level, while industrial wastes normally suffer from nutritional deficiencies.

It appears that the filamentous microorganisms are able to compete with the bacteria at oxygen levels between 0 and 0.5 mg/1. The bacteria begin to metabolize anaerobically, while the filamentous microorganisms continue with aerobic metabolism. The energy balance favors the filamentous forms in this region. If the system goes completely anaerobic, the bacteria will reestablish predominance since the filamentous microorganisms are generally strict aerobes.

In total oxidation systems, there is a tendency for filamentous microorganisms to predominate over a long period of operations unless sludge is wasted at reasonable intervals. It appears that the filamentous microorganisms are able to metabolize inert polysaccharide material produced by the bacteria, thus giving the filamentous forms a source of food that is unavailable to the bacteria. Further research is needed on this point. As the organic load increases on the activated sludge, the number of bacteria in the system increases with stimulation of the free-swimming ciliates. A good activated sludge system with a BOD between 10 mg/l and 20 mg/1 will have a high population of free-swimming ciliates and a high population of stalked ciliates. The two forms will be in almost equal predomination. Increasing the organic load stimulates the free-swimming ciliates to very high levels. At relatively high organic levels, the tiny flagellates appear in competition with the bacteria. It will be noted that the dispersed bacteria population is very high. One key bacterial form is the spirillum. The presence of large numbers of spirillum is evidence of a poor activated sludge system.

Recognition of key microbial operation characteristics can come only from repeated observations of various activated sludges. With experience, it is possible to analyze any activated sludge system just from microscopic examination of the activated sludge and a routine knowledge of how the system is operated. The importance of this technique to the plant operator cannot be overemphasized.

LABORATORY INSPECTION

On an unscheduled basis, the Plant Superintendent will make safety inspections of the laboratory using the Laboratory Inspection Checklist. See Figure 5-1. After the inspection is completed, a copy of the checklist will be given to the WWTP personnel to ensure that all corrections are made. After the corrections are made, the signed-off copy of the checklist will be returned to the Plant Superintendent for filing.

FIGURE 5-1
LABORATORY INSPECTION CHECKLIST
RUTLEDGE CREEK WWTP

	Action Required	O.K.
1. Broken & Chipped Glassware	________	________
2. Fire Extinguishers:		
a. Adequate Number	________	________
b. Unobstructed	________	________
c. Last Inspected	________	________
d. Tagged	________	________
3. Soap & Towels for Each Lavatory	________	________
4. General Cleanliness	________	________
5. Lights Burned Out	________	________
6. Safe Wiring:		
a. Frayed Cords	________	________
b. Overloaded Outlets	________	________
c. All outlets ground (no adapaters in use)	________	________
7. Flammables, Acids in approved place	________	________
8. Any unlabeled and undated reagents	________	________
9. Emergency Equipment:		
a. First Aid Kit Complete	________	________
b. Burn Spray Present	________	________
c. Eye Wash Works Properly	________	________
d. Soda Solution	________	________
e. Goggles	________	________
f. Apron	________	________
g. Emergency Lights	________	________

FIGURE 5-1
LABORATORY INSPECTION CHECKLIST
(Continued)

	Action Required	O.K.
10. Security - Lab Locked when no one present	________	________
11. Emergency Telephone Numbers Posted:		
a. Fire	________	________
b. Police	________	________
c. Ambulance	________	________
12. Safety Signs (Any Required)	________	________
13. Lab Personnel Checked out on Scott Air Pac	________	________
14. Inventory of Reagents and Chemicals	________	________

General Remarks:

Inspected By:

Last Inspection:

Items Not Corrected Since Last Inspection:

LABORATORY CHEMICALS

The WWTP personnel should maintain a list of chemicals used in making standard laboratory reagents. This list should be periodically updated and used for the purpose of maintaining an adequate inventory of appropriate chemicals and reagents. A recommended list of stock lab chemicals and their quantities is provided in Appendix 14.

OFFSITE LABORATORIES

The WWTP personnel conduct on-site testing for common wastewater parameters such as BOD_5, TSS, TVS, pH, and DO. For other testing, such as testing required for parameters listed under the Water Quality Standards Monitoring (Part I Paragraph E- Other Requirements or Special Conditions) section of the VPDES permit presented in Appendix 1, an offsite laboratory is used. The offsite laboratory may also test sludge for ignitability, corrosivity, reactivity, paint filter, and TCLP. The primary laboratory currently used is:

REI Consultants, Inc.
PO Box 286
Beaver, WV 25813
Phone: (800) 999-0105

The secondary laboratory is:

Prochem Analytical Corporation
18292 Forest Rd
Forest, VA 24551
Phone: (434) 847-2852

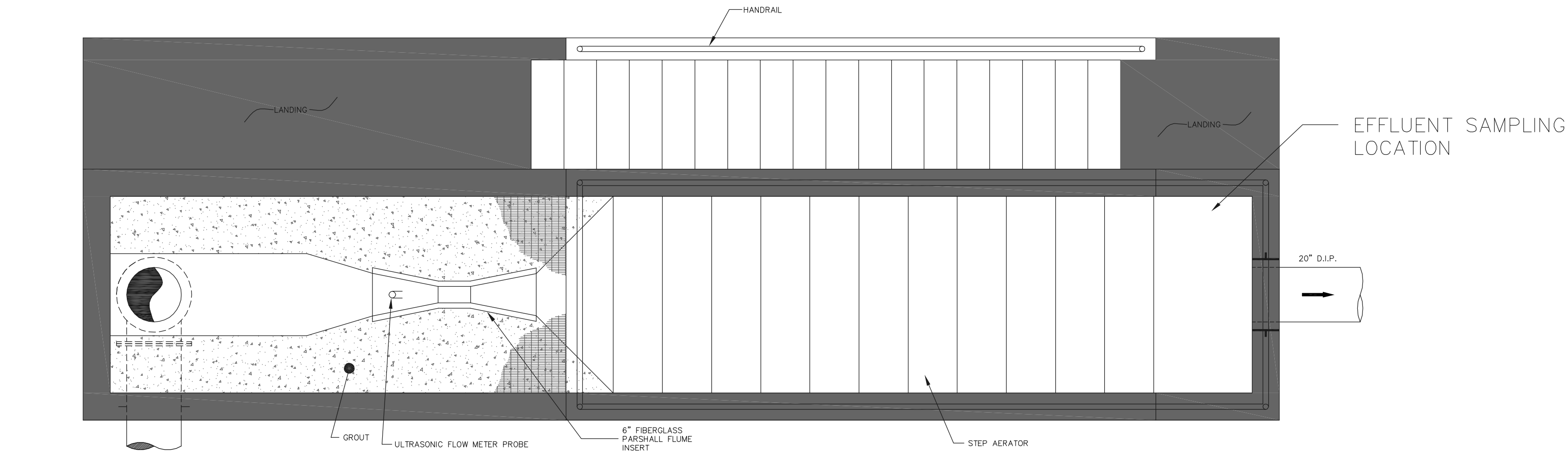
Periodically, other off-site labs may be used to accommodate special situations and the primary lab may change at the discretion of the Town of Amherst. When samples are collected and sent to the offsite lab, the guidelines for sampling and sample preservation presented in this section and Appendix 7 of this manual should be followed. In addition, any shipping procedures or requirements of the laboratory should be adhered.

Table 5-1
VPDES SAMPLING SCHEDULE
RUTLEDGE CREEK WWTP

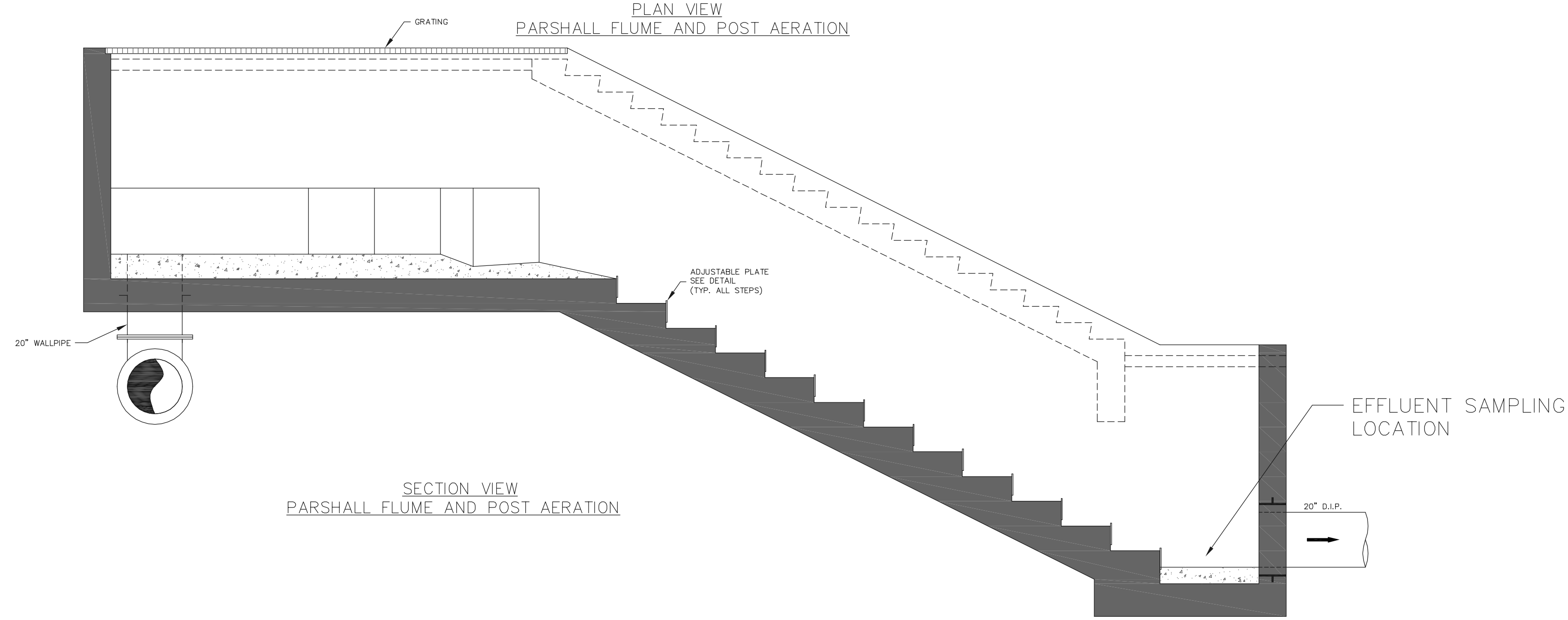
Test	Sample Type	Sampling Point	Frequency	Test Location	Recommended Test Method
Flow	TIRE	Plant Effluent	Continuous	Onsite	Totalizing, Indicating and Recording Equipment
$CBOD_5$	8 HC	Plant Effluent	2 Days / Week	Onsite	Conventional 5-day Incubation Test (Part 219 of Standard Methods)
TSS	8 HC	Plant Effluent	1 / Week	Onsite	Conventional Suspended Matter (Nonfilterable Residue) Method Using Glass Fiber Filter (Part 224c of Standard Methods)
Ammonia, as N (June- November)	8 HC	Plant Effluent	1 / Month	Offsite	N/A
pH	Grab	Plant Effluent	1 / Day	Onsite	pH Meter
Hardness	8 HC	Plant Effluent	1 / Week	Offsite	N/A
Fecal Coliform	Grab	Plant Effluent	3 days / week	Offsite	N/A
Total Phosphorous Total Phosphorous (kg/month) Total Phosphorous (kg/year)	8 HC Calculated Calculated	Plant Effluent	2 / Month 1 / Month 1 / Month	Offsite	N/A
Orthophosphate	8 HC	Plant Effluent	2 / Month	Offsite	N/A
Total Kjeldahl Nitrogen (as N)	8 HC	Plant Effluent	2 / Month	Offsite	N/A
Nitrate+Nitrite (as N)	8 HC	Plant Effluent	2 / Month	Offsite	N/A
Total Nitrogen Total Nitrogen (kg/month) Total Nitrogen (kg/year`	Calculated Calculated Calculated	Plant Effluent	2 / Month 1 / Month 1 / Month	Offsite	N/A

Notes:

1. This table is to be used for reference puposes only. The current VPDES permit should be consulted for detailed monitoring requirements and procedures.
2. All effluent samples are taken at the bottom of the cascade aerator.
3. Refer to Appendix 7 for a discussion of sample preservation from 40 CFR Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants.
4. Recommended test methods shown for on-site testing only.



PLAN VIEW
PARSHALL FLUME AND POST AERATION



SECTION VIEW
PARSHALL FLUME AND POST AERATION

W&W Engineers Surveyors Planners Associates	DRAWN:	EFA	TITLE: FLOW MONITORING & CASCADE AERATOR	FIGURE:	5–2
	APPROVED:	HFW		SCALE:	N.T.S.
				DATE:	9/2006

LABORATORY REFERENCES

1. Title 40 – Protection of the Environment – EPA – Part 136 “Guidelines Establishing Test Procedures for the Analysis of Pollutants.” (Appendix 7)
2. "Standard Methods for Examination of Water and Sewage" - American Public Health Association, Inc. Current DEQ approved edition.
3. EPA publication "Methods for Chemical Analysis of Water and Waste" (GPD Stock No. 5501-0067).
4. WPCF Publication No. 18, "Simplified Laboratory Procedures for Wastewater Examination."
5. WPCF Manual of Practice No. 11, "Operation of Wastewater Treatment Plants."
6. "Manual of Wastewater Operations," Texas Water Utilities Association.

CONTENTS

CHAPTER 6 - RECORDS

CHAPTER 6
RECORDS

PURPOSE

An important factor in any efficient wastewater treatment system is the maintenance of accurate operational and financial records. Without a record of past operational performance, it is impossible to identify trends in the process. Operating cost records are essential if meaningful budgets are to be prepared. Accurate records permit plant operating personnel and management to maintain proper control of the WWTP. Maintenance schedules and records encourage regular inspection and routine maintenance of treatment plant equipment, thus ensuring optimum performance and prolonged life of the plant equipment.

DAILY OPERATING LOG

The Daily Operating Log provides a record of the activities of each shift and information regarding the plant's overall operation. The Daily Operating Log for Rutledge Creek WWTP consists of five sheets – Oxidation Ditch 1 Daily Testing, Oxidation Ditch 2 Daily Testing, Raw Influent Daily Testing, Plant Effluent Daily Testing, and Daily Metered Readings. These five sheets are included in Appendix 11. Figure 6-1 is presented as an alternative to the current daily operating log previously mentioned. The summary forms a basic data source for each day's entry on the monthly operating report. Each shift completes the applicable sections of the forms and notes any observations that may be useful in evaluating the plant's operation.

DAILY INSPECTION LOG

The Daily Inspection Log provides a record of daily preventive maintenance tasks. Each piece of equipment is inspected daily and its operation noted. The record establishes a routine for inspecting critical parts on all mechanical equipment. The daily inspection is a part of the Equipment Records System (ERS). The supervisor should prepare a daily inspection schedule for each area of the plant according to the Equipment Records System (Chapter 7, "Maintenance.") Figure 6-2 is a suggested format for the Daily Inspection Log.

FIGURE 6-1
RUTLEDGE CREEK WWTP
DAILY OPERATING LOG

OPERATOR: ____________ **DATE:** ____________

	Daily						
Plant Influent Flow Meter (gallon)	pH	Temp (Degrees C)	DO (mg/l)	BOD	TSS	Coli	VSS
Final							
Initial							
TOTAL							

Plant Effluent Flow Meter (gallon)	pH	Temp (Degrees C)	DO (mg/l)	BOD	TSS	Coli	VSS
Final							
Initial							
TOTAL							

Chemicals Used (lbs)	Polymer	Lime	Sodium Hypochlorite
Final			
Initial			
TOTAL			

Oxidation Ditch #1 ____ pH: ____ DO (mg/l): ____

Waste Sludge Meter (gal)	
Final	
Initial	
TOTAL	

Oxidation Ditch #2 ____ pH: ____ DO (mg/l): ____

Waste Sludge Meter (gal)	
Final	
Initial	
TOTAL	

Checklist

Mechanical Screen	
Vortex Grit Unit	
Grit Chamber	
Influent Pump Station	
Influent Distribution Box	
Alkalinity Feed	
Oxidation Ditch #1	
#2	
WAS Vaults	
Effluent Filtration	
UV Disinfection	
NPW Tank	
Parshall Flume/Cascade Aerator	
Aerobic Digester #1	
#2	
Septage Station	
Sludge Drying Beds	

Weather: ____
Air temp.: ____
Precip.: ____

Comments (Visitors, Complaints, Accidents, etc.):

Dry Sludge Removal (lbs)

Power Usage (kWH)

FIGURE 6-2
RUTLEDGE CREEK WWTP
DAILY INSPECTION LOG

EQUIP. NO.	DESCRIPTION	INSP.		STATUS	WORK REQ. LUB.	WORK REQ. MAIN.

COMMENTS:

D - DAILY	TH - THURSDAY
M - MONDAY	F - FRIDAY
TU - TUESDAY	S - SATURDAY
W - WEDNESDAY	SU - SUNDAY

OPERATOR __________________ MAINTENANCE SUPER. __________________

DATE __________________

WORK ORDER REQUEST

Figure 6-3 is a copy of a Work Order Request Form. This form provides a means for initiating non-routine maintenance work. The Work Order Request Form also provides a record of maintenance tasks performed at the plant and can be used for determining maintenance cost for financial reports.

VIRGINIA STATE WATER CONTROL BOARD AND EPA

The Virginia State Water Control Board requires that the Rutledge Creek Wastewater Treatment Plant submit to the Board by the 10^{th} of each month a Discharge Monitoring Report (DMR). Information concerning reporting monitoring results is discussed in Chapter 2, "Permits and Standards."

LABORATORY RECORDS

Laboratory records in conjunction with the Daily Operating Log enable the plant operators to maintain efficient plant operation. It is recommended that worksheets used for calculating results of laboratory tests be filed as part of the laboratory records. Example worksheets are presented in Appendix 11.

ANNUAL REPORT

It is recommended that an annual report that indicates expenditures for the operation and maintenance of the wastewater treatment plant be prepared by plant management. Such a report is essential for preparing sound budget proposals.

The major categories of operating costs are labor, utilities, chemicals, and supplies. Labor should be broken down into operation, administration, and maintenance. Utilities should include electricity, fuel, oil, telephone, gas, potable water, and solid waste disposal. Chemicals should be limited to those used in the treatment processes.

Figure 6-4 is a recommended outline of information to be included in the Annual Report. The Town cost accounting records can be used as an aid in preparing the Annual Report.

FIGURE 6-3
RUTLEDGE CREEK WWTP
WORK ORDER

WORK ORDER NO. ____________________ DATE ________________

LOCATION:		REQUESTED BY: PHONE:	PRIORITY:
EQUIPMENT NAME	NUMBER	☐ INSPECT ☐ REPLACE ☐ SERVICE ☐ REPAIR ☐ OVERHAUL ☐ PAINT	
		WORK DESCRIPTION:	
		WORK PERFORMED/COMMENTS:	
JOB ESTIMATE: LABOR $ ________ MATERIAL $ ________		______________________________ MAINTENANCE SUPERINTENDENT	

WORK RECORD

PERSONNNEL ASSIGNED	MANHOURS	DATE	WORK DONE	PARTS AND MATERIALS
TOTAL:	________			

WORK COMPLETED BY: ______________________________ DATE: ________

WORK ACCEPTED BY: ______________________________ DATE: ________

FIGURE 6-4
RUTLEDGE CREEK WWTP
ANNUAL REPORT

WWTP SUMMARY		
Connected Population		
Equivalent Population		
Flow (mgd)		
pH	Influent	
	Effluent	
Screenings (ft^3/day)		
BOD_5 (mg/L)	Influent	
	Effluent	
	Reduction (%)	
Ammonia, NH_3 (mg/L)	Influent	
	Effluent	
	Reduction (%)	
Total Suspended Solids (mg/L)	Influent	
	Effluent	
	Reduction (%)	
Dewatered Sludge	Volume (gpd)	
	Moisture (%)	
	Volatile Solids (%)	
Polymer Solution Use (gal)		
Sodium Hypochlorite Solution Use (gal)		
Lime Use (lbs)		
OPERATING EXPENSES		
Personnel Salary		
Preventative Maintenance		
Corrective Maintenance		
Administrative Staff		
Chemicals		
Laboratory		
Utilities		
Equipment		
Parts		
Vehicle Operation		
Miscellaneous		
Total Operating Expense		
Budget		

MAINTENANCE RECORDS

A good maintenance program will ensure that the treatment facility produces a high quality effluent at a minimum cost and will prolong the life of the treatment equipment at the facility. Maintenance records should be kept at the plant in the office of the Control Building. Good maintenance records are essential for the preparation of financial reports. The Rutledge Creek WWTP uses a data management software called Antero™. This software allows the user to manage data pertaining to work orders, equipment, preventive maintenance, etc. A complete discussion of maintenance records and the Antero™ software is included in Chapter 7, "Maintenance."

PERSONNEL RECORDS

Personnel records of plant employees should be maintained at the Town Hall. The records are valuable for management decisions for scheduling work assignments and for promoting individuals. Education, special skills, training, and personal limitations and disabilities should be noted on personnel records. Figure 6-5 presents a suggested Personnel Record Form.

EMERGENCY CONDITIONS RECORD

If an emergency that affects the treatment process occurs, the Emergency Operating and Response Program should be implemented and the Emergency Conditions Record should be used to monitor the situation. Figure 6-6 is a suggested Emergency Conditions Record Form. If the emergency is due to mechanical failure, the maintenance supervisor should take immediate steps to correct the situation.

All bypasses of raw or inadequately treated wastewater should be reported immediately to the Department of Environmental Quality. The procedure for reporting bypasses and other violations is presented in the current permit (Appendix 1) and is also discussed in Chapter 2. Figure 6-7 is a recommended form to be executed during a manhole overflow, bypass situation, or unusual or extraordinary discharge event. In addition to this form, all relevant procedures in the current VPDES permit should be followed.

OPERATING COST RECORDS

Operating costs for the wastewater treatment plant are recorded as part of the Town’s cost accounting system. The Town’s cost accounting system records labor, utility, equipment, and chemical costs. The accounting records and the treatment plant records will provide the necessary information for the management to prepare the Annual Report and the operating budget proposal. Figure 6-8 is an example of a suggested form to record the operating costs of the plant.

FIGURE 6-5
RUTLEDGE CREEK WWTP
PERSONNEL RECORD FORM

Work Week __________ Hours

Original Date _________
Revision Date _________

Name ____________________________ Nickname ____________________________
Address ____________________________ Telephone ____________________________
____________________________ Marital Status ___________________
Date of Birth ___________________ Social Security No. ___________________
Drivers License No. ___________________ Expiration Date ___________________
U.S. Citizen _________ No. of dependents for tax purposes - Federal ____ State ____
Name of Spouse ___________________ Retirement No. ___________________
Name and Age of Children Living at Home ____________________________
____

Employee's Current Assignment ____________________________
Title
Duties ____________________________
____________________________ Supervisor ____________________________
Employee's Pay Code & Rate _________ Anniversary - Date ___________________

Emergency numbers and whom to call:

Name ____________________________ Number ____________________________
Name ____________________________ Number ____________________________
Employee's Condition of Health _________ Shots ____________________________
Physical defects or disabilities ____________________________
Highest Education ___________________ Special Skills ___________________
Special Education (including operator certificates - give date and level issued):
____
____
Military Exp. - Discharged _________ Highest Rank ___________________
Last principal duty ____________________________
Attach photo (Polaroid)

FIGURE 6-6
RUTLEDGE CREEK WWTP
EMERGENCY CONDITIONS RECORD

TYPE OF EMERGENCY:

Operation Emergency ______________________

Personal Injury ______________________

Describe ______________________

EFFLUENT CONDITIONS:

SHIFT NO. ______________

BOD_5	______________	HARDNESS	______________
TSS	______________	FECAL COLIFORM	______________
NH_3	______________	D.O.	______________
pH	______________		

TIME OF EMERGENCY:

FROM ______________

TO ______________

EMERGENCY RESPONSE, ACTION TAKEN: ______________________

PERSONS NOTIFIED: ______________________

TIME NOTIFIED: ______________________

SIGNATURE (Operator) ______________________

DATE ______________________

SIGNATURE (Supervisor) ______________________

Figure 6-7
Town of Amherst Manhole Overflow Sheet

Date:________________________________ **Time Reported:**___________________

Who Reported:__________________________ **Telephone Call Back # :**_____________

Arrival Time:___________________________ **Location of Manhole:**_______________

Person who took call:___________________ **Nearest Street Address:**_____________

Estimated gallons that overflowed the Manhole:___________________________________

Provide a brief description of work accomplished to mitigate the overflow of the manhole:

What was done to cleanup the overflow event:

What would you do in your own words to prevent this from happening again.

TOM FORE MUST BE NOTIFIED WHEN AN OVERFLOW OCCURS 434-944-3445
If TOM FORE is not able to be reached then call the Waste Plant and report to operator.
Take this completed report to the Rutledge Creek WWTP after the phone call is made.
If the event occurs after normal working hours take this completed form to the WWTP at A.M. next day.

Any other comments note here:

FIGURE 6-8
RUTLEDGE CREEK WWTP
MONTHLY RECORD OF OPERATING COSTS

			Dollars
I.	**SALARIES**		
	A.	Operating Personnel	$ ________
	B	Preventive Maintenance Personnel	$ ________
	C.	Corrective Maintenance Personnel	$ ________
	D.	Clerical Staff	$ ________
	E.	Administrative Staff	$ ________
		Subtotal	**$** ________
II.	**ELECTRICAL POWER**		**$** ________
	(kWh Used ________)		
III.	**REPAIRS TO MACHINERY, MOTORS, OFFICE, HEATING, COOLING EQUIPMENT AND BUILDINGS**		**$** ________
IV.	**ADMINISTRATIVE, MANAGEMENT, AND CLERICAL EXPENSES**		**$** ________
V.	**CHEMICALS**		
	A.	_____ lbs. Lime	$ ________
	B.	_____ gal. Polymer Solution	$ ________
	C.	_____ gal. Sodium Hypochlorite Solution	$ ________
		Subtotal	**$** ________
VI.	**GASOLINE, DIESEL FUEL, OIL, GREASE, ETC.**		**$** ________
VII.	**LABORATORY**		
	A.	Chemicals	$ ________
	B.	Supplies	$ ________
		Subtotal	**$** ________

VIII. REPLACEMENT

A.	Motor Vehicles	$ ___________
B.	Furniture and Fixtures	$ ___________
C.	Machinery and Motors	$ ___________
D.	Ultraviolet (UV) Lamps	$ ___________
E.	Laboratory Equipment	$ ___________
	Subtotal	**$** ___________

IX. NEW EQUIPMENT

A.	Office	$ ___________
B.	Laboratory	$ ___________
C.	Treatment Process	$ ___________
	Subtotal	**$** ___________

GRAND TOTAL $ __________

CONTENTS
CHAPTER 7 - MAINTENANCE

CHAPTER 7
MAINTENANCE

GENERAL

A preventive maintenance program ensures the continued efficient operation of the treatment plant and prolongs the life of the plant's mechanical equipment. The equipment related to the treatment process is complex and highly specialized. Disabled or improperly working equipment is a threat to the quality of the plant effluent, and repair cost for poorly maintained equipment usually exceeds the cost of maintenance. A maintenance management system is intended to reduce equipment breakdowns, prolong equipment life, and provide for efficient manpower utilization and performance. The Town of Amherst currently has a maintenance system in place and the Rutledge Creek WWTP is designated as number ten in its system. This designation is incorporated into the equipment record system of Rutledge Creek. The Rutledge Creek WWTP uses a data management software called Antero™. This software allows the user to manage all data pertaining to work orders, equipment, parts, materials, preventive maintenance, etc.

For specific preventive maintenance requirements and methods, maintenance personnel should refer to the manufacturer's operation and maintenance instructions. A summary of maintenance tasks is presented in Appendix 8, and a list of manufacturer contact information is presented in Appendix 3. Operation and maintenance manuals and shop drawings for major equipment are on file in the laboratory control building.

EQUIPMENT RECORD SYSTEM (ERS)

To develop the equipment record system, all major equipment and valves in the plant are assigned an identification number. A listing of the Rutledge Creek WWTP equipment and valve numbering can be found in Appendix 2.

After each piece of equipment has been assigned an identification number, the Antero™ software will be used to establish an electronic file system. The file system should contain the following information for each piece of equipment:

1. Description of equipment, equipment number, and location in plant.
2. Name of supplier with address, representative's name, phone number, date of purchase, and cost.
3. Size, model, type, and serial number.
4. Electrical and/or mechanical data.
5. Inventory of spare parts on hand.
6. Preventive maintenance items to be accomplished with their frequencies; dates when preventive maintenance was performed and names of maintenance personnel performing work; and data on man-hours expended for preventive maintenance, cost, and supplies or materials used.

Maintenance requirements and maintenance frequency for a piece of equipment are based on the recommendations of the equipment manufacturer. Manufacturer's operation and maintenance instructions for plant equipment should be maintained in a separate filing system and consulted during non-routine maintenance activities. These manuals should also be consulted for recommended equipment spare parts.

PREVENTIVE MAINTENANCE

The manufacturers' operation and maintenance manuals are the most comprehensive guide for preventive maintenance instructions for specific pieces equipment. All equipment operation and maintenance manuals are kept in the laboratory control building for reference. Ratings for each piece of equipment should be assigned in the Antero™ program specifying their critical position or function and their maintenance priority. The Antero™ program will automatically forecast and create Work Orders for equipment and tasks combined based on the information entered into the program. Appendix 8, Preventive Maintenance/Lubrication Schedule, lists the major equipment items and the preventive maintenance and frequency of maintenance and lubrication. This schedule should be used in conjunction with the manufacturer's operation and maintenance manuals and can be inputted into the software for each piece of equipment. Plant maintenance personnel should monitor the WWTP operations regularly to determine possible maintenance needs.

ALWAYS consult the manufacturer's operation and maintenance manual for troubleshooting instructions when a piece of equipment breaks down.

PLANNING AND SCHEDULING

The planning and scheduling of maintenance should be the responsibility of maintenance personnel and should be based on the preventive maintenance tasks established by the equipment record system (ERS). Corrective maintenance functions should be considered when setting up the preventive maintenance program. Corrective maintenance requirements can be estimated from previous experience and maintenance history records, which are a part of the equipment record system. Scheduled maintenance activities other than preventive maintenance may include the following:

1. Draining of basins to check, repair, or paint submerged equipment
2. Cleaning doors, windows, floors, and walls of plant buildings
3. Lawn and landscaping
4. Snow removal
5. Exterior painting

A work order system (Chapter 6, “Records”) should be used to initiate non-routine or corrective maintenance tasks. Work orders aid in identifying work to be accomplished and establishing priorities. In addition, a log of work orders provides a record of task initiation and completion.

Indoor and outdoor maintenance should be scheduled to take advantage of favorable weather, low load, and low flow periods. Preventive maintenance should be organized and work should be scheduled as the operating routine specifies. Unnecessary or frequent preventive maintenance can be as wasteful as improper maintenance procedures.

The use of an electronic schedule chart is recommended to schedule activities, assign personnel, and establish priorities. The schedule chart may be divided into daily, weekly, monthly, quarterly, semi-annual, and yearly sections so that a timeline of maintenance functions may be observed. The electronic chart may be customized for personnel and their duties. The chart provides a graphic indication of tasks that are behind schedule. Chart boards can easily be created using a spreadsheet program such as Microsoft Excel.

STOREROOM AND INVENTORY SYSTEM

The Antero™ equipment record file system provides a means of keeping an inventory of all spare parts. The recommended list of spare parts provided in manufacturers' literature should be the basis for parts inventory. Over time, inventory should be modified to suit the plant's operational needs.

In addition to the Antero™ equipment record file, there is a separate file should be maintained for filing purchase orders. This file is necessary to keep a record of the date an item was ordered, date received, quantity, unit cost, total cost, and supplier.

Spare parts, equipment, and supplies are stored and maintained at the WWTP site.. The Antero™ program is used to maintain accountability of parts, keep records, initiate information for purchase orders, and handle the withdrawal system to maintain information on parts. The spare parts and components should be assigned a number, and a minimum and maximum quantity to be stocked should be established. When items are taken from stock, the date and use should be noted in the inventory file. For items that may be long lead items, reorder dates should be established to assist with re-supply. Tickets or withdrawal slips should be completed when items are used. The tickets will serve as records that show the time and purpose for equipment use. Ticket information should be transferred to equipment record cards to aid in determining when reorder is required.

MAINTENANCE PERSONNEL

Maintenance personnel should be properly trained before performing inspections, repairs, or preventive maintenance tasks (see Chapter 4, "Personnel"). Maintenance personnel should possess thorough knowledge of equipment functions and the procedures for proper service. A comprehensive training program should be implemented to inform all plant personnel about the fundamental concepts for the operation and maintenance of the plant. It should also be noted that outside consultants or factory representatives may be required to perform difficult maintenance functions.

COST AND BUDGET FOR MAINTENANCE OPERATIONS

It is necessary to divide the maintenance operations into service categories before estimating maintenance costs or preparing maintenance budgets. Service categories may include preventive maintenance, corrective maintenance, and major operational repairs. Estimations for maintenance costs can be evaluated using the service categories, information in the equipment record system for work performed, contracted work, purchase orders, man-hours, and items provided from storeroom stock. The maintenance budget should be developed from a combination of maintenance estimations and additional allowances that account for equipment replacement and plant expansion. Furthermore, the plant's maintenance history should also be taken into consideration when preparing the budget.

LUBRICATION

The equipment record system establishes the type and frequency of preventive maintenance tasks to be performed. A lubrication schedule must be established and enforced to ensure proper operation of mechanical equipment. For convenience, a color-coded tag or decal label can be used to identify the location, frequency, and lubricant required for each piece of equipment. An example lubricant schedule for the advanced wastewater treatment equipment is shown in Appendix 8. The schedule lists the major equipment and the frequency it should be lubricated or checked. It is highly recommended that the manufacturer's instruction manual be consulted for specific instructions such as lubrication points and types of lubricants necessary for specific equipment.

Equipment manufacturers usually specify one or more trade name lubricants to be used on their equipment. Trade name lubricants are typically specified by the producer's number or an SAE number (Society of Automotive Engineers). It is likely that multiple manufacturers produce lubricants that are suitable for use on a piece of equipment. A lubricant's ISO number should be used to compare different brands of lubricants for the purpose of determining if it is an acceptable interchangeable lubricant. The July 1998 issue of the Plant Engineering Magazine contains an extensive tabular of chart lubricants and their ISO numbers. (A copy of the tabular chart showing comparable and interchangeable lubricants is in Appendix 9 of this manual). Using the ISO number can reduce the inventory of lubricants required at the treatment plant.

TOOLS AND EQUIPMENT

A review of the work to be performed by maintenance personnel will determine the tools and equipment required. Tools and repair equipment should be inspected and inventoried routinely to ensure their working status, availability, accessibility, and safety. Special tools may be required for some WWTP equipment.

WARRANTY PROVISIONS

Equipment purchased for the facility is covered by a guarantee or warranty from the manufacturer. The guarantee or warranty contract usually requires the manufacturer to repair, correct, or replace any equipment or materials within a specified period of time if the equipment fails to perform-in accordance with the terms and provisions of the contract. During this period, maintenance personnel should not alter any of the supplied equipment without the knowledge or written consent of the manufacturer. Maintenance personnel should, however, ensure that all equipment is properly maintained at all times. The plant guarantee begins upon acceptance of the plant by the owner. This guarantee covers all equipment.

OUTSIDE CONTRACT MAINTENANCE TASKS

The Operations Supervisor of the WWTP should maintain a list of outside maintenance firms that conduct minor and major construction jobs for the Town of Amherst. This list should be updated periodically so that a list of the most knowledgeable firms is maintained. A list of the current service contracts is presented in Figure 7-1.

FIGURE 7-1
RUTLEDGE CREEK WWTP
PRE-ARRANGED SERVICE CONTRACTS

Name of Contractor	Description of Duties	Contact Information
Dalton's Lawn Care	Mowing and landscaping services	208 Hunt Club Dr. Madison Heights, VA 24572 (434) 444-0579

CONTENTS
CHAPTER 8 – EMERGENCY OPERATING AND RESPONSE PROGRAM

CHAPTER 8
EMERGENCY OPERATING AND RESPONSE PROGRAM

OBJECTIVES

Emergency conditions may be imposed on a treatment system by natural disasters, strikes, civil disorders, and equipment failure. Emergency planning is essential to ensure effective operation during emergencies. Emergency operational procedures for each of the plant's unit operations and unit processes are included in Chapter 3 entitled "Description, Operation, and Control of Wastewater Treatment Facilities," also see Chapter 11, "Electrical System." The basic objectives of the Emergency Operating and Response Program include the following:

1. Eliminating or minimizing of adverse effects to the treatment system resulting from an emergency situation.
2. Development of procedures for properly responding to emergencies.
3. Provision of instructions to ensure that all plant personnel understand their responsibilities during emergency situations.
4. Provision of inventories of available emergency equipment and an outline of existing mutual aid agreements and contracts with outside organizations for specialized emergency assistance.

PRIORITY RANKING OF POTENTIAL EMERGENCY SITUATIONS

Since vulnerability is based on the potential emergency situations that can occur, it is necessary to determine potential emergency situations, evaluate these situations in terms of severity and frequency, and establish a priority list. Priority ranking of potential emergency situations is based on an evaluation of the relative severity or frequency. The following potential emergency situations were analyzed to determine the vulnerability of the facility.

1. Natural Disasters
    a. Heavy Rains
    b. Heavy snowfall
    c. Ice Storms
    d. Fire

    e. Tornado
    f. Stream flooding
    g. Earthquake

2. Civil disorders and strikes
3. Faulty maintenance
4. Negligent operation
5. Accidents
6. Sabotage

Based on severity/frequency considerations, the following ranking of potential emergency situations from the most significant to the least significant was determined based on system vulnerability analysis:

1. Faulty maintenance
2. Natural disaster - heavy snow, heavy rains, ice storms
3. Negligent operation
4. Accidents - chemical spills

METHOD TO REDUCE SYSTEM VULNERABILITY

A vulnerability analysis indicates that emergency operating conditions could be imposed on the plant because of a natural disaster such as heavy rains or heavy snow. Analyses of the vulnerability of the facility due to the adverse effects of faulty maintenance, natural disasters, negligent operation, accidental chemical spills, and associated preventive and remedial measures follow.

Analysis of System Vulnerability Due to Faulty Maintenance

Although emergencies caused by faulty maintenance are the easiest to prevent, they are also the most likely to occur. Some systems in the treatment plant can be by-passed, however, not all systems are duplicated and poor effluent quality can result from a by-pass. The importance of maintenance procedures in Chapter 7 and the manufacturer's literature cannot be over emphasized. As with any other type of equipment failure, consult the manufacturer's instructions and/or call the appropriate personnel.

Analysis of System Vulnerability Due to Natural Disasters (Heavy Rain, Heavy Snow and Ice Storms)

Preliminary Treatment

1. Adverse effects of natural disasters
   - a. Power failure
   - b. Blocked access
   - c. Hydraulic overload
   - d. Personnel absence

2. Preventive and/or remedial measures
   - a. Use alternate power source
   - b. Provide alternate access routes
   - c. Open secondary influent channel or bypass into digesters

Influent Pump Station

1. Adverse effects of natural disasters
   - a. Power failure
   - b. Hydraulic overload
   - c. Blocked access
   - d. Personnel absence
2. Preventive and/or remedial measures
   - a. Use alternate power source or utilize portable pump
   - b. Bypass into digesters
   - c. Provide alternate access routes

Oxidation Ditch

1. Adverse effects of natural disasters
   - a. Debris on water surface
   - b. Power failure
2. Preventive and/or remedial measures
   - a. Remove debris. Check equipment operation
   - b. Use alternate power source

Effluent Filter

1. Adverse effects of natural disasters
   - a. Equipment failure
   - b. Power failure
   - c. Ice formation on filter elements
2. Preventive and/or remedial measures
   - a. Maintain inventory of spare parts. Bypass using emergency overflow channel.
   - b. Use alternate power source

c. Keep filter unit covered. Inspect filters often during cold weather and de-ice with pressurized water if necessary

Aerobic Digester and Sludge Handling/Stabilization Facilities

1. Adverse effects of natural disasters
    a. Equipment failure
    b. Power failure
    c. Sludge beds freeze during cold weather
    d. Debris on water surface
    e. Hydraulic overload
2. Preventive and/or remedial measures
    a. Maintain inventory of spare parts
    b. Use alternate power source
    c. Avoid wasting sludge during prolonged cold weather periods
    d. Remove debris. Check equipment operation
    f. Use supernatant pumps and/or portable pump to avoid overflow

UV Disinfection System

1. Adverse effects of natural disasters
    a. Equipment Failure
    b. Power failure
2. Preventive and/or remedial measures
    a. Maintain inventory of spare parts
    b. Use alternate power source

Power Supply

1. Adverse effects of natural disasters
    a. Temporary interruption of power
2. Preventive and/or remedial measures
    a. Use emergency power source

Communications

1. Adverse effects of natural disasters
    a. Temporary interruption
2. Preventive and/or remedial measures
    a. Provide radio communications

Personnel

1. Adverse effects of natural disasters
    a. Access routes to plant blocked
    b. Personnel isolated at plant
2. Preventive and/or remedial measures
    a. Select alternate access routes
    b. Provide supplies for persons stranded at plant
    c. Provide auxiliary personnel
    d. Repair access routes to plant immediately

Analysis of System Vulnerability due to Negligent Operation

Similar to faulty maintenance, negligent operation is also easy to avoid. Repair costs and discharge permit violations are serious enough to warrant the attention of all employees. Improperly treated wastewater can affect water quality for miles downstream of the discharge point.

Preliminary Treatment

1. Adverse effects of negligent operation
   - a. Equipment failure
   - b. Accumulation of debris
   - c. Flooding
   - d. Obnoxious odors

2. Preventive and/or remedial measures
   - a. Remove screened material from dumpster regularly
   - b. Clean barscreens regularly
   - b. Prevent accumulation of debris on site

Oxidation Ditch

1. Adverse effects of negligent operation
   - a. Equipment failure
   - b. Drop in process efficiency
   - c. Violation of VPDES permit
   - d. Low quality effluent
2. Preventive and/or remedial measures
   - a. Implement proper process operation and control techniques
   - b. Maintain inventory of spare parts
   - c. Maintain a current emergency contact list including downstream users and ditch manufacturer information.

Effluent Filters

1. Adverse effects of negligent operation
   - a. Equipment failure
   - b. Drop in process efficiency
   - c. Violation of VPDES permit
   - d. Low quality effluent
2. Preventive and/or remedial measures
   - a. Implement proper process operation and control techniques
   - b. Maintain inventory of spare parts
   - c. Inspect filter elements for residue buildup and clean as necessary

Aerobic Digester and Sludge Handling/Stabilization Facilities
1. Adverse effects of negligent operation
    a. Wasted sludge too “wet”
    b. Production of unacceptable odors
2. Preventive and/or remedial measures
    a. Maintain proper sludge wasting operations
    b. Implement proper process operation and control techniques including optimal use of polymer for sludge dewatering

UV Disinfection System
1. Adverse effects of negligent operation
    a. Improper disinfection of effluent
    b. Fecal coliform limit exceeded
2. Preventive and/or remedial measures
    a. Implement proper process operation and control techniques
    b. Check for proper operation of UV lamps regularly

Power Supply
1. Adverse effects of negligent operation
    a. Startup failure
2. Preventive and/or remedial measures
    a. Check diesel fuel levels regularly
    b. Maintain diesel generator test schedule

Communication
1. Adverse effects of negligent operation
    a. Equipment failure
2. Preventive and/or remedial measures
    a. Check batteries regularly
    b. Maintain regular equipment test schedule

Personnel
1. Adverse effects of negligent operation
    a. Safety hazards
2. Preventive and/or remedial measures
    a. Provide personnel incentives
    b. Institute training program

<u>Analysis of System Vulnerability Due to Accidental Chemical Spills</u>

Pretreatment
(No adverse effects)

Oxidation Ditch

1. Adverse effects of accidental chemical spills
    a. Possible reduction of microorganisms
    b. Reduction in effluent quality
    c. Violation of VPDES permit
2. Preventive and/or remedial measures
    a. Determine origin, composition, and quantity of chemical. Respond accordingly.

Aerobic Digester and Sludge Handling/Stabilization Facilities
1. Adverse effects of accidental chemical spills
    a. Possible reduction of microorganisms
2. Preventive and/or remedial measures
    a. Determine origin, composition, and quantity of chemical. Respond accordingly.

Effluent Filters
1. Adverse effects of accidental chemical spills
    a. Possible damage to filter media.
2. Preventive and/or remedial measures
    a. Inspect, clean, and/or replace filter elements

UV Disinfection System
(No adverse effects)

Power Supply
(No adverse effects)

Communications
(No adverse effects)

Personnel
1. Adverse effects of accidental chemical spills
    a. Safety hazards
2. Preventive and/or remedial measures
    a. Take adequate precautions
    b. Familiarize personnel with spill procedures and safety equipment

MUTUAL AID AGREEMENTS

To obtain assistance during emergency situations, it is recommended that mutual aid agreements be negotiated with other municipalities, other community divisions, construction companies, consulting engineers, industrial firms, electrical, gas, and telephone utility companies, fire and police departments, civil defense organizations, and the health department. Figure 8-1 is a Sample Mutual Aid Agreement Form. Once mutual aid agreements have been negotiated, a contract sheet similar to the one shown in Figure 8-2 should be prepared which gives the name of the organization with which an agreement was made, a description of the type of assistance to be obtained, the type of equipment available for emergency use, and the names and phone numbers of persons to contact. A sample service contract record is presented in Figure 8-2. This record should be updated when more aid agreements are reached.

EMERGENCY EQUIPMENT INVENTORY

An inventory should be made of equipment, materials, supplies, and chemicals that are available for emergency use at the wastewater treatment plant. Figure 8-3 presents an example of an equipment inventory form that may be useful in planning for emergency situations. Plant management should keep duplicate copies of these inventory worksheets for equipment and supplies. These inventories and the system vulnerability analyses can be used to determine the additional emergency equipment, materials, supplies, and chemicals that should be purchased and stockpiled, and to determine what arrangements should be made to obtain these emergency items through mutual aid agreements or outside contracts. The following is a list of recommended emergency equipment that should be available for use.

1. Lightweight, quick-coupling pipe (approximately 100 feet of 3-inch diameter).
2. Fire hose (approximately 100 feet).
3. Portable explosion proof pump.
4. Emergency chemical supplies.
5. Portable explosion proof blower.
6. Portable air compressor.
7. Safety equipment (see Chapter 9, “Safety,” for required safety equipment).
8. Two-way radio communication system.
9. Fire extinguishers easily accessible to every plant process.

PRESERVING TREATMENT SYSTEM RECORDS

Plant management should ensure the protection of the treatment system records by making sure that all information and records are stored in a safe location and protected against damage. Fireproof, watertight files are essential or preserving treatment system records. In addition, all digitally collected data should have a daily backup.

COORDINATING INSTRUCTIONS FOR LOCAL POLICE AND FIRE DEPARTMENTS

The emergency operating and response program should be coordinated with the local police and department of public safety. The local police department should be requested to:

1. Make routine security checks of the treatment plant.
2. Notify treatment plant personnel if a street spill of hazardous materials occurs – give location, nature, and quantity of the spill.
3. Be prepared to assist during emergencies affecting the treatment system.

The local department of public safety should be requested to:

1. Routinely inspect the plant for fire hazards and check fire-fighting equipment.
2. Provide first aid instructions to plant personnel.

RESPONSIBILITIES OF WASTEWATER TREATMENT PLANT PERSONNEL

The Operations Supervisor is responsible for the emergency operating and response program. All regular and auxiliary wastewater treatment system personnel should be issued emergency response identification cards. The emergency response card should outline the task and responsibilities of the individual in given emergency situations. The emergency response cards can be used by plant management and staff as a basis for planning corrective actions.

EMERGENCY RESPONSE CENTER

The Wastewater Superintendent is also responsible for establishing an emergency response center (most likely the Lab/Control Building) and an alternate emergency response center. During an emergency situation, the Supervisor and operation and

FIGURE 8-1
RUTLEDGE CREEK WWTP
SAMPLE MUTUAL AID AGREEMENT FORM*

EMERGENCY SITUATIONS COULD ARISE IN A MUNICIPALITY'S WASTEWATER TREATMENT SYSTEM THAT WOULD REQUIRE ASSISTANCE FROM AN ADJOINING MUNICIPALITY TO RESTORE NORMAL OPERATION.

IF AN EMERGENCY SITUATION ARISES IN ______________________________ OR ______________________________
(City) (City)
THE OFFICIALS IN BOTH MUNICIPALITIES AGREE TO SUPPORT EACH OTHER DURING THE EMERGENCY.

EACH CITY HAS A CONTINGENCY PLAN FOR RESPONSE TO EMERGENCIES AFFECTING ITS WASTEWATER TREATMENT SYSTEM. THE ______________________________ AGREES TO SUPPORT
(City)
______________________________ IN THE FOLLOWING AREAS:
(City)

____
(Firefighting, Rescue Crews, Communications, Portable Chlorination, Operational/Maintenance, Personnel, etc.)
____

____

TO THE EXTENT POSSIBLE UPON REQUEST INITIATED BY:

Name	Name
Title	Title
City	City

PERSONNEL RESPONDING TO THE REQUESTS FOR ASSISTANCE UNDER THIS AGREEMENT WILL REMAIN UNDER THE CONTROL OF THE CITY PROVIDING THEM.

Signed	Signed
Name	Name
Title	Title
City	City

*Similar to format suggested by Planning Section, Virginia Office of Civil Defense.

FIGURE 8-2
RUTLEDGE CREEK WWTP
SAMPLE MUTUAL AID AGREEMENTS/CONTRACTS SHEET

Name of Organization	Description of Assistance	Coordination Information

FIGURE 8-3
RUTLEDGE CREEK WWTP
EMERGENCY INVENTORY

SYSTEM: ______________________________
PREPARED BY: ______________________ Date: ____________

DUPLICATE EQUIPMENT IN STOCK

DESCRIPTION	MAKE	SIZE	TYPE	VOLTAGE	HP	CAPACITY	NO.

PARTS & COMPONENTS IN STOCK

DESCRIPTION	SIZE	NO.	APPLICATION IN SYSTEM

EMERGENCY EQUIPMENT & REPAIR TOOLS

DESCRIPTION	NO.	APPLICATION IN SYSTEM

PIPE	**Size**						
	Type						
	Length						

AVERAGE CHEMICAL STOCK	**Type**				
	Form				
	Quantity				

COMMUNICATIONS EQUIPMENT

DESCRIPTION	LOCATION

MAPS AND FACILITY LAYOUT DETAILS

Official Authorizing Inventory ____________________ maintenance personnel should report to the emergency response center and determine a course of action to correct the emergency situation. A current telephone call list, collection system maps, and treatment plant piping and wiring plans should be maintained at the emergency response center.

A procedure should be established to critique emergency situation performance and procedures. The areas that should be critiqued include:

1. Performance of automatic alarm system.
2. Performance of emergency standby equipment.
3. Personnel response time.
4. Adequacy of personnel training.
5. Mutual aid agreements and/or contracted assistance.
6. Adequacy of emergency equipment and supplies.
7. Treatment process flexibility.
8. Adequacy of emergency procedures.
9. Possible preventive measures.

AUXILIARY PERSONNEL REQUIREMENTS

Plant management may find it necessary to have more personnel answer an alarm than are on hand during the shift; therefore, auxiliary personnel from other local governmental organizations or from other treatment plants in the surrounding area should be on call.

Auxiliary personnel should serve as backup to the regular staff, and should be properly trained to perform the tasks required. Plant management should develop procedures for alerting and training the auxiliary personnel. Chapter 3, "Description, Operation, and Control of Wastewater Treatment Facilities," should be used as a training aid to inform auxiliary personnel of the plant layout and operation.

EMERGENCY RESPONSE PLAN

An emergency response plan should be developed to ensure the effective operation of the WWTP under emergency conditions imposed by natural disasters, civil disorders, faulty maintenance, negligent operation, and accidents. The emergency response plan should have the following objectives:

1. To eliminate or minimize the adverse effects of emergency situations on the treatment system.
2. To develop procedures for properly responding to emergencies.
3. To provide instructions for system personnel to ensure that they understand their responsibilities during emergency situations.
4. To provide inventories of available emergency equipment and to outline existing mutual aid agreements and contracts with outside organizations for specialized assistance.
5. To emphasize the importance of continuously critiquing and refining emergency response plans.

In developing the emergency response plan, it is recognized that the procedure for responding to emergency situations is generally the same regardless of the nature of the emergency. The general emergency response procedure should be as follows:

1. Analyze the effects of the emergency to determine the proper course of action.
2. Check emergency equipment inventory.
3. Implement protective measures where applicable.
4. Dispatch trained crew where applicable.
5. Obtain assistance provided through mutual aid agreement, if necessary.
6. Check spare parts inventory before ordering parts.
7. Stop equipment unit operations only as a last resort.
8. Keep down-time to a minimum.
9. Critique the response plan.

CONTENTS
CHAPTER 9 - SAFETY

CHAPTER 9
SAFETY

GENERAL

The safety hazards associated with municipal wastewater treatment plants are numerous. They can range from chemical dangers to waterborne diseases. It is the responsibility of plant management to inform the personnel of these hazards. Personnel should have protection from these hazards to the greatest extent possible and should receive proper first aid training in the event of an accident.

The primary purpose of this chapter is to point out some of the daily hazards that treatment plant personnel may face, and to stress the importance of safety consciousness.

EMERGENCY ASSISTANCE

The telephone numbers of the nearest hospital, police and fire departments, ambulance services, and rescue squad should be posted at each phone in the treatment plant. In addition, chemical suppliers' phone numbers should be posted in relevant locations for emergency contact purposes. The possible dangers involved in using chemicals at the plant should be given to local physicians and hospitals in order for them to take quick action to treat any accident that might occur from handling of the chemicals. Figure 9-1 is a Sample Emergency Telephone List that should be posted at each telephone in the treatment plant.

ACCIDENT REPORTING PROCEDURES

All accidents that occur at the plant should be reported immediately, not only for the protection of the employee, but also for the protection of the Town of Amherst and its residents. Accident report forms from the plant’s insurance provider should be completed in the event of an accident. In addition, an attending physician's report form should also be completed immediately after a patient has been treated the first time.

FIGURE 9-1
EMERGENCY TELEPHONE LIST

• Emergencies	Telephone: 911
• State Police	Telephone: 434-582-5116 Telephone: 804-674-2000 (24-hour emergency)
• Sheriff's Office	Telephone: 434-946-9300
• Fire Department	Telephone: 434-946-7711
• Virginia Department of Environmental Quality	Telephone: 434-582-5120
• Virginia Department of Health	Telephone: 434-946-9408
• Virginia Department of Emergency Management	Telephone: 804-897-6500
• American Electric Power	Telephone: 800-956-4237 (24-hour service)
• Verizon Telephone Company	Telephone: 800-483-6272 (Daytime) Telephone: 800-483-2000 (Nighttime)
• Mays Farmer Service or Hill Hardware (Diesel Fuel)	Telephone: 434-985-8307 Telephone: 434-946-7711
• Amherst County Service Authority	Telephone: 434-845-1605

SAFETY EQUIPMENT

Conspicuously post (possibly on a bulletin board) the location and types of safety equipment available at the plant (such as first aid kit, breathing apparatus, gas detector, etc.). Plant operators should be thoroughly familiar with the operation and maintenance of each piece of equipment and should review equipment operation and maintenance at fixed intervals to be certain that each piece of equipment can be safely operated and that the equipment is in operating condition. The following is a list of recommended safety equipment that should be purchased and kept in a readily accessible location:

1. Portable blower with flexible hose for ventilating manholes or other submerged areas.
2. Self-contained compressed air breathing apparatus with one spare cylinder.
3. Industrial type first aid kit.
4. Safety harness with 100 foot (minimum) 1/2-inch nylon line.
5. Fire fighting equipment, including multipurpose dry chemical and carbon dioxide type extinguishers.
6. Life saving ring buoys with 100 feet of 1/2-inch nylon line at or near working areas over water.
7. Protective clothing including safety goggles, face masks, hearing protection, hard hats, safety shoes, rubber boots, gloves, rubber apron and rain gear.

Figure 9-3 presents a list of available emergency equipment. Contact should be made with the local fire, rescue squad, and police departments to acquaint them with hazards and to inform them of the safety equipment necessary to cope with problems that may arise. Quite often it is possible to arrange a joint training session with these departments on the use of safety equipment and the handling of emergencies. They should also be made aware of the access routes to and around the wastewater treatment plant.

FIGURE 9-3
SAFETY EQUIPMENT & LOCATIONS

Equipment:	Location:
Fire Extinguishers	Lab Building/Influent Pump Station/Lime Feed Building/NPW Building
First Aid Kit, OSHA compliant	Lab Building
Eyewash/Shower	Lab Building
Safety Glasses	Lab Building
Rubber Gloves	Lab Building/Polymer Feed Building
Apron	Lab Building/Polymer Feed Building
Rain Gear	Lab Building

HAZARDS AND HAZARDOUS AREAS

Confined Spaces

According to OSHA (Occupational Safety and Health Administration), a confined space:

1. Is large enough for an employee to enter fully and perform assigned work;
2. Is not designed for continuous occupancy by the employee; and
3. Has a limited or restricted means of entry or exit.

Confined spaces may include underground vaults, tanks, storage bins, vessels, vats, silos, ventilation and exhaust ducts, sewers, tunnels, and other similar areas.

Hazards associated and or encountered when working and/or entering a confined space may include:

1. Hazardous Atmospheres
   a. Flammable Atmospheres – generally arises from enriched oxygen atmospheres, chemical reactions, byproducts of work, etc.
   b. Toxic Atmospheres – Sources include the manufacturing process, product stored (decomposed organic material), an operation performed in the confined space (i.e. welding), etc. Carbon Monoxide (CO) is a colorless, odorless, hazardous gas that may build up in a confined space. It can be formed from chemical reactions, work activities, microbial decomposition of organic matter (i.e. sewers).
   c. Irritant (Corrosive) Atmospheres – Irritants may include ammonia, chlorine, hydrochloric acid, sulfuric acid, benzene, etc. Gases may be found in paint manufacturing, chemical plants, plastic plants, etc.
   d. Asphyxiating Atmospheres – Reduction of oxygen as a result of consumption or displacement. Oxygen may be consumed during combustion of flammable substances (i.e. welding, etc.) and chemical reactions. Nitrogen, helium, argon, and carbon monoxide can displace oxygen.
2. Mechanical/Electrical – Isolate potential hazards.
3. Communication Problem – between worker inside confined space and standby person outside.

4. Physical
    a. Thermal Effects – temperature of work environment
    b. Noise
    c. General/Physical – Physical hazards that include scaffolding, surface residues, and structural hazards.

Purge/ventilate the confined space as necessary. Test the atmosphere of the confined space for oxygen content, flammable gases, and /or toxics. See Appendix 16 for the confined space entry permit and details of the Town of Amherst Confined Space Entry Program.

Abnormal Atmosphere

Air that is less than 20 percent oxygen is considered hazardous because a person can lose consciousness. A deficiency of oxygen can exist with or without the presence of explosive, toxic, or noxious gases. The following safety measures should be observed:

1. Provide familiarity of a hazard to two or more men if they need to work under conditions where that hazard exists.
2. Use and properly maintain adequate ventilation systems.
3. Prior to entering test the air in suspected hazardous areas such as manholes, tanks, conduits, or submerged structures. In addition, use portable ventilation systems, including blowers and compressed air.
4. Use all applicable safety equipment whenever pertinent, including self-contained breathing apparatus, safety harnesses, and gas detectors. When safety harnesses are used, station two capable persons at the top of the opening to remove the person inside if necessary. Fasten the trailing end of the lifeline above ground to prevent its being pulled into the manhole or opening. Provide proper protective clothing for workmen.

Airborne Diseases

Microorganisms found in wastewater can become airborne by being carried by aerosols in the air. Workers in the vicinity of treatment processes and sewage conveyors may be exposed to infectious diseases. Ventilation and aeration processes may cause the formation of aerosols.

Effects of such toxic microorganisms may include typhoid fever, amebic dysentery, and other serious illnesses, as well as eye, ear, nose, and throat infections. The following preventive measures should be observed:

1. Use protective clothing and equipment where necessary.
2. Practice good personal hygiene.
3. Encourage all personnel to participate in the instituted program of inoculations and injections for all personnel.

Below Surface Work Areas

The major below surface work areas include sewer manholes and vaults, which must be periodically inspected, maintained, cleaned, and sometimes used to sample or measure wastewater flows. Other below ground maintenance work may be conducted in repairing stoppages, breakage, or leakage of sewer or process pipe in trenches, buried pipelines, wet wells, basins, tanks, and channels.

Major hazards associated with this work include:

1. Oxygen deficiency
2. Explosive and toxic gases
3. Falling due to slippery conditions
4. Trench or excavation support failure
5. Exposure to, or contact with, sewage or sludge and the possibility of infections or diseases

The following safety precautions should be observed when working in below surface areas:

1. Always ensure that there are three workmen assigned and present during below ground maintenance work, and ensure that sufficient personnel remain on the surface at all times for communications or to initiate rescue if required.
2. Always ventilate below ground structures adequately before entering and during below ground maintenance work. Test the atmosphere for gases before entering and at regular intervals while work is in progress.

3. Ensure that a suitable resuscitator and trained operator are present at all times during work.
4. Use a safety harness if necessary.
5. Due to the danger of explosion, no smoking should be allowed in below ground maintenance operations.
6. Wear safety hats and appropriate protective clothing while performing below ground maintenance work.
7. Use warning signs and safety guard railings around all below ground maintenance operations. Use warning lights during nighttime operations or when trenches are left open.

<u>Sodium Hypochlorite Tablets (HTH) Safety Precautions</u>

The HTH tablets are used in the NPW System to disinfect the water. The following information are pertinent for safety.

1. The tablets should be stored in a cool, dry, well-ventilated area and not at temperatures above 125° F.
2. May be fatal if swallowed. Avoid breathing dust or fumes.
3. Effects of overexposure and corresponding first aid procedures are
    a. Skin Contact: Can cause severe irritation and or burns. Immediately Remove contaminated clothes and shoes and flush with water for 15 minutes. Notify supervisor and seek medical attention.
    b. Eye Contact: Can cause severe irritation and or burns. Contact may impair vision. Flush eyes with plenty of water for 15 minutes lifting upper and lower eyelids. Notify supervisor and seek medical attention.
    c. Inhalation: May be irritating to the nose, mouth, throat and lungs. High levels of dust in confined areas can result in chlorine vapor which may result in burns to the respiratory tract. Remove to fresh air. Notify supervisor and seek medical attention.
    d. Ingestion: Can cause irritation and/or burns to the entire gastrointestinal tract.
4. Fire extinguishing media should be water only. This product is chemically reactive to dry powder fire extinguishers, corrosive, flammable or combustible material.

5. Suggested special protection in handling material includes: splashproof goggles, neoprene gloves, NIOSH approved masks if dusts are created. Keep area well ventilated.

Lime Safety Precautions

Lime is a strongly alkaline material and can cause severe injury. Skin or eye contact with lime can cause irritation, chemical burns, corrosion damage, etc. Exposure to high dust levels may irritate the skin, eyes, nose, throat or upper respiratory tract. Wear safety glasses or goggles to avoid contact and particulate irritation. Gloves, long-sleeved shirts and pants should be worn to prevent prolonged exposure to skin. Dust generation/accumulation should be minimized. Avoid breathing the dust. Keep area ventilated, but if the area is poorly ventilated then wear a NIOSH/MSHA approved filtering anti-dust mask. Store lime at room temperature and in a dry location.

Polymer Safety Precautions

Polymer is an irritant to the eyes and skin. Heated vapors may irritate the respiratory tract. Wear safety glasses, long sleeved clothing, neoprene gloves and protective apron for protection. Work area should be well ventilated. Store polymer away from sources of ignition. Be cautious of polymer spills on floor surface; floor can be slippery. Spills on floor surface should be cleaned immediately to avoid work hazard.

Laboratory Chemicals

In handling laboratory chemicals, the precautions printed on the container labels should be strictly observed. The following general safety rules apply when handling chemicals:

1. When working in areas where chemicals are present, wear protective apparel (for example: gloves, boots, and coveralls resistant to the chemical being handled; safety glasses; and protective masks if needed).
2. Observe all warnings and instruction signs (which should include first aid for swallowing, skin contact, burns, etc.) for the particular chemicals.
3. Practice good housekeeping in the vicinity of chemical storage operations.
4. Read the labels on the chemical containers and follow the label's instructions. Provide antidote or neutralizing solution where applicable.

Material Safety Data Sheets (MSDS) sheets for chemicals should be stored on site. Operating personnel should be familiar with flushing/washing procedures, and be trained to understand the information on the MSDS's.

Electrical

Many people do not realize that ordinary 110-volt electricity can be fatal. Never underestimate low voltage and low amperage electricity. Extensive studies have shown that five thousandths (0.005) of an ampere will cause loss of muscle control and that current as low as 12 volts may, on good contact, cause injury. Electrical systems at the Rutledge Creek WWTP operate at voltages from 120 to 480 volts. Treat all electricity with respect. Never guess the nature of an electrical circuit.

Electricity kills by paralyzing the nervous system and stopping muscular action. Frequently, electricity may interrupt the transmission of the nervous impulses from the brain to the muscles responsible for breathing. In other cases, the electric current directly affects the heart, causing it to cease pumping blood. In such cases, death follows from lack of oxygen in the brain.

The following should be considered:

1. A regular and organized program of preventive maintenance for all plant electrical equipment to reduce or eliminate electrical hazards.
2. Train operations and maintenance personnel in the handling and use of electrical machinery and equipment.
3. In extinguishing fires in electrical equipment, use only non-conducting extinguishing agents that minimize shock hazard to the operator and do not permanently damage the equipment (e.g., carbon dioxide or dry chemical extinguishers).
4. Use properly sized electrical overload devices that will function when an overload or short circuit occurs.
5. Allow only authorized and qualified electricians to work on any phase of the electrical system.

6. Provide and use lockout switches and tags at all off-site or remotely located equipment for use during maintenance and repair work.
7. Use wood or other nonconductors for ladders and moving live wires that may have fallen.
8. Do not work alone on energized equipment.
9. Use emergency stop buttons to isolate electrical equipment remote from the main control center.
10. Be sure electrical controls, switch boxes, and distribution panels are identified and easily accessible.
11. Use rubber matting at control centers and operating stations.
12. Use safety tools, special devices, and protective clothing when working on or near energized circuits.

Explosive Gases

Gases encountered in wastewater treatment include the following:

1. Methane (CH_4)—Methane is one of the most common combustible gases encountered in wastewater treatment works, is produced from the decomposing organic matter in the wastewater or sludge.
2. Sewer Gas (combination of carbon dioxide, methane, hydrogen, and hydrogen sulfide) — Sewer Gas accumulates as a result of fermentation and decomposition of organic matter. When the methane content is between 5 and 15 percent, it presents an explosion hazard.
3. Utility or Natural Gas (comprised of mostly methane)—Natural gas may leak into sewers from gas mains, and it is highly explosive when mixed with air.
4. Ammonia (NH_3)—Ammonia is explosive if exposed to flame, silver, or mercury.
5. Ethane (C_2He)—Ethane is present in artificial gas and natural gas, therefore, it may leak into sewers. This gas presents an explosion hazard.
6. Carbon Monoxide (CO)—Carbon monoxide is produced by incomplete oxidation or combustion of carbonaceous material and can leak into the sewer system. This gas is odorless, poisonous, flammable, and constitutes an explosion and asphyxiation hazard.
7. Gasoline Vapors—Gasoline vapors from accidental spills in sewers or other enclosed areas constitute a dangerous explosion hazard.

Dangerous combustible gases and vapors can also occur due to the following set of circumstances:

1. Gasoline truck spill, the local fire department hoses down the spillage into the separate or combined sewer system, and all exposed wastewater surfaces at the treatment facilities may have gasoline floating over the wet surface areas.
2. Industrial discharges of grease, fats, oils, volatile solvents, carbon bisulfide, carbon tetrachloride, and methyl chloride mix with or float on the surface of the wastewater, generating their own gases and vapors or combining with methane. Solvents, in particular, are very dangerous, since many of them have a low flash point.
3. Storage of flammable and combustible liquids and materials such as gasoline, solvents, lubricants, paints, thinners, and acetylene present a respiratory and explosion hazard.

Aside from potential combustible situations, the presence of vapors and gases could cause respiratory tract, eye irritation or suffocation due to the displacement of oxygen. Explosions also result in property damage and loss of facility operation, which in turn, may affect public health and the environment.

Operation and maintenance considerations to eliminate or reduce explosive gas hazards include the following:

1. Perform preventive maintenance on all ventilation equipment. Ensure that fans are operating properly with no mechanical defects, restrictions, or obstructions in the air flow. Additionally, there should be sufficient fresh air exchange to support life and prevent the formation of explosive mixtures. Regularly change filters and intake screens, and inspect positions of adjustable dampers.
2. Check ventilation intake and exhaust louvers to ensure that they are not blocked or restricted due to improper placement of portable material or equipment. Also check that they are not corroded into a fixed position.
3. Enforce no smoking and no open flames rules. Illuminants of almost any kind can be dangerous when used in sewers and manholes because they may cause explosions.
4. Use non-spark producing tools for maintenance whenever possible, and use positive ventilation when spark tools must be employed.

Fires

An outbreak of fire is dependent on three items: 1) a source of ignition, 2) material to burn, and 3) oxygen. Routine removal of dust, oily rags, wastepaper, and disposal of this material in covered, metal containers is essential.

Management plays a key role in fire prevention because it is the management's responsibility to instruct all employees about the fundamental objectives for fire prevention. These objectives include:

1. Good housekeeping and cleanliness.
2. Safe operation of equipment and processes.
3. Smoking in authorized areas only.
4. Proper supervision of maintenance operations such as welding, burning, spray painting, and soldering.
5. Abiding fire preventive maintenance programs for electrical and mechanical equipment.
6. Recognition of all potential explosion hazards.

Electricity is the leading cause of industrial fires, and the majority of electrical fires originate in wiring and electrical devices. Smoking is the second cause of fires, followed in order by friction, overheated materials, hot surfaces, burner flames, combustion sparks, spontaneous ignition, burning and welding, incendiary actions, mechanical sparks, molten substances, chemical action, static sparks, and lightning.

Food Contamination, Infections, and Diseases

All food, including beverages, is a potential carrier of disease or infection at wastewater treatment plants. If food is left uncovered and/or in a warm place, there is the possibility of contamination or spoilage due to the presence of airborne and waterborne microorganisms in wastewater treatment facilities.

Contaminants can settle upon or enter carrying media such as personnel, clothes, food, or dishes. With good personal hygiene, the ingestion of contaminants can be avoided. Refrigerated or covered food storage is absolutely necessary to prevent food spoilage by bacteria buildup.

Some effects of this hazard are:

1. Food poisoning
2. Dysentery
3. Infection by pathogenic organisms

The following rules should be observed to prevent possible food contamination:

1. All operators must practice a high level of personal hygiene (hand washing, changing clothes, and separation of work and personal clothes). Visiting personnel and service operators shall be provided with lockers for storage of clothes.
2. Food should never be eaten in wastewater treatment plants before washing hands. Do not eat or smoke in the laboratory.
3. Any illness or symptom such as dysentery or stomach pains should be reported immediately to the facility supervisor. Any person suffering from these symptoms should go promptly for a medical checkup by the Town's doctor or his own personal physician.
4. The daily maintenance schedule should include refilling soap dispensers with germicidal soap, replacing paper towels and toilet paper, and general cleaning and disinfection of all toilet and washroom facilities.
5. In general, good housekeeping procedures should be practiced.
6. At the completion of a shift, the operators should change clothes and shower before leaving the facility.
7. Disposable cups and spoons should be provided at coffee machines.
8. Operators should have a regular medical examination as part of personal maintenance routine.
9. Trash and garbage disposal barrels should be emptied regularly.
10. The Town of Amherst makes available a program of inoculations and injections for plant personnel to participate.

Machinery

All mechanical and electrical machinery should incorporate standard safety features. For example, rotating or reciprocating shafts, rods, eccentrics, belt drives, couplings, fly wheels, and gears should be protected by shields or guards to prevent any contact with moving parts.

Adequate safety devices on all pressure and temperature vessels used in wastewater treatment works must be in full compliance with existing national and state codes. Intake and exhaust silencers on diesel and dual fuel engines and compressors shall be properly insulated or otherwise protected to prevent injury. The following should be considered to reduce potential hazards:

1. Use positive lockout mechanisms and tagging procedures at electrical starters.
2. Instruct all operating personnel about the correct use of machinery (this may be done by conducting an operator training program).
3. Maintain all mechanical equipment and work areas properly.
4. Institute a preventive maintenance program for all machinery.
5. Keep and use welding equipment in an assigned safe area away from combustibles. Shield such equipment properly to protect employees from eye injuries due to electric areas or hot metals.
6. Use a separate portable air exhaust system to control fumes that are generated while welding, burning, or metal spraying.
7. Restrict the use of pneumatic, explosive-activated, and machine shop tools to properly trained mechanics.
8. Use warning signs at openings or where machinery is being repaired.

Open Tanks

Open process structures include uncovered or unprotected tanks, channels, hatches, sumps, wet wells, manholes, and sewers. Operation and maintenance considerations to eliminate or reduce hazards include the following:

1. Maintain adequate lighting.
2. Mark and protect hazardous areas.
3. Keep safety, rescue, and first aid equipment close by.
4. Instruct operators in life-saving and first aid techniques.
5. When practical, at least a two-man crew should work around open tanks.
6. Perform work in manholes or tanks with a safety harness and standby help in attendance.
7. Care must be taken where icing or slippery conditions exist.

8. Isolate equipment being worked on to protect workmen from being injured; make use of “hold cards” and “lockouts” to inform other personnel that repair work is in progress.

TREATMENT UNITS AND ASSOCIATED HAZARDS

The following is a partial list of specific hazards and recommended safety precautions associated with various process units at the WWTP:

<u>Headworks Unit</u>

1. Physical injuries
   a. Remove all slime, rags, greases, or other material that may cause a worker to slip.
   b. Wear gloves to protect hands.
   c. Do not allow material to build up on the working surface.
   d. Do not leave rakes lying on the deck.

2. Infections and infectious diseases
   a. Wear protective clothing over wounds.

3. Electrical shock
   a. Lock out and tag circuit breakers before performing maintenance work.

4. Oxygen deficiency and suffocating gases
   a. Provide continuous ventilation before and during grit pump vault operations.
   b. Wear safety harness.
   c. Never enter without having sufficient people on hand to hoist out.

<u>Influent Pump Station</u>

1. Physical injuries
   a. Remove all oil and grease that could cause slipping and falling.
   b. Barricade open hatches to wet well.
   c. Allow pump to completely cool if overheated.

2. Oxygen deficiency and suffocating gases
    a. Provide continuous ventilation before and during wet well or pump station operations.
    b. Wear safety harness.
    c. Never enter without having sufficient people on hand to hoist out.

3. Explosive gas mixtures
    a. Provide ventilation.
    b. Use explosion proof lights and tools.
    c. No open flames or smoking should be allowed until the atmosphere is clear of all flammable gases or material.

4. Electrical shock
    a. Lock out and tag circuit breakers before performing maintenance work.

Oxidation Ditch, Aerobic Digesters, and UV Channel

1. Physical injuries
    a. Maintain a nonskid surface on steps and access platforms.
    b. Remove all slime, rags, greases, or other material that may cause a worker to slip.
    c. Wear a safety harness with a safety line, and have someone assist when entering tanks for cleaning.
    d. Wear protective clothing and eyewear near UV Channel.

2. Infections and infectious diseases
    a. Wear protective clothing.
    b. Always wash before eating or smoking.

3. Electrical shock
    a. Lock out and tag circuit breakers before performing maintenance work.

Chlorination System/NPW Building

(See previous discussion entitled “NPW Building/Chlorination Facility” in this chapter)

Sludge Stabilization Facilities

1. Physical injuries
    a. Maintain a nonskid surface on steps and access platforms.
    b. Remove all slime, rags, greases, or other material that may cause a worker to slip.

2. Infections and infectious diseases
    a. Wear protective clothing.
    b. Always wash before eating or smoking.

Alkalinity Feed System

1. Physical injuries
    a. Maintain a nonskid surface on steps and access platforms.
    b. Remove all slime, rags, greases, or other material that may cause a worker to slip.
    c. Wear protective clothing and eyewear when handling lime.
    d. Be cautious of loose clothing, etc. near machinery.

2. Infections and infectious diseases
    a. Wear protective clothing.
    b. Always wash before eating or smoking.

3. Electrical shock
    a. Lock out and tag circuit breakers before performing maintenance work.

Effluent Filtration

1. Physical injuries
    a. Maintain a nonskid surface on steps and access platforms.
    b. Remove all slime, rags, greases, or other material that may cause a worker to slip.

c. Wear protective clothing and eyewear when handling using caustic solutions in cleaning the equipment.
d. Be cautious of loose clothing, etc. near machinery.

2. Infections and infectious diseases
   a. Wear protective clothing.
   b. Always wash before eating or smoking.

3. Electrical shock
   a. Lock out and tag circuit breakers before performing maintenance work.

Parshall Flume/Cascade Aerator

1. Physical injuries
   a. Maintain a nonskid surface on steps and access platforms.
   b. Remove all slime, rags, greases, or other material that may cause a worker to slip.

Laboratory

1. Infections and infectious disease safety precautions
   a. Wear rubber gloves when taking samples.
   b. Wash gloves thoroughly before removing.
   c. Wash hands with a disinfectant soap.
   d. Always wash after working in area.
   e. Never use laboratory glassware for coffee cups or food dishes.
   f. Avoid smoking or eating in the lab.
   g. Do not pipette chemicals or wastewater samples by mouth. Always use a suction bulb.

2. Physical injury safety precautions
   a. When taking samples, do not climb beyond guardrails or chains - use poles and ropes to collect samples.
   b. Use safety goggles.
   c. Use care in making rubber-to-glass connections.

d. Always check labels on bottles to make sure that the proper chemical is selected.

e. Never permit unlabeled or undated bottles to accumulate around lab.

f. Never handle chemicals with the bare hand. Use a spoon or spatula.

g. When handling hot equipment, always use tongs, asbestos gloves, or other suitable tools.

h. Read and become familiar with all precautions and warnings on reagent labels. Know and have available the antidote for all poisonous chemicals.

i. Dispose of all broken or cracked glassware immediately.

3. Fire safety precautions

    a. Separate flammable, explosive, and hazardous chemicals for storage in an approved manner.

    b. Do not try to extinguish electrical equipment fires with water. Use carbon dioxide or dry chemical extinguishers.

4. Toxic gas safety precautions

    a. Always work in a fume hood when working with chemicals or samples having toxic fumes.

SAFETY INSPECTIONS

<u>Formal - With Checklist</u>

On an unscheduled basis, the Plant Superintendent, or an appointed representative will make safety inspections of the plant area noting any deficiencies regarding safety equipment, fist aid, tools, general housekeeping, electrical system, and fire equipment. After the inspection is completed, copies of the checklist will be given to the individuals in charge of specific operations to ensure that all necessary corrections are made. After the corrections are made, the signed checklist will be returned to the Plant Superintendent for filing.

<u>Informal</u>

On an unscheduled basis, the Utilities Engineer, Plant Superintendent, or an appointed representative will make safety inspections of the WWTP. Areas that do not meet safety protocols will be brought to the attention of the individual in charge of the area during the inspection. After the inspection is completed, the individual in charge of the area will be responsible for having the corrections made.

SUMMARY

The following is a summary of important safety precautions:

1. Good design without proper safety precautions will not prevent accidents. All personnel must be involved in a safety program and provided with frequent safety reminders.
2. Never attempt to do a job unless sufficient help, the proper tools, and necessary safety equipment are available.
3. Never use fingers to remove a manhole cover or heavy grate. Use the proper tool.
4. Lift with your legs to prevent back strain.
5. Use ladders of any kind with caution. Be certain that portable ladders are positioned so they will not slip or twist. Whenever possible, tie the top of a ladder used to enter below grade structures. Do not use metal ladders near electrical boards or appliances.
6. Never enter a manhole, pit, sump, or below grade enclosed area alone.
7. Always test manhole, pits, sumps, and below-grade areas for explosive atmosphere, oxygen deficiency, and hydrogen sulfide. Before entering, thoroughly ventilate with forced air blower.
8. Wear or use safety devices such as safety harnesses, gas detectors, and rubber gloves to prevent infections and injuries.
9. Never use a tool or piece of equipment unless you are thoroughly familiar with its use or operation and know its limitations.
10. Before starting a job, be certain that the work area is an adequate size. Keep all working surfaces free of material that may cause the surface to be slippery.
11. Ensure that all guardrails and chains are properly installed and maintained.
12. Provide and maintain guards on all chains, sprockets, gears, shafts, and other similar moving pieces of equipment that are normally accessible.
13. Before working on mechanical or electrical equipment, properly turn off and/or tag breakers to prevent the accidental starting of the equipment while you are working on it. Wear rubber gloves and boots wherever you may contact live electrical circuits.

14. Never enter a channel, conduit, or slippery area alone.
15. Maintain a good housekeeping program. This is a proven method of preventing many accidents.
16. Conduct an effective safety awareness and training program.

ONGOING SAFETY EDUCATION

Operators are required to attend an annual Material Data Safety Sheet (MSDS) class and a 10-hour continuing profession education (CPE) class approved by the Virginia Board for Waterworks and Wastewater Works Operators to maintain their wastewater operator license. Plant employees are advised to read Chapter 9 of the O&M manual, read excerpts from the annual AWWA publication "Let's Talk Safety" on a weekly basis, and to use the safety references below for detailed safety information.

REFERENCE CHECKLIST

General: References (1) (3)
Sewers: References (1) (2) (12)
Electrical Hazards: References (3) (4) (11)
Mechanical Equipment Hazards: References (3) (4) (11)
Explosion and Fire Hazards: References (1) (3)
Bacterial Infection (Health Hazards): References (3) (5)
Oxygen Deficiency and Noxious Gases: References (1) (4)
Laboratory Hazards: References (1) (9)
Safety Equipment: References (1) (2)
Process Chemical Handling: References (2) (7)

REFERENCES

1. WPCF MOP No. 1, <u>Safety in Wastewater Works</u>.
2. WPCF NOP No. 7, <u>Sewer Maintenance.</u>
3. EPA Technical Bulletin entitled "Safety in the Operation and Maintenance of Wastewater Treatment Works," Contract No. 68-01-0324.
4. <u>Operation of Wastewater Treatment Plants,</u> A Field Study Training Program, EPA Technical Training Grant No. 5TT1-LP-16-03
5. <u>Manual of Instruction for Sewage Plan Operators</u>, New York State Health Department.
6. <u>Water Quality and Treatment</u>, AWWA, 3rd Edition.
7. <u>Simplified Laboratory procedures for Wastewater Examination</u>, WPCF MOP No. 18.
8. <u>Operation of Wastewater Treatment Plants</u>, WPCF MOP No. 11.
9. <u>Manual of Wastewater Operations</u>, Texas Water Utilities Association.

CONTENTS
CHAPTER 10 - UTILITIES

CHAPTER 10
UTILITIES

GENERAL

The utility services for the Rutledge Creek Wastewater Treatment Plant play a vital role in providing a smooth and uninterrupted operation. Frequent or prolonged disruptions in service or failure to respond quickly to service calls can adversely affect plant operation. The names and telephone numbers of the appropriate utility companies should be posted at every telephone in the plant.

UTILITIES

Electrical

Electrical power is purchased from American Electric Power. American Electric Power's electric service is brought to the treatment plant underground. The following is the phone number of the electric utility company to be called for repair service:

- American Electric Power Telephone: 800-956-4237

The service is backed up by a standby diesel generator located next to the lab control building. More information about the electrical system is presented in Chapter 11.

Telephone Service

Telephone service at the treatment plant is provided by Verizon. The following is the customer service phone number:

- Verizon Telephone: 800-483-8860

Water

Potable water service is provided by the Town of Amherst. The following is the water service provider's phone number to be called for repair service:

- Town of Amherst Telephone: 434-946-1267

Solid Waste Disposal

Solid waste disposal is provided by Amherst County. The following is the contact information:

- Solid Waste Facility 715 Kentmoor Farm Road
  Madison Heights, VA 24572
  Telephone: 434-846-3324

Diesel Fuel

Diesel Fuel can be obtained through the following:

- Mays Farmer Service 555 S. Main St.
  Amherst, VA 24521
  Telephone: 434-946-7531

- Hill Hardware 400 Main St.
  Amherst, VA 24521
  Telephone: 434-946-7711

CONTENTS
CHAPTER 11 – ELECTRICAL SYSTEM

CHAPTER 11
ELECTRICAL SYSTEM

GENERAL

The electrical system at the Rutledge Creek Wastewater Treatment Plant powers, controls, and monitors plant operations.

Electrical supply for the facility is served by American Electric Power and a standby diesel generator system. Electrical supply throughout the plant consists of three-phase, four-wire primary service at 480/277 volts.

NORMAL AND ALTERNATE POWER SOURCES

Normal operation of the facility is served by American Electric Power. The electrical service is brought to the plant underground.

The standby diesel generator supplies power to essential loads for plant operation if a utility failure occurs. The unit is a Caterpillar Model 3406 diesel generator set and is located beside the Lab Building. The generator is equipped with a 1000 gallon fuel tank and provides the required 277/480 volt, 3 phase, 60 Hertz service.

The main control panel for automatic plant monitoring and operations is located in the Lab Building. Its function is to annunciate and indicate alarms and provide start/stop control at all automatic systems.

MAINTENANCE RECOMMENDATIONS

<u>Molded Case Circuit Breakers and Motor Circuit Protectors</u>

1. Once a year
    a. Manually exercise each device.
2. Every three years
    a. Conduct voltage drop test of all motor circuit protectors and branch circuit molded case circuit breakers.

b. Torque all bolted bus bar connections and cable connections to bus bars and to circuit breaker lugs.

Motors and Motor Starters

1. At the major maintenance interval of the driven equipment or at least once every three years, whichever is less:
    a. Measure motor winding insulation resistance.
    b. Measure motor line current normally loaded.
    c. Measure motor voltage when normally loaded.
    d. Test starter overload relays.
    e. Inspect starter contacts.

Diesel Generator

1. Monthly
    a. Manually exercise the generator.
    b. Check diesel fuel level.

Wire and Cable

Periodic inspection should be conducted every six to twelve months. Look for mechanical damage, evidence of overheating, or insulation deterioration.

Electrical Procedure During Loss of Normal Power

Power for the plant is available from two sources, the utility source (American Electric Power) and the standby source (an on-site diesel generator for essential loads only). Transfer from one source to the other may be directed manually.

Upon failure of the utility source, transfer to the generator is performed automatically by the automatic transfer switch (ATS). The transfer from utility to standby is initiated by a drop of any phase of utility supply voltage below a factory setting of 80 percent of rated voltage.

An adjustable time delay is provided on the ATS in order to accommodate momentary power outages or fluctuations. The delay is initially set at a factory setting of 3 seconds.

Load is transferred to the generator only after the generator has attained factory settings of at least 90 percent of rated voltage and 95% of frequency. When the Utility Source returns, transfer back to the utility source is performed automatically by the ATS.

The transfer from standby to utility supply is made only when each phase of the utility has continuously remained above factory settings of 90 percent for 30 minutes. The diesel engine is stopped after a 5 minute (factory setting) cool-down run following load transfer back to utility supply.

Once the utility source main breaker is energized, many WWTP processes may need to be manually activated.

Municipal Minor 07/12/2005

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

PERMITTEE NAME/ADDRESS (INCLUDE FACILITY NAME/LOCATION IF DIFFERENT)

NAME Amherst Town - Sewage Treatment Plant

ADDRESS P. O. Box 280
Amherst VA 24521

FACILITY LOCATION 731 Industrial Dr

VA0031321	001
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD						
YEAR	MO	DAY	TO	YEAR	MO	DAY

DEPT. OF ENVIRONMENTAL QUALITY
(REGIONAL OFFICE)

South Central Regional Office
7705 Timberlake Road

Lynchburg VA 24502

NOTE: READ PERMIT AND GENERAL INSTRUCTIONS BEFORE COMPLETING THIS FORM.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX.	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
001 FLOW	REPORTED			MGD	*********	*********	*********			CONT	REC
	REQRMNT	0.6	NL	MGD	*********	*********	*********			CONT	REC
002 pH	REPORTED	*********	*********			*********		SU		1 / Day	GRAB
	REQRMNT	*********	*********		6.0	*********	9.0	SU		1 / Day	GRAB
003 BOD5	REPORTED			KG/D	*********			MG/L		2 D / W	8 HC
	REQRMNT	16.8	25.2	KG / D	*********	11.1	16.7	MG / L		2 D / W	8 HC
004 TSS	REPORTED			KG/D	*********			MG/L		2 D / W	8 HC
	REQRMNT	45.4	68.1	KG / D	*********	30	45	MG / L		1 D / W	8 HC
012 PHOSPHORUS,TOTAL (AS P)	REPORTED		*********	KG/D	*********		*********	MG/L		2 / M	8 HC
	REQRMNT	NL	*********	KG / D	*********	NL	*********	MG / L		2 / M	8 HC
013 NITROGEN,TOTAL (AS N)	REPORTED		*********	KG/D	*********		*********	MG/L		2 / M	CALC
	REQRMNT	NL	*********	KG / D	*********	NL	*********	MG / L		2 / M	CALC
068 TKN (N-KJEL)	REPORTED		*********	KG/D	*********		*********	MG/L		2 / M	8 HC
	REQRMNT	NL	*********	KG / D	*********	NL	*********	MG / L		2 / M	8 HC
120 E. COLI	REPORTED	*********	*********		*********		*********	N/CML		3 D / W	8 HC
	REQRMNT	*********	*********		*********	126	*********	N/CML		3 D / W	8 HC

ADDITIONAL PERMIT REQUIREMENTS OR COMMENTS

BYPASSES AND OVERFLOWS	TOTAL OCCURRENCES	TOTAL FLOW (M.G.)	TOTAL BOD5 (K.G.)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information. The information submitted is to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. See 18 U.S.C. & 1001 and 33 U.S. C. & 1319. (Penalties under these statutes may include fines up to $10,000 and / or maximum imprisonment of between 6 months and 5 years)

OPERATOR IN RESPONSIBLE CHARGE			DATE		
TYPED OR PRINTED NAME	SIGNATURE	CERTIFICATE NO.	YEAR	MO.	DAY
PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		TELEPHONE			
		AREA CODE NUMBER	YEAR	MO.	DAY
TYPED OR PRINTED NAME	SIGNATURE				

COMMONWEALTH *of* VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

SOUTH CENTRAL REGIONAL OFFICE
7705 Timberlake Road, Lynchburg, Virginia 24502
(434) 582-5120 Fax (434) 582-5125
www.deq.virginia.gov

Robert G. Burnley
Director

Thomas L. Henderson
Regional Director

December 28, 2004

Mr. Jack Hobbs, Town Manager
Town of Amherst
P.O. Box 280
Amherst, Virginia 24521

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

RE: VPDES Permit No. **VA0031321; Reissuance**
Rutledge Creek Wastewater Treatment Plant

Dear Mr. Hobbs:

Your VPDES permit is enclosed along with the final public participation item (No. 29) of the fact sheet. A Discharge Monitoring Report (DMR) form for 001 is included with the permit. Please make additional copies of the DMR for future use. The first DMR for the month of **January** is due by **February 10, 2005**. Please send the DMR to:

Department of Environmental Quality
South Central Regional Office
7705 Timberlake Road
Lynchburg, VA 24502

As provided by Rule 2A:2 of the Supreme Court of Virginia, you have thirty days from the date of service (the date you actually received this decision or the date it was mailed to you, whichever occurred first) within which to appeal this decision by filing a notice of appeal in accordance with the Rules of the Supreme Court of Virginia with the Director, Department of Environmental Quality. In the event that this decision is served on you by mail, three days are added to the period.

Alternatively, any owner under §§62.1-44.16, 62.1-44.17, and 62.1-44.19 of the State Water Control Law aggrieved by any action of the state water Control Board taken without formal hearing, or by inaction of the Board, may demand in writing a formal hearing of such owner's grievance, provided a petition requesting such hearing is filed with the Board. Said petition must meet the requirements set forth in §1.23(b) of the Board's Procedural Rule No. 1. In cases involving actions of the Board, such petition must be filed within thirty days after notice of such action is mailed to such owner by certified mail.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

Permit No.: **VA0031321**
Effective Date: December 28, 2004
Expiration Date: December 27, 2009

AUTHORIZATION TO DISCHARGE UNDER THE

VIRGINIA POLLUTANT DISCHARGE ELIMINATION SYSTEM

AND

THE VIRGINIA STATE WATER CONTROL LAW

In compliance with the provisions of the Clean Water Act as amended and pursuant to the State Water Control Law and regulations adopted pursuant thereto, the following owner is authorized to discharge in accordance with the effluent limitations, monitoring requirements, and other conditions set forth in this permit.

Owner:	**Town of Amherst**
Facility Name:	**Rutledge Creek Wastewater Treatment Plant**
City:	Amherst, Virginia
County:	Amherst
Facility Location:	731 Industrial Drive

The owner is authorized to discharge to the following receiving stream:

Stream:	Rutledge Creek
River Basin:	James River
River Subbasin:	James River (Upper)
Section:	11
Class:	III
Special Standards:	None

The authorized discharge shall be in accordance with this cover page, Part I - Effluent Limitations and Monitoring Requirements and Part II - Conditions Applicable To All VPDES Permits, as set forth herein.

Director, Department of Environmental Quality

12/28/04
Date

If you have any questions about the permit, please call Kevin Crider at (434) 582-5120, ext. 6012 or by e-mail kacrider@deq.virginia.gov.

Sincerely,

Thomas L. Henderson
Regional Director

Enclosure: Fact Sheet Public Participation Item (No.29), DMR and VPDES Permit

cc: OWPP
EPA, Region III-3WP12
SCRO Compliance (Permit Part I, Attachment A, Transmittal Letter and DMR Only)
Permit File – VA0031321

ADJACENT STATE COMMENTS RECEIVED ON DRAFT PERMIT: Document any comments received from an adjacent state and noted how resolved.

Not Applicable.

OTHER AGENCY COMMENTS RECEIVED ON DRAFT PERMIT: Document any comments received from any other agencies (e.g., VIMS, VMRC, DGIF, etc.) and noted how resolved.

Not Applicable.

OTHER COMMENTS RECEIVED FROM RIPARIAN OWNERS/CITIZENS ON DRAFT PERMIT: Document any comments received from other sources and note how resolved.

PUBLIC NOTICE INFORMATION: 1st Comment Period: **Start Date:** September 16, 2004
End Date: October 18, 2004

The application and draft permit received public notice in accordance with the VPDES Permit Regulation. During the initial public notice period, a request for hearing dated 10/8/04 were received from the owner (Town of Amherst) on 10/15/04. The basis for the hearing request was the Copper and Nickel limits remaining in the reissued permit. A copy of the comment letter is attached.

In the previous cycle the effluent hardness was estimated (50mg/l) and a nickel limit was placed into the permit for the lower tier. In this permit cycle, an actual hardness datum of 94 mg/l was submitted and thus showed no need for the nickel limit at the lower flow tier. Applying a minimum hardness of 120 mg/l on the new WWTP indicates no need for a limit, therefore in lieu of copper and nickel limits for the higher flow tier, a minimum hardness limit was proposed to Town of Amherst in an email dated 11/10/04. By email dated 11/10/04 from Town Manager Jack Hobbs, Amherst withdrew their request for hearing and agreed to the proposed minimum hardness limit.

On September 30, 2004, Copies of the draft permit and fact sheet requested by Carolyn Pravlik (Washington D.C.). Draft permit transmitted on October 1, 2004 and FS transmitted on October 4, 2004 to Email Address: cpravlik@verizon.net After the copies were transmitted, no further information was requested.

On October 5, 2004, Copies of the draft permit and fact sheet requested by Tom Bledsoe (Chesapeake Bay Foundation). Draft permit and FS transmitted on October 7, 2004 to Email Address: VA_Intern1@savethebay.cbf.org After the copies were transmitted, no further information was requested.

PUBLIC NOTICE INFORMATION: 2nd Comment Period: **Start Date:** November 25, 2004
End Date: December 27, 2004

Persons may comment in writing or by e-mail to the DEQ on the proposed reissuance of the permit within 30 days from the date of the first notice. Address all comments to the contact person listed below. Written or e-mail comments shall include the name, address, and telephone number of the writer, and shall contain a complete, concise statement of the factual basis for comments. Only those comments received within this period will be considered. The Director of the DEQ may decide to hold a public hearing if public response is significant. Requests for public hearings shall state the reason why a hearing is requested, the nature of the issues proposed to be raised in the public hearing and a brief explanation of how the requestor's interests would be directly and adversely affected by the proposed permit action.

All pertinent information is on file and may be inspected, and arrangements made for copying by contacting Kevin A. Crider at: Department of Environmental Quality (DEQ), South Central Regional Office, 7705 Timberlake Road, Lynchburg, Virginia 24502. Telephone: (434) 582-5120 x6012. Facsimile: (434) 582-5125. E-mail: kacrider@deq.virginia.gov.

applied. Attach any memoranda or other information which helped to develop permit conditions (i.e. flow determination memo, tier determinations, PReP complaints, special water quality studies, STORET data and other biological and/or chemical data, etc.

SEE ATTACHMENT 9

1. **303(d) LISTED SEGMENTS:** Indicate if the facility discharges directly to a segment that is listed on the current 303(d) list, if the allocations are specified by an approved TMDL and, if so, provide all appropriate information/calculations. If the facility discharges directly to a stream segment that is on the current 303(d) list, the fact sheet must include a description of how the TMDL requirements are being met.

This facility discharges directly to ***Rutledge Creek***. This stream segment receiving the effluent is listed on Part 1A of the approved 2002 303(d) list for non-attainment of Fecal Coliform. A TMDL has not been prepared or approved for this stream segment. The permit contains a TMDL reopener clause which will allow it to be modified, in compliance with section 303(d)(4) of the Act once a TMDL is approved.

SEE ATTACHMENT 10

25. **CHANGES TO PERMIT:** Use **TABLE A** to record any **changes from the previous permit** and the rationale for those changes. Use **TABLE B** to record any **changes made to the permit during the permit processing period** and the rationale for those changes [i.e., use for comments from the applicant, VDH, EPA, other agencies and/or the public where comments resulted in changes to the permit limitations or any other changes associated with the special conditions or reporting requirements].

SEE ATTACHMENT 11

26. **NPDES INDUSTRIAL PERMIT RATING WORKSHEET:**

N/A - This is a municipal facility.

27. **EPA/VIRGINIA DRAFT PERMIT SUBMISSION CHECKLIST:**

SEE ATTACHMENT 12

28. **DEQ PLANNING COMMENTS RECEIVED ON DRAFT PERMIT:** Document any comments received from DEQ planning.

The discharge is in conformance with the existing planning documents for the area.

29. **PUBLIC PARTICIPATION:** Document comments/responses received during the public participation process. If comments/responses provided, especially if they result in changes to the permit, place in the attachment.

VDH COMMENTS RECEIVED ON DRAFT PERMIT: Document any comments received from the Virginia Dept. of Health and noted how resolved.

By memorandum dated April 6, 2004, the VDH provided the following comments on the application: "There are no public water supply raw water intakes located within 15 miles downstream of the discharge. We do not object to the discharge."

New Agency guidance does not require the VDH to review draft permits prior to issuance, therefore there were no comments received.

EPA COMMENTS RECEIVED ON DRAFT PERMIT: Document any comments received from the U.S. Environmental Protection Agency and noted how resolved.

The draft permit was transmitted to EPA on July 12, 2004 because the facility discharges to a stream segment listed on Part 1A of 303(d) list for Fecal Colifom. By letter dated August 13, 2004, EPA has no objections to the adequacy of the draft permit.

Following the comment period, the Board will make a determination regarding the proposed reissuance. This determination will become effective, unless the Director grants a public hearing. Due notice of any public hearing will be given.

30. **ADDITIONAL FACT SHEET COMMENTS/PERTINENT INFORMATION:**

The Town of Amherst completed the study of Bacteria Standards for E. Coli and submitted the results to DEQ SCRO on November 7, 2004. However, this study was completed while the plant used chlorination as a disinfectant, thus the permittee is required to complete another study based on the Ultraviolet disinfection system being in place.

This facility is being expanded from 0.4 MGD to 0.6 MGD with a projected completion date around late September 2004; however, the flows will not immediately increase. Even with the design flow going to 0.6 MGD, the permit will allow for limitations for the 0.4 MGD facility to continue until such time as there have been three (3) consecutive months which equal or exceed 95% of the monthly average flow (0.38 MGD). The limitations for the 0.4 MGD facility have been shown to be protective of water quality. Once there have been three consecutive months which equal or exceed a monthly average flow of 0.38 MGD (regardless of reason), the limitations will revert to the tighter requirements for the 0.6 MGD facility.

The permit expired on August 4, 2004 due to the finalization of the DEQ Nutrient Guidance Document 04-2017, which was received by the regional office on July 19, 2004 and the receipt of the last set of Form 2A data received on July 22, 2004. The nutrient monitoring and special conditions were included in the permit and the draft was submitted on July 30, 2004 for owner concurrence. Comments were received from the owner on August 27, 2004 (dated August 19, 2004) and a revised draft permit and public notice was submitted to the owner on September 8, 2004.

SUMMARY OF SPECIFIC ATTACHMENTS LABELED AS:

Attachment 1 Site Inspection Report/Memorandum
Attachment 2 Discharge Location/Topographic Map
Attachment 3 Schematic/Plans & Specs/Site Map/Water Balance
Attachment 4 Discharge/Outfall Description
Attachment 5 Limitations/Monitoring
Attachment 6 Special Conditions
Attachment 7 Effluent/Sludge/Ground Water Limitations/Monitoring Rationale/Suitable Data/ Stream Modeling/Antidegradation/Antibacksliding
Attachment 8 Special Conditions Rationale
Attachment ___ Material Stored
Attachment 9 Receiving Waters Info./Tier Determination/STORET Data
Attachment 10 303(d) Listed Segments
Attachment 11 TABLE A and TABLE B - Change Sheets
Attachment ___ NPDES Industrial Permit Rating Worksheet
Attachment 12 EPA/Virginia Draft Permit Submission Checklist
Attachment 13 Chronology Sheet
Attachment ___.

PERMITTEE NAME/ADDRESS(INCLUDE FACILITY NAME/LOCATION IF DIFFERENT)

NAME Rutledge Creek WWTP
ADDRESS PO Box 280
Amherst VA 24521

FACILITY LOCATION 731 Industrial Dr

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM(NPDES)
DISCHARGE MONITORING REPORT(DMR)

PERMIT NUMBER	DISCHARGE NUMBER
VA0031321	001

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM				TO			

Municipal Minor 12/

DEPT. OF ENVIRONMENTAL QUALITY (REGIONAL OFFICE)

South Central Regional Office
7705 Timberlake Rd

Lynchburg VA 24502

NOTE: READ PERMIT AND GENERAL INSTRUCTIONS BEFORE COMPLETING THIS FORM.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	QUALITY OR CONCENTRATION UNITS	NO. EX.	FREQUENCY OF ANALYSIS	SAMPLE TYPE
001 FLOW	REPORTD				*********	*********	*********				
	REQRMNT	0.6	NL	MGD	*********	*********	*********			CONT	REC
002 PH	REPORTD	*********	*********			*********					
	REQRMNT	*********	*********		6.0	*********	9.0	SU		1/DAY	GRAB
003 BOD5	REPORTD				*********						
	REQRMNT	16.8	25.2	KG/D	*********	11.1	16.7	MG/L		2D/W	8HC
004 TSS	REPORTD				*********						
	REQRMNT	45.4	68.1	KG/D	*********	30	45	MG/L		1/W	8HC
006 COLIFORM, FECAL	REPORTD	*********	*********		*********		*********				
	REQRMNT	*********	*********		*********	200	*********	N/CML		3D/W	GRAB
012 PHOSPHORUS, TOTAL (AS P)	REPORTD		*********		*********		*********				
	REQRMNT	NL	*********	KG/D	*********	NL	*********	MG/L		2/M	8HC
013 NITROGEN, TOTAL AS N	REPORTD		*********		*********		*********				
	REQRMNT	NL	*********	KG/D	*********	NL	*********	MG/L		2/M	CALC
068 TKN (N-KJEL)	REPORTD		*********		*********		*********				
	REQRMNT	NL	*********	KG/D	*********	NL	*********	MG/L		2/M	8HC

ADDITIONAL PERMIT REQUIREMENTS OR COMMENTS

BYPASSES AND OVERFLOWS	TOTAL OCCURRENCES	TOTAL FLOW(M.G.)	TOTAL BOD5(K.G.)

I CERTIFY UNDER PENALTY OF LAW THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHER AND EVALUATE THE INFORMATION SUBMITTED. BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM OR THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, THE INFORMATION SUBMITTED IS TO THE BEST OF MY KNOWLEDGE AND BELIEF TRUE, ACCURATE AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS. SEE 18 U.S.C. & 1001 AND 33 U.S.C. & 1319. (Penalties under these statutes may include fines up to $10,000 and/or maximum imprisonment of between 6 months and 5 years.)

OPERATOR IN RESPONSIBLE CHARGE

TYPED OR PRINTED NAME	SIGNATURE	CERTIFICATE NO.	DATE YEAR	MO.	DAY

PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TYPED OR PRINTED NAME	SIGNATURE	TELEPHONE	YEAR	MO.	DAY

PERMITTEE NAME/ADDRESS(INCLUDE
FACILITY NAME/LOCATION IF DIFFERENT)

NAME Rutledge Creek WWTP
ADDRESS PO Box 280
Amherst VA 24521

FACILITY LOCATION 731 Industrial Dr

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM(NPDES)
DISCHARGE MONITORING REPORT(DMR)

VA0031321	001
PERMIT NUMBER	DISCHARGE NUMBER

	MONITORING PERIOD					
	YEAR	MO	DAY		YEAR	MO	DAY
FROM				TO			

Municipal Minor 12/

DEPT. OF ENVIRONMENTAL QUALITY
(REGIONAL OFFICE)

South Central Regional Office
7705 Timberlake Rd

Lynchburg VA 24502

NOTE: READ PERMIT AND GENERAL INSTRUCTIONS BEFORE COMPLETING THIS FORM.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX.	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
137 HARDNESS, TOTAL (AS CACO3)	REPORTD	*********	*********			*********	*********				
	REQRMNT	*********	*********		120	*********	*********	MG/L		1/W	BHC
312 AMMONIA, AS N JUN-NOV	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	14.7	14.7	MG/L		1/M	BHC
389 NITRITE+NITRATE-N,TOTAL	REPORTD		*********		*********		*********				
	REQRMNT	NL	*********	KG/D	*********	NL	*********	MG/L		2/M	BHC
791 NITROGEN, TOTAL AS N (KG/MO)	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	KG/MO	*********	*********	*********			1/M	CALC
792 NITROGEN, TOTAL AS N (KG/YR)	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	KG/YR	*********	*********	*********			1/M	CALC
793 PHOSPHORUS, TOTAL (AS P) (KG/MO)	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	KG/MO	*********	*********	*********			1/M	CALC
794 PHOSPHORUS, TOTAL (AS P) (KG/YR)	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	KG/YR	*********	*********	*********			1/M	CALC
795 ORTHOPHOSPHATE (AS P)	REPORTD		*********		*********		*********				
	REQRMNT	NL	*********	KG/D	*********	NL	*********	MG/L		2/M	BHC

ADDITIONAL PERMIT REQUIREMENTS OR COMMENTS

BYPASSES AND OVERFLOWS	TOTAL OCCURRENCES	TOTAL FLOW(M.G.)	TOTAL BOD5(K.G.)

I CERTIFY UNDER PENALTY OF LAW THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHER AND EVALUATE THE INFORMATION SUBMITTED. BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM OR THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, THE INFORMATION SUBMITTED IS TO THE BEST OF MY KNOWLEDGE AND BELIEF TRUE, ACCURATE AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS. SEE 18 U.S.C. & 1001 AND 33 U.S.C. & 1319. (Penalties under these statutes may include fines up to $10,000 and/or maximum imprisonment of between 6 months and 5 years.)

OPERATOR IN RESPONSIBLE CHARGE			DATE		
TYPED OR PRINTED NAME	SIGNATURE	CERTIFICATE NO.	YEAR	MO.	DAY
PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		TELEPHONE			
TYPED OR PRINTED NAME	SIGNATURE		YEAR	MO.	DAY

REQUIRED BY LAW (33 U. S. C. § 1318 40 CFR 122.6 FAILURE TO REPORT OR FAILURE TO REPORT TR[illegible] LY CAN RESUL IN CIVIL PENALTIES NOT TO EXCEED $10,000 PER Y OF VIOLATION: OR IN CRIMINAL PENALTIES NOT TO EXCEED $25,00 R DAY OF VIOLATION OR BY IMPRISONMENT FOR NO MORE THAN FIVE YEARS, OR BOTH.

GENERAL INSTRUCTIONS

1. Complete this form in permanent ink or indelible pencil.
2. Be sure to enter the dates for the first and last day of the period covered by the report on the form in the space marked "Monitoring Period".
3. For those parameters where the "permit requirement" spaces are blank or a limitation appears, provide data in the "reported" spaces in accordance with your permit.
4. Enter the average and, if appropriate, maximum quantities and units in the "reported" spaces in the columns marked "Quantity or Loading". KG/DAY = Concentration(mg/l) x Flow(MGD) x 3.785.
5. Enter maximum, minimum, and/or average concentrations and units in the "reported" spaces in the columns marked "Quality or Concentration".
6. Enter the number of samples which do not comply with the maximum and /or minimum permit requirements in the "reported" space in the column marked "No. Ex.".
7. Enter the actual frequency of analysis for each parameter (number of times per day, week, month) in the "reported" space in the column marked "Frequency of Analysis".
8. Enter the actual type of sample collected for each parameter in the "reported" space in the column marked "Sample Type".
9. Enter additional required data or comments in the space marked "additional permit requirements or comments".
10. Record the number of bypasses during the month, the total flow in million gallons and BOD5 in kilograms in the proper columns in the section marked "Bypasses and Overflows".
11. The operator in responsible charge of the facility should review the form and sign in the space provided. If the plant is required to have a licensed operator, the operator's certificate number should be reported in the space provided.
12. The principal executive officer should then review the form and sign in the space provided and provide a telephone number where he/she can be reached.
13. You are required to sample at the frequency and type indicated in your permit.
14. Send the completed form to your Dept. of Environmental Quality Regional Office by the 10th of each month.
15. You are required to retain a copy of the report for your records.
16. Where violations of permit requirements are reported, attach a brief explanation in accordance with the permit requirements describing causes and corrective actions taken. Reference each violation by date.
17. If you have any questions, contact the Dept. of Environmental Quality Regional Office.

A. INTERIM EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date **OR** upon three (3) consecutive months with the monthly average effluent flow equal to or greater than 0.38 MGD, if earlier, the permittee is authorized to discharge from outfall serial number **001**, after Parshall Flume.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS	
	MONTHLY AVERAGE		WEEKLY AVERAGE		MINIMUM	MAXIMUM	FREQUENCY	SAMPLE TYPE
	mg/l*	kg/day*	mg/l*	kg/d*	mg/l*	mg/l*		
Flow (MGD) [a]	NL		NA		NA	NL	Continuous	TIRE
BOD_5 [d]	11.1	16.8	16.7	25.2	NA	NA	2 Days/Week	8-HC
Total Suspended Solids [d]	30	45.4	45	68.1	NA	NA	1/Week	8-HC
Ammonia (June – Nov) [c]	14.7	NA	14.7	NA	NA	NA	1/Month	8-HC
pH (standard units)	NA		NA		6.0	9.0	1/Day	Grab
Hardness	NA		NA		120	NA	1/Week	8-HC
Fecal Coliform (N/CML - geometric mean) [b]	200		NA		NA	NA	3 Days/Week	Grab
Total Phosphorus [c]	NL	NL	NA	NA	NA	NA	2/Month [f]	8 HC
Total Phosphorus (kg/month) [g]	NA	NA	NA	NA	NA	NL	1/Month	Calculated
Total Phosphorus (kg/calendar year) [g]	NA	NA	NA	NA	NA	NL	1/Month	Calculated
Orthophosphate [c]	NL	NL	NA	NA	NA	NA	2/Month [f]	8 HC
Total Kjeldahl Nitrogen (as N) [c] [e]	NL	NL	NA	NA	NA	NA	2/Month [f]	8 HC
Nitrate plus Nitrite (as N) [c] [e]	NL	NL	NA	NA	NA	NA	2/Month [f]	8 HC
Total Nitrogen [e]	NL	NL	NA	NA	NA	NA	2/Month [f]	Calculated
Total Nitrogen (kg/month) [g]	NA	NA	NA	NA	NA	NL	1/Month	Calculated
Total Nitrogen (kg/calendar year) [g]	NA	NA	NA	NA	NA	NL	1/Month	Calculated

* = UNLESS OTHERWISE NOTED   NA = NOT APPLICABLE   NL = NO LIMIT, MONITORING REQUIREMENT ONLY

TIRE = TOTALIZING, INDICATING AND RECORDING EQUIPMENT

[a] See Part I.D.6.a. and b. for additional flow requirements.

[b] See Part I.B. and C. for additional bacterial and chlorine limitations and monitoring requirements, respectively.

[c] See Parts I.D.7.a. and I.D.7.b. for quantification levels and reporting requirements, respectively.

[d] See Part I.D.9. for additional instructions regarding effluent monitoring frequencies.

[e] Total Nitrogen, which is the sum of Total Kjeldahl Nitrogen and Nitrates plus Nitrites, shall be derived from the results of those tests.

[f] 2/Month = two samples taken during the calendar month, no less than two weeks apart.

[g] See Part I.D.12. for calculation procedures.

a. The design flow of this treatment facility is **0.6 MGD**.
b. There shall be no discharge of floating solids or visible foam in other than trace amounts.
c. At least 85% removal for BOD5 and TSS must be attained for this effluent.

A. FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

2. Upon three (3) consecutive months with the monthly average effluent flow equal to or greater than 0.38 MGD and lasting until the permit's expiration date, the permittee is authorized to discharge from outfall serial number **001**, after Parshall Flume.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS						MONITORING REQUIREMENTS	
	MONTHLY AVERAGE		WEEKLY AVERAGE		MINIMUM	MAXIMUM	FREQUENCY	SAMPLE TYPE
	mg/l*	kg/day*	mg/l*	kg/d*	mg/l*	mg/l*		
Flow (MGD) [a]	NL		NA		NA	NL	Continuous	TIRE
BOD_5 [d]	7.4	16.8	11.1	25.2	NA	NA	2 Days/Week	8-HC
Total Suspended Solids [d]	30	68.1	45	102.1	NA	NA	1/Week	8-HC
Ammonia (June – Nov) [c] [d]	12.1	NA	12.1	NA	NA	NA	1/Month	8-HC
pH (standard units)	NA		NA		6.0	9.0	1/Day	Grab
Hardness	NA		NA		120	NA	1/Week	8-HC
Fecal Coliform (N/CML - geometric mean)	200		NA		NA	NA	3 Days/Week	Grab
Total Phosphorus [c]	NL	NL	NA	NA	NA	NA	2/Month [f]	8 HC
Total Phosphorus (kg/month) [g]	NA	NA	NA	NA	NA	NL	1/Month	Calculated
Total Phosphorus (kg/calendar year) [g]	NA	NA	NA	NA	NA	NL	1/Month	Calculated
Orthophosphate [c]	NL	NL	NA	NA	NA	NA	2/Month [f]	8 HC
Total Kjeldahl Nitrogen (as N) [c] [e]	NL	NL	NA	NA	NA	NA	2/Month [f]	8 HC
Nitrate plus Nitrite (as N) [c] [e]	NL	NL	NA	NA	NA	NA	2/Month [f]	8 HC
Total Nitrogen [e]	NL	NL	NA	NA	NA	NA	2/Month [f]	Calculated
Total Nitrogen (kg/month) [g]	NA	NA	NA	NA	NA	NL	1/Month	Calculated
Total Nitrogen (kg/calendar year) [g]	NA	NA	NA	NA	NA	NL	1/Month	Calculated

* = UNLESS OTHERWISE NOTED NA = NOT APPLICABLE NL = NO LIMIT, MONITORING REQUIREMENT ONLY

TIRE = TOTALIZING, INDICATING AND RECORDING EQUIPMENT

[a] See Part I.D.6.b. for additional flow requirements.

[b] See Part I.B. and C. for additional bacterial and chlorine limitations and monitoring requirements, respectively.

[c] See Parts I.D.7.a. and I.D.7.b. for quantification levels and reporting requirements, respectively.

[d] See Part I.D.9. for additional instructions regarding effluent monitoring frequencies.

[e] Total Nitrogen, which is the sum of Total Kjeldahl Nitrogen and Nitrates plus Nitrites, shall be derived from the results of those tests.

[f] 2/Month = two samples taken during the calendar month, no less than two weeks apart.

[g] See Part I.D.12. for calculation procedures.

a. The design flow of this treatment facility is **0.6 MGD**.
b. There shall be no discharge of floating solids or visible foam in other than trace amounts.
c. At least 85% removal for BOD5 and TSS must be attained for this effluent.

B. BACTERIAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS – ADDITIONAL INSTRUCTIONS

1. Beginning **no later than July 1, 2005,** the permittee shall initiate a demonstration study as described below.

   a. *E. coli* monitoring shall be performed at the minimum prescribed below:

      Once per week by grab sample taken between 10 a.m. and 4 p.m. until a minimum of 12 data points are collected.

   b. Effluent flow shall be measured within 15 minutes of the time each *E. coli* sample is taken. The date and time the samples were collected shall also be recorded.

   c. If only one datum is collected in any given calendar month, it shall be compared to the single sample maximum of 235 colonies/100 ml for compliance with the applicable water quality criterion. If more than one datum are collected in any given calendar month, the geometric mean for that month shall be compared to the 126 colonies/100 ml for compliance with the applicable water quality criterion.

   Upon initiation of the study, **reports of progress shall be submitted with the monthly discharge monitoring reports.** The reports are to include the data collected during the previous month.

2. a. **No later than January 10, 2006,** the permittee shall either:

      (1) Complete the demonstration study and submit the results to the DEQ regional office; or,

      (2) Advise the DEQ regional office, in writing, that the demonstration study is still ongoing. The latest status of the study is to be provided.

   b. The submitted results of the demonstration study, as described in I.B.1. above, shall include the following:

      (1) The original data set, including the following information/data for each sample:

         (a) Date and time sample collected
         (b) *E. coli* result (N/100 ml)
         (c) Fecal coliform (N/100 ml)
         (d) Flow (mgd)

      (2) The geometric mean calculations and results; and

      (3) A summary of results in tabular format and a statement of successful or unsuccessful demonstration of the requirements of Part I.B.3.

3. During the demonstration period, the permittee is to provide a data set which demonstrates adequate disinfection showing no exceedences of the applicable *E. coli* criterion in a minimum of 12 consecutive samples collected as under Part I.B.1. In addition, there must be full compliance with the permitted fecal coliform limitations during the demonstration period. Once the above is completed and submitted, then upon written notification from DEQ, beginning with the month following receipt of the

written notice and continuing until the permit expiration date:

a. The fecal coliform limitations and monitoring required by Part I.A. shall no longer be required; and,

b. The following limitations and monitoring requirements shall become effective:

	Discharge Limitations Monthly Average	Monitoring Requirements Frequency	 Sample Type
E. coli (n/100 ml)	126*	3/Week	Grab (Between 10 AM & 4 PM)

* Geometric Mean

4. If the results of the study demonstrate that there are any exceedences of the applicable *E. coli* criterion in the data set collected under Part I.B.1. while the fecal coliform limitations are being complied with, then the permittee shall achieve compliance with the final limits for *E. coli* specified in Part I.B.3.b. above in accordance with the following schedule:

a.	Submit Progress Report	**By January 10, 2007, and annually thereafter**
b.	Achieve compliance with final limits	**By January 1, 2009**

Annually = Between January 1 and December 31, due January 10 of following year.

Upon achievement of the final limits for *E. coli*, the fecal coliform limitations and monitoring required in Part I.A. shall no longer be required.

5. *E. coli* sampling and analysis shall be performed in accordance with 40 CFR 141.21, except that maximum holding times shall be limited in accordance with 40 CFR 136 to six hours.

C. TOTAL RESIDUAL CHLORINE (TRC) LIMITATIONS AND MONITORING REQUIREMENTS

1. If, based on the results of the demonstration study in I.B. above, the permittee elects to convert to chlorination as the disinfection method, compliance with the final TRC limitations and monitoring requirements specified in Part 2.C. below shall be achieved in accordance with the following schedule:

a.	**Submit Proposed Plan for Achievement of Compliance or Select Engineering Firm for Design of Facilities**	**No later than March 10, 2005.**
b.	**Submit Progress Reports to the DEQ Regional Office**	**Quarterly after #1, with the first report due July 10, 2005.**
c.	**Achieve Compliance with Part I.A. Limitations**	**No later than July 1, 2007.**

Quarterly = In accordance with the following schedule: 1st quarter (January 1 – March 31, **due April 10**); 2nd quarter (April 1 – June 30, **due July 10**); 3rd quarter (July 1 – September 30, due **October 10**); 4th quarter (October 1 – December 31, **due January 10**).

No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit to the DEQ Regional Office, either a **report of progress** or, in the case of specific actions being required by identified dates, a written **notice of compliance or noncompliance.** In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

2. The TRC shall be limited and monitored as follows:

a. Effluent TRC shall be monitored, following dechlorination, 1/day by grab sample and limited as specified below:

	Monthly Average	Weekly Average	Quantification Level
TRC (µg/l)	17	21	100

b. TRC shall also be monitored at the outlet of the chlorine contact tank, prior to dechlorination, 3 per day @ 4-hour intervals by grab sample.

c. No more than 9 of all samples taken after the chlorine contact tank, prior to dechlorination, shall be less than 1.0 mg/l for any one calendar month.

d. No TRC sample collected after the chlorine contact tank, prior to dechlorination, shall be less than 0.6 mg/l.

D. OTHER REQUIREMENTS OR SPECIAL CONDITIONS

1. Permit Reopeners

a. Sludge Reopener

This permit may be modified or, alternatively, revoked and reissued if any applicable standard for sewage sludge use or disposal promulgated under Section 405(d) of the Clean Water Act is more stringent than any requirements for sludge use or disposal in this permit, or controls a pollutant or practice not limited in this permit.

b. Nutrient Enriched Waters Reopener

This permit may be modified or, alternatively, revoked and reissued to incorporate new or alternative nutrient limitations and/or monitoring requirements should the State Water Control Board adopt nutrient standards for the waterbody receiving the discharge, including the Chesapeake Bay or its tributaries, or if a future water quality regulation or statute requires new or alternative nutrient control.

This permit may be modified or, alternatively, revoked and reissued to incorporate annual maximum total nitrogen and total phosphorus effluent limitations based on three years of monitoring data collected as required by this permit.

c. Total Maximum Daily Load (TMDL) Reopener

This permit shall be modified or, alternatively, revoked and reissued if any approved waste load allocation procedure, pursuant to section 303(d) of the Clean Water Act, imposes waste load allocations, limits or conditions on the facility that are not consistent with the requirements of this permit.

2. Licensed Wastewater Operator Requirement

The permittee shall employ or contract at least one Class II licensed wastewater works operator for the facility. The license shall be issued in accordance with Title 54.1 of the Code of Virginia and the regulations of the Board for Waterworks and Wastewater Works Operators. The permittee shall notify the DEQ Regional Office, in writing, whenever he is not complying, or has grounds for anticipating he will not comply with this requirement. The notification shall include a statement of reasons and a prompt schedule for achieving compliance.

3. Reliability Class Requirement

The permitted treatment works shall meet Reliability Class II.

4. Certificate to Construct (CTC) and Certificate to Operate (CTO) Requirements

The permittee shall, in accordance with the Sewage Collection and Treatment Regulations, obtain a CTC and a CTO from the DEQ prior to constructing wastewater treatment facilities and operating the facilities, respectively.

5. Operations and Maintenance (O & M) Manual

The permittee shall review the existing O & M Manual and notify the DEQ Regional Office, in writing, that it is still accurate and complete. If the O & M Manual is no longer accurate and complete, a revised O & M Manual shall be submitted for approval to the DEQ Regional Office. The permittee will maintain an accurate, approved O & M Manual for the treatment works. This manual shall include, but not necessarily be limited to, the following items, as appropriate:

a. Treatment works design, operation, routine preventative maintenance of units within the treatment system, critical spare parts inventory and record keeping;
b. Techniques to be employed in the collection, preservation and analysis of effluent samples;
c. Procedures for handling, storing, and disposing of all wastes, fluids, and pollutants characterized in Part I.D.8 (Materials Handling and Storage) that will prevent these materials from reaching state waters.

Any changes in the practices and procedures followed by the permittee shall be documented and submitted for approval, as noted above, within 90 days of the effective date of the changes. Upon approval of the submitted manual changes, the revised manual becomes an enforceable part of this permit. Noncompliance with the O & M Manual shall be deemed a violation of the permit.

Letter/Revised Manual Due: No later than January 10, 2006

6. Flow Requirements

a. 95% Effluent Flow Limitation

Upon three consecutive months with the monthly average effluent flow equal to or greater than 0.38 MGD, the monitoring and reporting requirements of Part I.A.2. of this permit shall become effective on the first of the following month. The permittee shall initiate those monitoring and reporting requirements at that time and notify the DEQ Regional Office with the DMR representing the third consecutive month.

b. 95% Design Capacity Notification

A written notice and a **plan of action** for ensuring continued compliance with the terms of this permit shall be submitted to the DEQ Regional Office when the monthly average flow influent to the sewage treatment plant reaches 95 percent of the design capacity authorized in this permit for each month of any three consecutive month period. The written notice shall be submitted within 30 days and the plan of action shall be received at the DEQ Regional Office **no later than 90 days from the third consecutive month for which the flow reached 95 percent of the design capacity.** The plan shall include the necessary steps and a prompt schedule of implementation for controlling any current or reasonably anticipated problem resulting from high influent flows. Failure to submit an adequate plan in a timely manner shall be deemed a violation of this permit.

7. Compliance Reporting Under Part I.A. and I.B.

a. Quantification Levels

(1) The quantification levels (QL) shall be as follows:

Effluent Characteristic	Quantification Level
Ammonia as N	0.2 mg/l
Total Phosphorus	0.1 mg/l
Orthophosphate	0.1 mg/l
Total Kjeldahl Nitrogen	0.5 mg/l
Nitrate-Nitrite	0.5 mg/l

(2) The permittee may use any approved method which has a QL equal to or lower than the QL listed in a.(1) above. The QL is defined as the lowest concentration used to calibrate a measurement system in accordance with the procedures published for the method.

(3) It is the responsibility of the permittee to ensure that proper QA/QC protocols are followed during the sampling and analytical procedures. QA/QC information shall be documented to confirm that appropriate analytical procedures have been used and the required QLs have been attained.

b. Reporting

(1) **Monthly Average** -- Compliance with the monthly average limitations and/or reporting requirements for the parameters listed in a.(1) above shall be determined as

follows: All concentration data below the specified QL listed in a.(1) above shall be treated as zeros. All concentration data equal to or above the QL shall be treated as reported. An arithmetic average shall be calculated using all reported data, including the defined zeros, for the month. This arithmetic average shall be reported on the DMR as calculated. If all data are below the QL, then the average shall be reported as "<QL". If reporting for quantity is required on the DMR and the calculated concentration is <QL, then report "<QL" for the quantity; otherwise, use the calculated concentration to calculate the quantity.

(2) **Maximum Weekly Average** – Compliance with the weekly average limitations and/or reporting requirements for the parameters listed in a.(1) above shall be determined as follows: All concentration data below the specified QL listed in a.(1) above shall be treated as zeros. All concentration data equal to or above the QL shall be treated as reported. An arithmetic average shall be calculated using all reported data, including the defined zeros, collected within each complete calendar week entirely contained within the reporting month. The maximum value of the weekly averages thus determined shall be reported on the DMR. If all data for each weekly average are below the QL, then the average shall be reported as "<QL". If reporting for quantity is required on the DMR and the calculated concentration for each weekly average is <QL, then report "<QL" for the quantity; otherwise, use the calculated maximum value of the weekly averages to calculate the quantity.

(3) Any single datum required shall be reported as "<QL" if it is less than the QL listed in a.(1) above. Otherwise, the numerical value shall be reported.

8. Materials Handling and Storage

Any and all product, materials, industrial wastes, and/or other wastes resulting from the purchase, sale, mining, extraction, transport, preparation and/or storage of raw or intermediate materials, final product, by-product or wastes, shall be handled, disposed of and/or stored in such a manner so as not to permit a discharge of such product, materials, industrial wastes and/or other wastes to State waters, except as expressly authorized.

9. Effluent Monitoring Frequencies

If the facility permitted herein is issued a Notice of Violation for any of the parameters listed below, then the following effluent monitoring frequencies shall become effective upon written notice from DEQ and remain in effect until permit expiration.

Effluent Parameter	Frequency
BOD_5	3/Week
TSS	3/Week

No other effluent limitations or monitoring requirements are affected by this special condition.

10. Indirect Dischargers

The permittee shall provide adequate notice to the DEQ Regional Office of the following:

a. Any new introduction of pollutants into the treatment works from an indirect discharger which would be subject to Section 301 or 306 of Clean Water Act and the State Water Control Law if it were directly discharging those pollutants; and

b. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of this permit.

Adequate notice shall include information on (i) the quality and quantity of effluent introduced into the treatment works, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the treatment works.

11. Sludge Use and Disposal

The permittee shall conduct all sewage sludge use or disposal activities in accordance with the Sludge Management Plan (SMP) approved with the issuance of this permit. Any **proposed changes** in the sewage sludge use or disposal practices or procedures followed by the permittee shall be documented and **submitted for Department of Environmental Quality and Department of Health approval 90 days prior to the effective date of the changes.** Upon approval, the revised SMP becomes an enforceable part of the permit. The permit may be modified or, alternatively, revoked and reissued to incorporate limitations or conditions necessitated by substantive changes in sewage sludge use or disposal practices.

12. Nutrient Reporting Calculations

For each calendar month, the DMR shall show the total monthly load (kg) and the cumulative load for the calendar year, to date (kg) calculated in accordance with the following formulae.

$ML = ML_{avg} * d$　　where: ML = total monthly load in kg
ML_{avg} = monthly average load as reported on DMR (kg/d)
d = number of discharge days in the calendar month

$AL\text{-}YTD = \Sigma_{(Jan\text{-}current\ month)} ML$　　where: AL-YTD = calendar year-to-date annual load in kg

The total nitrogen load and total phosphorus load for each calendar year (AL) shall be shown on the December DMR due January 10th of the following year.

13. Nutrient Reports

a. Basis of Design Report for Nutrient Removal

A Basis of Design Report addressing the construction and operation of a range of nutrient removal technologies up to and including the limit of technology, shall be submitted to the Department of Environmental Quality. Additional information on the scope and contents of a Basis of Design Report is available from DEQ staff.

Basis of Design Report Due: No later than January 10, 2006

b. Interim Optimization Plan for Nutrient Removal

A report addressing alternatives and interim measures that may be taken to optimize nutrient removal with the existing facilities shall be submitted to the Department of Environmental Quality. The report shall describe alternatives considered and a plan to implement the selected interim measures.

Interim Optimization Plan Due: No later than January 10, 2006

E. PRETREATMENT

1. The permittee's pretreatment program has been approved. The program is an enforceable part of this permit. The permittee shall:

   a. Implement a pretreatment program that complies with the Clean Water Act, Water Control Law, State regulations and the approved program.

   b. Submit to the DEQ Regional Office an annual report that describes the permittee's program activities over the previous year. The annual report shall be submitted no later than January 31 of each year and shall include:

      (1) An updated list of the Significant Industrial Users* showing the categorical standards and local limits applicable to each.

      (2) A summary of the compliance status of each Significant Industrial User with pretreatment standards and permit requirements.

      (3) A summary of the number and types of Significant Industrial User sampling and inspections performed by the POTW.

      (4) All information concerning any interference, upset, VPDES permit or Water Quality Standards violations directly attributable to Significant Industrial Users and enforcement actions taken to alleviate said events.

      (5) A description of all enforcement actions taken against Significant Industrial Users over the previous 12 months.

      (6) A summary of any changes to the submitted pretreatment program that have not been previously reported to the DEQ Regional Office.

      (7) A summary of the permits issued to Significant Industrial Users since the last annual report.

      (8) POTW and self-monitoring results for Significant Industrial Users determined to be in significant non-compliance during the reporting period.

      (9) Results of the POTW's influent/effluent/sludge sampling, not previously submitted to DEQ.

      (10) Copies of newspaper publications of all Significant Industrial Users in significant non-compliance during the reporting period. This is due no later than March 31 of each year.

(11) Signature of an authorized representative.

c. Submit any changes to the approved pretreatment program to the DEQ Regional Office and obtain approval before implementation of the changes.

d. Ensure all Significant Industrial Users' permits are issued and reissued in a timely manner and that the Significant Industrial User permits issued by the POTW are effective and enforceable.

e. Inspect and sample all Significant Industrial Users at a minimum of once a year.

(1) Sampling shall include all regulated parameters, and shall be representative of the wastewater discharged.

(2) Inspection of the Significant Industrial Users shall cover all areas which could result in wastewater discharge to the treatment works including manufacturing, chemical storage, pretreatment facilities, spill prevention and control procedures, hazardous waste generation and Significant Industrial User's self-monitoring and records.

f. Implement the reporting requirements of Part VII of the VPDES Permit Regulation.

g. Review the Enforcement Response Plan (ERP) and ensure it meets state and federal regulatory requirements. The approved ERP is an enforceable part of this permit and shall be implemented.

h. Develop local limits or reevaluate local limits using current influent, effluent and sludge monitoring data and submit the data and results of the evaluation to the DEQ Regional Office within one year of the effective or modification date. All Significant Industrial Users shall be sampled at the end of any categorical process and at the entrance to the treatment works.

i. Ensure that adequate resources are available to implement the approved program.

j. Meet all public participation requirements and annually public notice Significant Industrial Users in significant non-compliance with pretreatment standards and requirements for the previous 12 months.

k. Submit to the DEQ Regional Office a survey of all Industrial Users discharging to the POTW. The information shall be submitted to the POTW on the DEQ's Discharger Survey Form or an equivalent form that includes the quantity and quality of the wastewater. Survey results shall include the identification of significant industrial users of the POTW.

Survey Due: No later than July 10, 2005.

In lieu of the survey, the permittee may elect to develop, submit for approval and implement the plan to continuously survey the industrial community in their jurisdiction.

2. The DEQ may require the POTW to institute changes to its pretreatment program:

a. If the approved program is not implemented in a way satisfying the requirements of the Clean Water Act, Water Control Law or State regulations;

b. If problems such as pass-through, interference, water quality standards violations or sludge contamination develop or continue; and

c. If federal, state or local requirements change.

* A <u>significant industrial user</u> is one that:

- Has a process wastewater (**) flow of 25,000 gallons or more per average workday;
- Contributes a process wastestream which makes up 5-percent or more of the average dry weather hydraulic or organic capacity of the POTW;
- Is subject to the categorical pretreatment standards; or
- Has significant impact, either singularly or in combination with other Significant Dischargers, on the treatment works or the quality of its effluent.

** Excludes sanitary, non-contact cooling water and boiler blowdown.

F. TOXICS MANAGEMENT PROGRAM

1. Biological Monitoring:

a. In accordance with the schedule in 2. below, the permittee shall conduct quarterly acute and chronic toxicity tests for a period of five quarters using 24-hour flow-proportioned composite samples of final effluent from outfall 001.

<u>The acute multi-dilution NOAEC tests to use are:</u>

48 Hour Static Acute test using *Pimephales promelas*
48 Hour Static Acute test using *Ceriodaphnia dubia*

These acute tests are to be conducted using 5 geometric dilutions of effluent with a minimum of 4 replicates, with 5 organisms in each. The NOAEC (No Observed Adverse Effect Concentration), as determined by hypothesis testing, shall be reported converted to TU_a (100/NOAEC). The LC_{50} should also be determined and noted on the submitted report. Tests in which control survival is less than 90% are not acceptable.

<u>The chronic tests to use are:</u>

Chronic 7-Day Static Renewal Survival and Growth Test using *Pimephales promelas*
Chronic 3-Brood Static Renewal Survival and Reproduction Test using *Ceriodaphnia dubia*

These chronic tests shall be conducted in such a manner and at sufficient dilutions (minimum of five dilutions, derived geometrically) to determine the "No Observed Effect Concentration" (NOEC) for survival and reproduction or growth. Results which cannot be determined (i.e., a "less than" NOEC value) are not acceptable, and a retest will have to be performed. Express the test NOEC as TU_c (Chronic Toxic Units), by dividing 100/NOEC for DMR reporting. Report the LC_{50} at 48 hours and the IC_{25} with the NOEC's in the test report.

The permittee may provide additional acute and/or chronic tests to address data variability during the period of data generation. These data shall be reported and may be included in the evaluation of effluent toxicity. Test procedures and reporting shall be in accordance with the

WET testing methods cited in 40 CFR 136.3

b. The test dilutions should be able to determine compliance with the following endpoints:

(1) Acute NOAEC of 100% effluent equivalent to a TU_a of 1.0

(2) Chronic NOEC of 78% effluent equivalent to a TU_c of 1.28

c. All toxicity test data will be evaluated by STATS.EXE for reasonable potential at the conclusion of the test period. The data may be evaluated sooner if requested by the permittee, or if toxicity has been noted. Should evaluation of the data indicate that a limit is needed, a WET limit and compliance schedule will be required and the toxicity tests of 1.a. may be discontinued.

d. If after evaluating the data, it is determined that no limit is needed, the permittee shall continue acute and chronic toxicity testing (both species) of the outfall annually, as on the reporting schedule in 2.

e. All applicable data will be reevaluated for reasonable potential at the end of the permit term.

2. Reporting Schedule:

The permittee shall supply 1 copy of the toxicity test reports specified in this Toxics Management Program in accordance with the following schedule:

Period	Compliance Periods	DMR/Report Submission Dates
1st quarter	January 1 – March 31, 2005	April 10, 2005
2nd quarter	April 1 - June 30, 2005	July 10, 2005
3rd quarter	July 1 - September 30, 2005	October 10, 2005
4th quarter	October 1 - December 31, 2005	January 10, 2006
5th quarter	January 1 – March 31, 2006	April 10, 2006
1st Annual	April 1 – December 31, 2006	January 10, 2007
2nd Annual	January 1 – December 31, 2007	January 10, 2008
3rd Annual	January 1 – December 31, 2008	January 10, 2009
4th Annual	January 1 – September 30, 2009	October 10, 2009

CONDITIONS APPLICABLE TO ALL VPDES PERMITS

A. Monitoring

1. Samples and measurements taken as required by this permit shall be representative of the monitored activity.

2. Monitoring shall be conducted according to procedures approved under Title 40 Code of Federal Regulations Part 136 or alternative methods approved by the U.S. Environmental Protection Agency, unless other procedures have been specified in this permit.

3. The permittee shall periodically calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals that will insure accuracy of measurements.

B. Records

1. Records of monitoring information shall include:

   a. The date, exact place, and time of sampling or measurements;

   b. The individual(s) who performed the sampling or measurements;

   c. The date(s) and time(s) analyses were performed;

   d. The individual(s) who performed the analyses;

   e. The analytical techniques or methods used; and

   f. The results of such analyses.

2. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years, the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period of retention shall be extended automatically during the course of any unresolved litigation regarding the regulated activity or regarding control standards applicable to the permittee, or as requested by the Board.

C. Reporting Monitoring Results

1. The permittee shall submit the results of the monitoring required by this permit not later than the 10th day of the month after monitoring takes place, unless another reporting schedule is specified elsewhere in this permit. Monitoring results shall be submitted to:

   Virginia Department of Environmental Quality
   South Central Regional Office
   7705 Timberlake Road
   Lynchburg, Virginia 24502

2. Monitoring results shall be reported on a Discharge Monitoring Report (DMR) or on forms provided, approved or specified by the Department.

3. If the permittee monitors any pollutant specifically addressed by this permit more frequently than required by this permit using test procedures approved under Title 40 of the Code of Federal Regulations Part 136 or using other test procedures approved by the U.S. Environmental Protection Agency or using procedures specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or reporting form specified by the Department.

4. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this permit.

D. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Board may require the permittee to furnish, upon request, such plans, specifications, and other pertinent information as may be necessary to determine the effect of the wastes from his discharge on the quality of state waters, or such other information as may be necessary to accomplish the purposes of the State Water Control Law. The permittee shall also furnish to the Department upon request, copies of records required to be kept by this permit.

E. Compliance Schedule Reports

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

Unauthorized Discharges

Except in compliance with this permit, or another permit issued by the Board, it shall be unlawful for any person to:

1. Discharge into state waters sewage, industrial wastes, other wastes, or any noxious or deleterious substances; or

2. Otherwise alter the physical, chemical or biological properties of such state waters and make them detrimental to the public health, or to animal or aquatic life, or to the use of such waters for domestic or industrial consumption, or for recreation, or for other uses.

G. Reports of Unauthorized Discharges

Any permittee who discharges or causes or allows a discharge of sewage, industrial waste, other wastes or any noxious or deleterious substance into or upon state waters in violation of Part II F; or who discharges or causes or allows a discharge that may reasonably be expected to enter state waters in violation of Part II F, shall notify the Department of the discharge immediately upon discovery of the discharge, but in no case later than 24 hours after said discovery. A written report of the unauthorized discharge shall be submitted to the Department, within five days of discovery of the discharge. The written report shall contain:

1. A description of the nature and location of the discharge;
2. The cause of the discharge;
3. The date on which the discharge occurred;
4. The length of time that the discharge continued;
5. The volume of the discharge;
6. If the discharge is continuing, how long it is expected to continue;
7. If the discharge is continuing, what the expected total volume of the discharge will be; and

8. Any steps planned or taken to reduce, eliminate and prevent a recurrence of the present discharge or any future discharges not authorized by this permit.

Discharges reportable to the Department under the immediate reporting requirements of other regulations are exempted from this requirement.

H. Reports of Unusual or Extraordinary Discharges

If any unusual or extraordinary discharge including a bypass or upset should occur from a treatment works and the discharge enters or could be expected to enter state waters, the permittee shall promptly notify, in no case later than 24 hours, the Department by telephone after the discovery of the discharge. This notification shall provide all available details of the incident, including any adverse affects on aquatic life and the known number of fish killed. The permittee shall reduce the report to writing and shall submit it to the Department within five days of discovery of the discharge in accordance with Part II I 2. Unusual and extraordinary discharges include but are not limited to any discharge resulting from:

1. Unusual spillage of materials resulting directly or indirectly from processing operations;
2. Breakdown of processing or accessory equipment;
3. Failure or taking out of service some or all of the treatment works; and
4. Flooding or other acts of nature.

I. Reports of Noncompliance

The permittee shall report any noncompliance which may adversely affect state waters or may endanger public health.

1. An oral report shall be provided within 24 hours from the time the permittee becomes aware of the circumstances. The following shall be included as information which shall be reported within 24 hours under this paragraph:

   a. Any unanticipated bypass; and
   b. Any upset which causes a discharge to surface waters.

2. A written report shall be submitted within 5 days and shall contain:

   a. A description of the noncompliance and its cause;
   b. The period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and
   c. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

   The Board may waive the written report on a case-by-case basis for reports of noncompliance under Part II I if the oral report has been received within 24 hours and no adverse impact on state waters has been reported.

3. The permittee shall report all instances of noncompliance not reported under Parts II I 1 or 2, in writing, at the time the next monitoring reports are submitted. The reports shall contain the information listed in Part II I 2.

NOTE: The immediate (within 24 hours) reports required in Parts II G, H and I may be made to the Department's Regional Office at (434) 582-5120 (voice) or (434) 582-5125 (fax). For reports outside normal working hours, leave a message and this shall fulfill the immediate reporting requirement. For emergencies, the Virginia Department of Emergency Services maintains a 24 hour telephone service at 1-800-468-8892.

J. Notice of Planned Changes

1. The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

   a. The permittee plans alteration or addition to any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced:

      (1) After promulgation of standards of performance under Section 306 of Clean Water Act which are applicable to such source; or

      (2) After proposal of standards of performance in accordance with Section 306 of Clean Water Act which are applicable to such source, but only if the standards are promulgated in accordance with Section 306 within 120 days of their proposal;

   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations nor to notification requirements specified elsewhere in this permit; or

   c. The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

2. The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

K. Signatory Requirements

1. Applications. All permit applications shall be signed as follows:

   a. For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

   b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

   c. For a municipality, state, federal, or other public agency: By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a public agency includes: (i) The chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

2. Reports, etc. All reports required by permits, and other information requested by the Board shall be signed by a person described in Part II K 1, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described in Part II K 1;

b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.); and

c. The written authorization is submitted to the Department.

3. Changes to authorization. If an authorization under Part II K 2 is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part II K 2 shall be submitted to the Department prior to or together with any reports, or information to be signed by an authorized representative.

4. Certification. Any person signing a document under Parts II K 1 or 2 shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

L. Duty to Comply

The permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the State Water Control Law and the Clean Water Act, except that noncompliance with certain provisions of this permit may constitute a violation of the State Water Control Law but not the Clean Water Act. Permit noncompliance is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act within the time provided in the regulations that establish these standards or prohibitions or standards for sewage sludge use or disposal, even if this permit has not yet been modified to incorporate the requirement.

M. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall apply for and obtain a new permit. All permittees with a currently effective permit shall submit a new application at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the Board. The Board shall not grant permission for applications to be submitted later than the expiration date of the existing permit.

N. Effect of a Permit

This permit does not convey any property rights in either real or personal property or any exclusive privileges, nor does it authorize any injury to private property or invasion of personal rights, or any infringement of federal, state or local law or regulations.

O. State Law

Nothing in this permit shall be construed to preclude the institution of any legal action under, or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any other state law or regulation or under authority preserved by Section 510 of the Clean Water Act. Except as provided in permit conditions on "bypassing" (Part II U), and "upset" (Part II V) nothing in this permit shall be construed to relieve the permittee from civil and criminal penalties for noncompliance.

P. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Sections 62.1-44.34:14 through 62.1-44.34:23 of the State Water Control Law.

Q. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes effective plant performance, adequate funding, adequate staffing, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by the permittee only when the operation is necessary to achieve compliance with the conditions of this permit.

R. Disposal of solids or sludges

Solids, sludges or other pollutants removed in the course of treatment or management of pollutants shall be disposed of in a manner so as to prevent any pollutant from such materials from entering state waters.

S. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

T. Need to Halt or Reduce Activity not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

U. Bypass

1. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Parts II U 2 and U 3.

2. Notice

   a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, prior notice shall be submitted, if possible at least ten days before the date of the bypass.

   b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Part II I.

3. Prohibition of bypass.

   a. Bypass is prohibited, and the Board may take enforcement action against a permittee for bypass, unless:

(1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(3) The permittee submitted notices as required under Part II U 2.

b. The Board may approve an anticipated bypass, after considering its adverse effects, if the Board determines that it will meet the three conditions listed above in Part II U 3 a.

V. Upset

1. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of Part II V 2 are met. A determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is not a final administrative action subject to judicial review.

2. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;

   b. The permitted facility was at the time being properly operated;

   c. The permittee submitted notice of the upset as required in Part II I; and

   d. The permittee complied with any remedial measures required under Part II S.

3. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

W. Inspection and Entry

The permittee shall allow the Director, or an authorized representative, upon presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act and the State Water Control Law, any substances or parameters at any location.

For purposes of this section, the time for inspection shall be deemed reasonable during regular business hours, and whenever the facility is discharging. Nothing contained herein shall make an inspection unreasonable during an emergency.

X. Permit Actions

Permits may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

Y. Transfer of permits

1. Permits are not transferable to any person except after notice to the Department. Except as provided in Part II Y 2, a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued, or a minor modification made, to identify the new permittee and incorporate such other requirements as may be necessary under the State Water Control Law and the Clean Water Act.

2. As an alternative to transfers under Part II Y 1, this permit may be automatically transferred to a new permittee if:

   a. The current permittee notifies the Department at least 30 days in advance of the proposed transfer of the title to the facility or property;

   b. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

   c. The Board does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in Part II Y 2 b.

Severability

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

APPENDIX 10
OXIDATION DITCH EXAMPLE CALCULATIONS
RUTLEDGE CREEK WWTP

Calculation of Sludge Retention Time, SRT

$$\text{SRT} = \frac{\text{Mass of Sludge Within Aeration Basins}}{\text{Wasted Sludge} + \text{Sludge Influent}}$$

A. <u>Data</u>

Volume of Aeration Basin	0.6 MG
MLSS	3,500 mg/l
Flow	0.6 MGD
BOD-influent	140 mg/l
BOD – Effluent	7 mg/l

Assume sludge yield of 1.0 lbs TSS/lbs BOD and Effluent TSS Conc. = 10 mg/l
Waste Sludge, WAS = [0.6 MGD x 8.34 x (140 mg/l -10 mg/l) x 1.0 lbs TSS/lb BOD]
= 650 lbs/day
Effluent TSS Load = 0.6 MGD x 10 mg/l x 8.34 = 50 lbs/day

<u>Calculation</u>

SRT = 0.6 x 3,500 x 8.34/(650 + 50) = 25 days

NOTE: Typically if TSS in effluent is ≤ 10 mg/l, the mass of sludge leaving in the effluent is small compared to WAS sludge and can therefore be neglected in SRT calculations.

Calculation of Oxic Sludge Mass

A. <u>Data</u>

B & H Phase Length	90 min.	1 ditch oxic, 1 ditch settling
D & J Phase Length	90 min	1 ditch oxic, 1 ditch settling
E & K Phase Length	30 min.	both ditches settling
F & L Phase Length	30 min	both ditches settling

<u>Calculation</u>

$$\text{Oxic Sludge Mass} = \frac{\text{Oxic Operational Time}}{\text{Total Operational Time}}$$

Consequently, the oxic SRT is 0.38 x Total SRT as calculated in 7.1 above.

Oxic SRT = 0.38 x 25 days = 9.5 days

$$= \frac{(1 \text{ x } 90 + 1 \text{ x } 90 + 0 \text{ x } 60 + 0 \text{ x } 60)}{(2 \text{ x } 90 + 2 \text{ x } 90 + 2 \text{ x } 30 + 2 \text{ x } 30)} = 0.38 = 38\% \text{ of total}$$

Calculation of Sludge Wasting

NOTE: The calculations assume wasting occurs during oxic phases (MLSS wasting)

Data

WAS flow	0.02 MGD
TSS concentration	4,000 mg/I

Calculation

WAS = 0.02 MG x 4,000 mg/I x 8.34 = 667 Ibs/day

Data

WAS to be wasted	650 Ibs/day
Typical WAS concentration	4,000 mg/I

Calculation

WAS flow = 650/(4,000 x 8.34) = 0.0195 MGD

Wasting 0.0195 MGD or 19,500 gpd in 6 even intervals equals

$$\frac{19{,}500 \text{ gpd}}{6 \dfrac{\text{intervals}}{\text{day}}} = 3{,}250 \frac{\text{gal}}{\text{interval}}$$

Data

SRT Target (oxic)	12 days
Volume of Aeration Basins	0.6 MG
MLSS	3,500 mg/l

Neglect TSS in effluent

Calculation

SRT_{TOTAL} = SRT_{oxic} / Rotor Operating Time

= 12 days/0.38

= 31 days

Calculation

SRT = Sludge Mass / WAS

31 = (0.6 MG x 3,500 mg/I x 8.34) / (WAS Ibs/day)

31 = 17,514 / WAS

WAS = 17,514 / 31 = 564 lbs/day

Raw Influent Daily Testing

Month / Year

Sunday

Sampling and Analyses By:

Sampling Time and Sample Volume (Flow in gpm = volume in ml)

Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

pH Sample Time:

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su

In Situ Testing Results

Temp, c	DO, mg/L

Sample Holding Bottle ID : Raw BOD / TSS

Notations:

Monday

Sampling and Analyses By:

Sampling Time and Sample Volume (Flow in gpm = volume in ml)

Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

pH Sample Time:

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su

In Situ Testing Results

Temp, c	DO, mg/L

Sample Holding Bottle ID : Raw BOD / TSS

Notations:

Tuesday

Sampling and Analyses By:

Sampling Time and Sample Volume (Flow in gpm = volume in ml)

Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

pH Sample Time:

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su

In Situ Testing Results

Temp, c	DO, mg/L

Sample Holding Bottle ID : Raw BOD / TSS

Notations:

Wednesday

Sampling and Analyses By:

Sampling Time and Sample Volume (Flow in gpm = volume in ml)

Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

pH Sample Time:

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su

In Situ Testing Results

Temp, c	DO, mg/L

Sample Holding Bottle ID : Raw BOD / TSS

Notations:

Thursday

Sampling and Analyses By:

Sampling Time and Sample Volume (Flow in gpm = volume in ml)

Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

pH Sample Time:

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su

In Situ Testing Results

Temp, c	DO, mg/L

Sample Holding Bottle ID : Raw BOD / TSS

Notations:

Friday

Sampling and Analyses By:

Sampling Time and Sample Volume (Flow in gpm = volume in ml)

Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

pH Sample Time:

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su

In Situ Testing Results

Temp, c	DO, mg/L

Sample Holding Bottle ID : Raw BOD / TSS

Notations:

Saturday

Sampling and Analyses By:

Sampling Time and Sample Volume (Flow in gpm = volume in ml)

Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

pH Sample Time:

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su

In Situ Testing Results

Temp, c	DO, mg/L

Sample Holding Bottle ID : Raw BOD / TSS

Notations:

Dissolved Oxygen, Temperature, pH, Solids Testing by Standard Methods, 18th Edition - 4500 O G, 2550 B, and 4500 H B, 2710 C

Oxidation Ditch 1 Daily Testing

Month / Year

Sunday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 1

pH Test Started: :
pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Monday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 1

pH Test Started: :
pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Tuesday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 1

pH Test Started: :
pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Wednesday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 1

pH Test Started: :
pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Thursday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 1

pH Test Started: :
pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Friday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 1

pH Test Started: :
pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Saturday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 1

pH Test Started: :
pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Dissolved Oxygen, Temperature, pH, Solids Testing by Standard Methods, 18th Edition - 4500 O G, 2550 B, and 4500 H B, 2710 C

Town of Amherst
Department of Wastewater
Rutledge Creek Facility
448 Industrial Drive
Amherst, Virginia

BOD5 ANALYSIS BENCH SHEET

	Blanks		BOD Seed Inoculum			GGA			Plant Effluent					Plant Influent			
A) Bottle Number																	
B) Bottle Volume	300 ml	300 ml	300 ml	300 ml	300 ml	300 ml	300 ml		300 ml	300 ml	300 ml	300 ml	300 ml	300 ml	300 ml	300 ml	300 ml
C) Sample Volume			10 ml	15 ml	20 ml	6 ml	6 ml		20 ml	120 ml	190 ml	220 ml	290 ml	5 ml	10 ml		
D) Seed Volume						2 ml	2 ml		2 ml	2 ml	2 ml	2 ml	2 ml				
E) Initial DO	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
F) Final DO	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
G) Depletion (E-F)	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
H) Seed Depletion (G/C)			mg/L	mg/L	mg/L												
I) Average Seed Depletion				mg/L													
J) Seed Correction (DxI)						mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L			mg/L	mg/L
K) Corrected Depletion (G-J)						mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L) Dilution Factor (B/C)						50.0 mg/L	50.0 mg/L		15.0 mg/L	2.5 mg/L	1.6 mg/L	1.4 mg/L	1.0 mg/L	60.0 mg/L	30.0 mg/L	mg/L	mg/L
M) BOD5 (KxL)						mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
N) Average BOD5											mg/L			mg/L		mg/L	
O) Initial Temperature	c	c	c	c	c	c	c		c	c	c	c	c	c	c	c	c
P) Final Temperature	c	c	c	c	c	c	c		c	c	c	c	c	c	c	c	c

Parameter: Biochemical Oxygen Demand (BOD5)
Method: Dissolved Oxygen Depletion
Method of Analysis: 18th Edition of Standard Methods, 5210 - B

Parameter: Dissolved Oxygen
Method: Electrode
Method of Analysis: 18th Edition of Standard Methods, 4500 - O - G

Parameter: Hydrogen Ion (pH)
Method: Electrometric
Method of Analysis: 18th Edition of Standard Methods, 4500 - H - B

Parameter: Temperature
Method: Thermometric
Method of Analysis: 18th Edition of Standard Methods, 2550 - B

Test Prep Information

Dilution Water Prep Date: - 06
Prep Time: :
Distilled Water Lab Code: ______
Nutrient Buffer (3L) Lab Code: ______
Nutrient Buffer (300ml) Lab Code: ______

Seed Inoculum Prep Date: - 06
Prep Time: :
Seed Inoculum Lab Code: ______

GGA BOD Standard Prep Date: - 06
Prep Time: :
BOD Standard Lab Code: ______

Dilution Water Temp / pH Check
Date: - 06
Start Time: :
End Time: :
Temp (C): ______
pH (su): ______

Sampling Information

Plant Effluent Sampling Date: - 06
Sample Type: Composite
Duration (Hours): 8 HR 24 HR
Sample Volume By: FLOW
Sampling Started: :
Sampling Ended: :

Plant Influent Sampling Date: - 06
Sample Type: Composite
Duration (Hours): 8 HR 24 HR
Sample Volume By: FLOW
Sampling Started: :
Sampling Ended: :

-
Sampling Date: 06
Sample Type: Composite
Duration (Hours): 8 HR 24 HR
Sample Volume By: FLOW
Sampling Started: :
Sampling Ended: :

Sample Temp Post Holding

Time: :
Temp (C): ______

Time: :
Temp (C): ______

Time: :
Temp (C): ______

Sample Temp / pH Post Warming for Testing

Start Time: :
End Time: :
Temp (C): ______
pH (su): ______

Start Time: :
End Time: :
Temp (C): ______
pH (su): ______

Start Time: :
End Time: :
Temp (C): ______
pH (su): ______

Initial BOD5 Analysis

Analyst Performing Initial Set Up/Analysis: ______
5 Day Incubation Start Date: - 06
5 Day Incubation Start Time: ___:___
Incubator Temperature (C): ______

Final BOD5 Analysis

Analyst Performing Final Analysis: ______
5 Day Incubation End Date: - 06
5 Day Incubation End Time: ___:___
Incubator Temperature (C): ______

Oxidation Ditch 2 Daily Testing

Month / Year

Sunday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 2

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Monday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 2

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Tuesday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 2

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Wednesday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 2

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Thursday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 2

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Friday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 2

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Saturday

Sampling and Analyses By:

Sample Time: :

Process Phase / Min: /

Sample Bottle ID: OD 2

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	DO, mg/L

Settled Sludge Test Started: :

5 Min	15 Min	30 Min
:	:	:
ml	ml	ml

Notations:

Dissolved Oxygen, Temperature, pH, Solids Testing by Standard Methods, 18th Edition - 4500 O G, 2550 B, and 4500 H B, 2710 C

Plant Effluent Daily Testing

Month / Year

Sunday

Sampling Time and Sample Volume (Flow in gpm = volume in ml)							
Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

Sampling and Analyses By:

pH Sample Time: :

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	Turb, NTU	In Situ Testing Results	Temp, c	DO, mg/L

Sample Holding Bottle ID : Eff BOD / Eff TSS

Notations:

Monday

Sampling Time and Sample Volume (Flow in gpm = volume in ml)							
Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

Sampling and Analyses By:

pH Sample Time: :

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	Turb, NTU	In Situ Testing Results	Temp, c	DO, mg/L

Sample Holding Bottle ID : Eff BOD / Eff TSS

Notations:

Tuesday

Sampling Time and Sample Volume (Flow in gpm = volume in ml)							
Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

Sampling and Analyses By:

pH Sample Time: :

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	Turb, NTU	In Situ Testing Results	Temp, c	DO, mg/L

Sample Holding Bottle ID : Eff BOD / Eff TSS

Notations:

Wednesday

Sampling Time and Sample Volume (Flow in gpm = volume in ml)							
Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

Sampling and Analyses By:

pH Sample Time: :

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	Turb, NTU	In Situ Testing Results	Temp, c	DO, mg/L

Sample Holding Bottle ID : Eff BOD / Eff TSS

Notations:

Thursday

Sampling Time and Sample Volume (Flow in gpm = volume in ml)							
Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

Sampling and Analyses By:

pH Sample Time: :

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	Turb, NTU	In Situ Testing Results	Temp, c	DO, mg/L

Sample Holding Bottle ID : Eff BOD / Eff TSS

Notations:

Friday

Sampling Time and Sample Volume (Flow in gpm = volume in ml)							
Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

Sampling and Analyses By:

pH Sample Time: :

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	Turb, NTU	In Situ Testing Results	Temp, c	DO, mg/L

Sample Holding Bottle ID : Eff BOD / Eff TSS

Notations:

Saturday

Sampling Time and Sample Volume (Flow in gpm = volume in ml)							
Tag 1	Tag 2	Tag 3	Tag 4	Tag 5	Tag 6	Tag 7	Tag 8
:	:	:	:	:	:	:	:
ml	ml	ml	ml	ml	ml	ml	ml

Sampling and Analyses By:

pH Sample Time: :

pH Test Started: :

pH Test Ended: :

Temp, c	pH, su	Turb, NTU	In Situ Testing Results	Temp, c	DO, mg/L

Sample Holding Bottle ID : Eff BOD / Eff TSS

Notations:

Dissolved Oxygen, Temperature, pH, Solids Testing by Standard Methods, 18th Edition - 4500 O G, 2550 B, and 4500 H B, 2710 C

Daily Metered Readings

Month / Year

Date	DOTW	Raw Influent Flow Daily Meter Reading	Final Effluent Flow Daily Meter Reading	WAS Flow Daily Meter Reading	Precipitation		Air Temperature- C	
					Liquid Inch	In The Form Of	Daily Low	Daily High
1		00	.		.			
2		00	.		.			
3		00	.		.			
4		00	.		.			
5		00	.		.			
6		00	.		.			
7		00	.		.			
8		00	.		.			
9		00	.		.			
10		00	.		.			
11		00	.		.			
12		00	.		.			
13		00	.		.			
14		00	.		.			
15		00	.		.			
16		00	.		.			
17		00	.		.			
18		00	.		.			
19		00	.		.			
20		00	.		.			
21		00	.		.			
22		00	.		.			
23		00	.		.			
24		00	.		.			
25		00	.		.			
26		00	.		.			
27		00	.		.			
28		00	.		.			
29		00	.		.			
30		00	.		.			
31		00	.		.			

Town of Amherst
Department of Wastewater
Rutledge Creek Facility
448 Industrial Drive
Amherst, Virginia

Solids Testing

Analyses By: Standard Methods, 18th Edition -- Methods 2540 D and 2540 E

See Laboratory Manual for Solids Testing Formulas

Plant Final Effluent -- Permit Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Blank		mg		ml		mg		mg
Effluent		mg		ml		mg		mg
Effluent		mg		ml		mg		mg

Plant Final Effluent -- Permit Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Blank		mg		ml		mg		mg
Effluent		mg		ml		mg		mg
Effluent		mg		ml		mg		mg

Plant Final Effluent -- Permit Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Blank		mg		ml		mg		mg
Effluent		mg		ml		mg		mg
Effluent		mg		ml		mg		mg

Plant Final Effluent -- Permit Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Blank		mg		ml		mg		mg
Effluent		mg		ml		mg		mg
Effluent		mg		ml		mg		mg

Plant Final Effluent -- Permit Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Blank		mg		ml		mg		mg
Effluent		mg		ml		mg		mg
Effluent		mg		ml		mg		mg

Town of Amherst

Department of Wastewater

Rutledge Creek Facility

448 Industrial Drive

Amherst, Virginia

Solids Testing

Analyses By: Standard Methods, 18th Edition -- Methods 2540 D and 2540 E

See Laboratory Manual for Solids Testing Formulas

Plant Oxidation Ditches 1 and 2 -- Daily Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
OD # 1		mg		ml		mg		mg
OD # 2		mg		ml		mg		mg

Plant Oxidation Ditches 1 and 2 -- Daily Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
OD # 1		mg		ml		mg		mg
OD # 2		mg		ml		mg		mg

Plant Oxidation Ditches 1 and 2 -- Daily Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
OD # 1		mg		ml		mg		mg
OD # 2		mg		ml		mg		mg

Plant Oxidation Ditches 1 and 2 -- Daily Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
OD # 1		mg		ml		mg		mg
OD # 2		mg		ml		mg		mg

Plant Oxidation Ditches 1 and 2 -- Daily Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
OD # 1		mg		ml		mg		mg
OD # 2		mg		ml		mg		mg

Plant Oxidation Ditches 1 and 2 -- Daily Solids Testing

Sample Date:
Analyses Date:
Analyses By:

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
OD # 1		mg		ml		mg		mg
OD # 2		mg		ml		mg		mg

Town of Amherst
Department of Wastewater
Rutledge Creek Facility
448 Industrial Drive
Amherst, Virginia

Solids Testing

Analyses By: Standard Methods, 18th Edition -- Methods 2540 D and 2540 E

See Laboratory Manual for Solids Testing Formulas

Plant Raw Influent -- Solids Testing

Sample Date:			
Analyses Date:			
Analyses By:			

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Raw Inf		mg		ml		mg		mg

Plant Raw Influent -- Solids Testing

Sample Date:			
Analyses Date:			
Analyses By:			

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Raw Inf		mg		ml		mg		mg

Plant Raw Influent -- Solids Testing

Sample Date:			
Analyses Date:			
Analyses By:			

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Raw Inf		mg		ml		mg		mg

Plant Raw Influent -- Solids Testing

Sample Date:			
Analyses Date:			
Analyses By:			

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Raw Inf		mg		ml		mg		mg

Plant Raw Influent -- Solids Testing

Sample Date:			
Analyses Date:			
Analyses By:			

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Raw Inf		mg		ml		mg		mg

Plant Raw Influent -- Solids Testing

Sample Date:			
Analyses Date:			
Analyses By:			

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Raw Inf		mg		ml		mg		mg

Plant Raw Influent -- Solids Testing

Sample Date:			
Analyses Date:			
Analyses By:			

Sample	P / F Number	(a) Pan/Filter Weight	Vac Time Start/End	Sample Volume	Dry Time Start/End	(b) Dried Weight	Burn Time Start/End	(c) Burn Weight
Raw Inf		mg		ml		mg		mg

BASIS OF DESIGN REPORT

RUTLEDGE CREEK
WASTEWATER TREATMENT PLANT

TOWN OF AMHERST, VIRGINIA

PREPARED BY

ENGINEERS
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WWA Project No. 204232.07

Page

EXECUTIVE SUMMARY

The Virginia State Water Control Board's approval of new Water Quality Standards for the Chesapeake Bay and passage of legislation establishing the Chesapeake Bay Watershed Nutrient Credit Exchange Program has created new requirements for significant dischargers in the Chesapeake Bay's watershed.

The Town of Amherst owns and operates the Rutledge Creek Wastewater Treatment Plant (VPDES No. VA0031321). The facility is identified as a significant discharger to the James River Basin. According to the approved Water Quality Management Program Regulations, the Rutledge Creek WWTP has an allocated total nitrogen concentration of 6 mg/L and a total phosphorus allocation of 0.5 mg/L at its current design capacity of 0.6 MGD. At full capacity this equates to a Waste Load Allocation (WLA) of 10,964 lbs/yr of total nitrogen, and 913 lbs/yr of total phosphorus.

These limits have not been incorporated into individual Virginia Pollutant Discharge Elimination System (VPDES) permits, but it is anticipated they will be in place by 2006 through general permit. According to its existing VPDES permit, the Rutledge Creek WWTP is required to monitor nutrients and submit a Basis of Design (BoD) Report to DEQ by January 10, 2006.

The BoD report is to address the construction and operation of a range of nutrient removal technologies up to and including the limits of technology. The range of nutrient removal technologies is separated into four levels, or tiers. The BoD report will enable the Town of Amherst to make informed decisions on the approach to complying with the nutrient loads allocated to the Rutledge Creek WWTP. The BoD report is also designed to assist in decisions on upgrade schedules and nutrient trading issues that may arise under the watershed group permit.

Rutledge Creek WWTP currently receives an average daily flow of approximately 0.35 MGD. The Rutledge Creek WWTP was designed to treat an average daily flow of 0.6 MGD.

Effluent monitoring results from January to August 2005 were obtained and analyzed as part of the BoD report. Also, a testing protocol was developed and executed in October and November 2005 to further understand the waste load entering and leaving the facility. The sampling protocol called for consecutive days of testing in October and November on the influent, effluent, and waste streams of the treatment plant.

Process control testing was performed as part of the sampling protocol to gauge performance of the D-ditch system. These tests were completed to help identify any limiting factors, insufficiencies, and to aide in identifying process adjustments to maximize treatment efficiency.

Analysis of the monitoring results and testing protocol shows that the facility, on average, has produced a low nutrient effluent, with a TP of less than 1.0 mg/L and a TN of approximately 4.0 mg/L.

The Town of Amherst completed a facility upgrade in 2005 increasing the plant capacity from 0.4 MGD to 0.6 MGD. The upgrade consisted of installing a Kruger Double Ditch system. The existing D-Ditch system is a non-conventional oxidation ditch type of reactor, similar to a sequencing batch reactor in the fact that it is a self-contained process that operates in phases without the use of clarifiers. Given the uniqueness of the D-Ditch, the most feasible alternatives for upgrading the process will incorporate the existing treatment technology. The D-Ditch manufacturer (Kruger) assisted in the development of the alternatives for enhanced nutrient removal discussed in this section.

The identified alternatives are presented below in Table E-1. The alternatives were identified to achieve the four treatment tiers defined by the Chesapeake Bay Program. A fifth alternative was developed to meet the approved waste load allocation for the Rutledge Creek WWTP. Capital costs and operations and maintenance (O&M) cost increases were generated and are also presented.

Table E-1: Alternative Cost Summary

Alternative	WWTP Improvements					Effluent Limits (TN/TP)	Estimated Capital Cost	Estimated O&M Cost Increase ($/year)
	STAC	Alum	Clarifiers	Anaerobic Selector	Secondary Anoxic			
Tier 1	☑					8/-	$250,000	$18,000
Tier 2	☑	☑				8/1	$500,000	$80,000
WLA	☑	☑	☑			6/0.5	$2,500,000	$96,000
Tier 3	☑	☑	☑	☑	☑	4/0.3	$3,500,000	$126,000
Tier 4	☑	☑	☑	☑	☑	3/0.1	$3,500,000	$126,000

At a minimum, the Town of Amherst will be required to design and construct the WLA Alternative identified above to comply with the effluent nutrient requirements recently adopted.

At the current flow rates, and given the effluent monitoring results reported, it is apparent that the Rutledge Creek WWTP is presently meeting average effluent TN concentration below 6 mg/L. As the influent wastewater flow rates increase, the plant will not be able to achieve compliance for TN. Also, since the existing effluent TP concentrations are approximately 1.0 mg/L, the facility will need the upgrade as soon as the 0.5 mg/L limit for TP is put into place.

Consideration should be given to the design and construction of the Tier 3 Improvements. The same treatment processes have been identified to meet Tier 3 and Tier 4 nutrient limits. From a permit perspective we believe the identified improvements will consistently meet the Tier 3 limits. Tier 4 limits, specifically TP (0.1 mg/L), will be more difficult to meet on a consistent basis since they are considered the limits of technology.

The construction of Tier 3 improvements may provide opportunities in the form of nutrient exchange with other facilities located in the Upper James River Basin (based on current developing rules), or could provide higher levels of treatment necessary to the Town of Amherst in the future.

Recent developments by the Department of Environmental Quality indicate that the new limits will be placed into existing permits through the Watershed General Permit. This will likely be enacted in 2006, and will supercede any existing schedules or requirements. Final schedules have not been released to date, however preliminary discussions indicate that the Rutledge Creek WWTP will be required to meet the WLAs by December 2010.

The Water Quality Improvement Fund (WQIF) was established as a result of action taken by the Virginia General Assembly in 1997. The fund was established in response to the need to finance nutrient reduction projects in the Chesapeake Bay Watershed. It is recommended that the Town of Amherst pursue financial assistance through the WQIF for the Tier 3 improvements identified in this report.

Based on discussions with DEQ, it is apparent that if grant money is approved and used for Tier 3 improvements, then the Rutledge Creek WWTP will be required through a technical performance standpoint to comply with Tier 3 effluent nutrient requirements (TN = 4mg/L, TP = 0.3 mg/L). These effluent nutrient requirements would then be incorporated into the VPDES permit during the next renewal cycle.

SECTION 1 – INTRODUCTION

1.1 Background

A large portion of the Chesapeake Bay and its tributaries are listed as impaired on Virginia's 303(d) list. These waters are cited for not meeting the aquatic life use support goal. One of the main reasons for this is the number of nutrient (nitrogen and phosphorus) rich tributaries flowing into the Bay.

The Virginia State Water Control Board's approval of new Water Quality Standards for the Chesapeake Bay and passage of legislation establishing the Chesapeake Bay Watershed Nutrient Credit Exchange Program has created new requirements for significant dischargers in the Chesapeake Bay's watershed. Final limits for the Upper James River Basin are established as 6 mg/L for total nitrogen (TN) and 0.5 mg/L of total phosphorus (TP) for most dischargers on the significant discharger list. These limits have not been incorporated into individual Virginia Pollutant Discharge Elimination System (VPDES) permits, but it is anticipated they will be in place by 2006 through general permit. Even though not all requirements of the new legislation have been established, significant dischargers in the watershed are required to monitor nutrients, and are required to submit a Basis of Design (BoD) Report and an Interim Optimization Plan (IOP).

The Town of Amherst owns and operates the Rutledge Creek Wastewater Treatment Plant (VPDES No. VA0031321). The facility completed an upgrade from 0.4 MGD to 0.6 MGD in 2005. The treatment facility is equipped with the following unit processes:

- Screening & Grit Removal
- Influent Pump Station
- Phased Isolation Oxidation Ditch Secondary Treatment
- Disc Filter Tertiary Treatment
- UV Disinfection
- Post Aeration
- Aerobic Digestion & Sludge Drying Bed
- Septage Receiving Facilities

Rutledge Creek is a tributary of the James River, and the treatment plant is listed on the significant discharger list. According to the approved Water Quality Management Program Regulations, the Rutledge Creek WWTP has an allocated total nitrogen concentration of 6 mg/L and a total phosphorus allocation of 0.5 mg/L at its current design capacity of 0.6 MGD. At full capacity, this equates to Waste Load Allocation (WLA) of 10,964 lbs/yr of total nitrogen, and 913 lbs/yr of total phosphorus.

1.2 Purpose

The BoD report is required by the Rutledge Creek VPDES permit (No. VA0031321) and is to be submitted to the Department of Environmental Quality (DEQ) no later than January 10, 2006. The permit requires that the BoD report address the construction and operation of a range of nutrient removal technologies up to and including the limit of technology. The range of nutrient removal technologies is separated into four levels, or tiers. The four tiers of treatment defined by DEQ for development of the BoD report are presented below in Table 1-1. In addition to the four tiers, the actual WLA is also included in the analysis of this report.

Table 1-1:
Treatment Levels for Point Source Significant Municipal Dischargers

Level	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
Tier 1*	8.0	---
Tier 2	8.0	1.0
Tier 3	4.0	0.3
Tier 4	3.0	0.1
WLA**	6.0	0.5

* TN = 8.0 mg/L for those with BNR operating or planned; TN and TP for rest of facilities = 2000 conc.
** WLA = Waste Load Allocation for the Rutledge Creek WWTP.

SECTION 1 – INTRODUCTION

The Basis of Design Report is to evaluate various nutrient removal technologies to enable the Town of Amherst to make informed decisions on the approach to complying with the nutrient loads allocated to the Rutledge Creek WWTP. The BoD report is also designed to assist in decisions on upgrade schedules and nutrient trading issues that may arise under the watershed group permit.

2.1 General WWTP Description

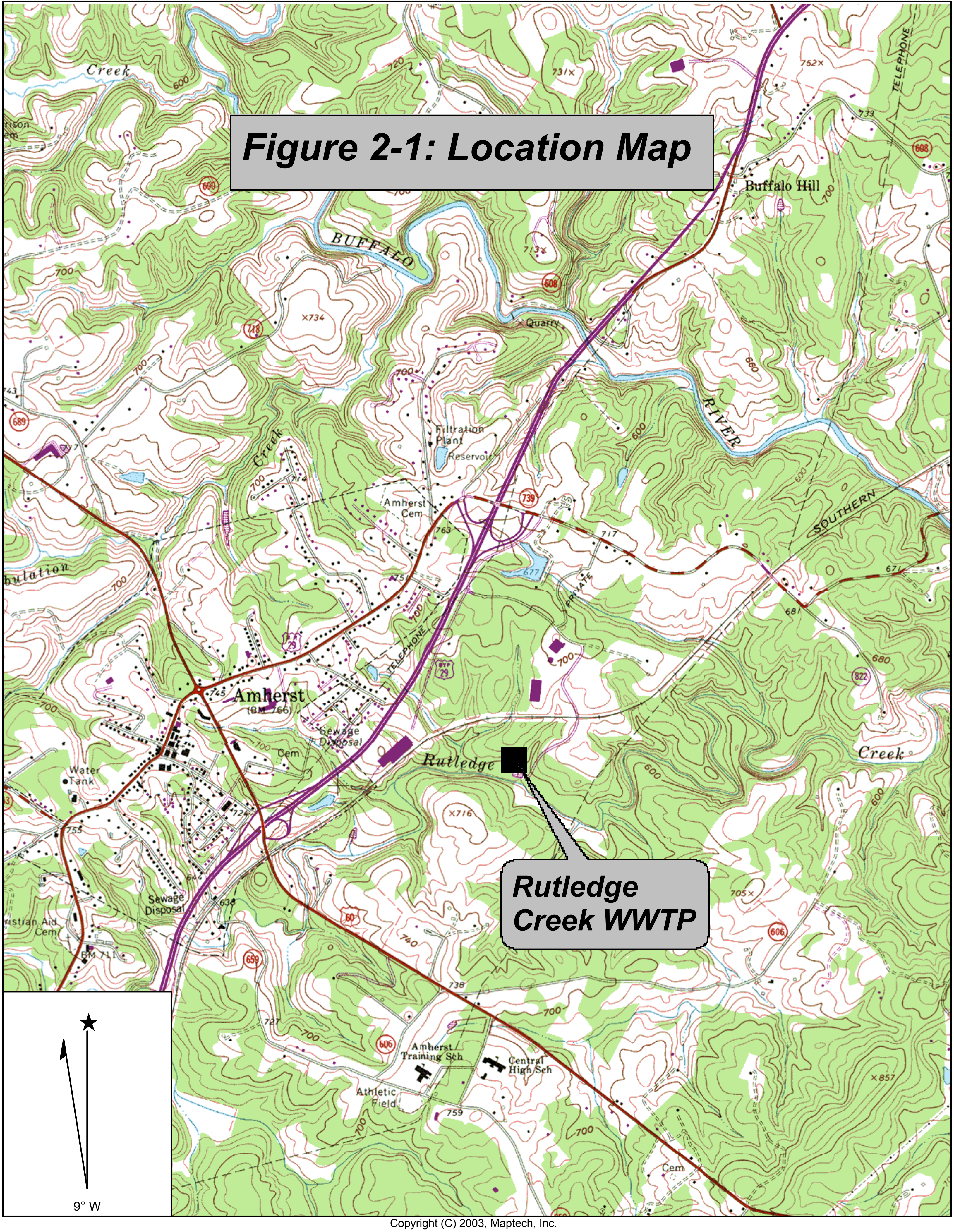
The Rutledge Creek WWTP (VPDES No. VA0031321) is located at the end of Industrial Drive in the Town of Amherst. See Figure 2-1 for a location map. The treatment plant is owned and operated by the Town of Amherst, and receives wastewater from the Town, nearby industrial parks, and Sweet Briar College. The VPDES permit has an effective date of December 28, 2004, and expires December 27, 2009. Current VPDES permit limits are summarized below in Table 2-1.

Table 2-1: Rutledge Creek WWTP Current VPDES Effluent Limits

Parameter	Q < 0.38 MGD		Q > 0.38 MGD	
	Monthly Avg.	Avg.	Monthly Avg.	Weekly Avg.
BOD_5	11.1 mg/L	16.7 mg/L	7.4 mg/L	11.1 mg/L
TSS	30 mg/L	45 mg/L	30 mg/L	45 mg/L
Ammonia-N (Jun-Nov)	14.7 mg/L	14.7 mg/L	12.1 mg/L	12.1 mg/L
Fecal Coliform	200 N/Cml	---	200 N/Cml	---
Total Hardness	120 mg/L (minimum)	---	120 mg/L (minimum)	---

The Town of Amherst completed a facility upgrade in 2005 increasing the plant capacity from 0.4 MGD to 0.6 MGD. The upgrade consisted of installing a Kruger Double Ditch system. In addition to the Kruger D-Ditch, the upgrade included the following new facilities: Lab/Control Building, Headworks and Influent Pump Station, Lime Feed Building, Disc Filter, UV disinfection, Post Aeration, Non-Potable Water System, and

Figure 2-1: Location Map

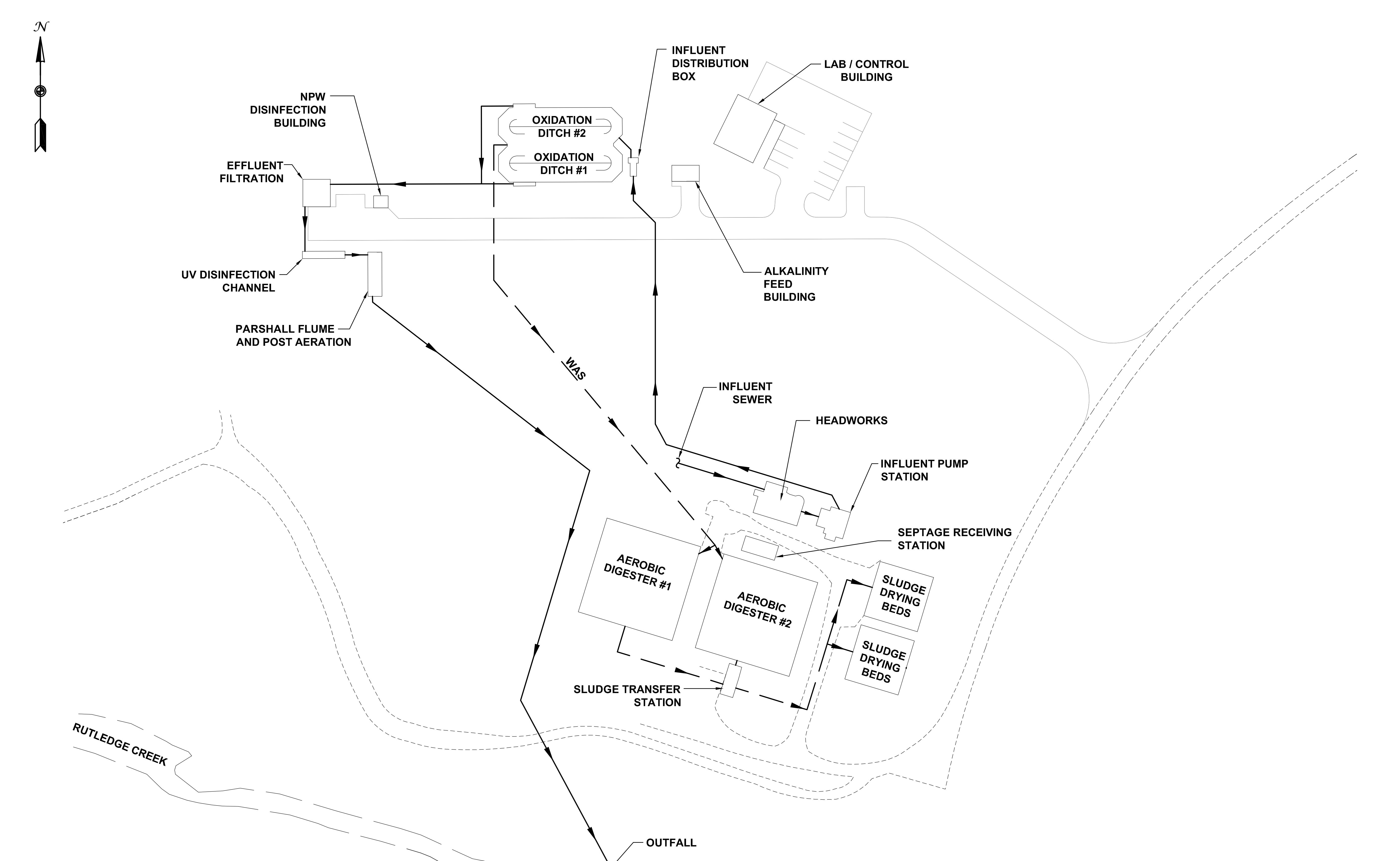


Septage Receiving Station. Elements of the original WWTP were converted for use as aerobic sludge digesters. Sludge drying beds are used to dewater sludge, which is disposed of in the local landfill. Effluent is discharged to Rutledge Creek, a tributary of the James River and part of the Chesapeake Bay Watershed.

2.2 Preliminary Treatment

Influent wastewater flows into the WWTP through a 24-inch sewer that enters the headworks operation in the southern area of the facility. Refer to Figure 2-2 for a plant flow diagram. The influent sewer discharges to a 4-ft. deep dual concrete channel. The primary channel consists of a mechanical step screen with ¼-inch openings. The secondary channel is provided with a manual bar screen with 1 ½-inch bar spacing. Screenings are washed and compacted, then discharged and stored in a nearby dumpster for offsite disposal at the landfill.

After screening, wastewater flows into a 7-ft. diameter vortex grit unit. De-gritted raw sewage then flows through a 24-inch sewer to the Influent Pump Station Wet Well. Grit is pumped from the bottom of the vortex unit to a classifier, and then discharges to a dumpster for offsite disposal. The headworks channel is provided with a 12-inch overflow pipe that transfers influent wastewater to the aerobic digesters if necessary. This operation is used to control infiltration and inflow (I&I) by sending excessive influent flow to the aerobic digesters during wet weather flows. The held volume can later be decanted from the digester to the headworks.



WW ASSOCIATES ENGINEERS SURVEYORS PLANNERS 147 MILL RIDGE ROAD LYNCHBURG, VIRGINIA 24502 PHONE: 434.582.6175 FAX: 434.582.6179	DESIGNED BY: JPC	PROJECT: RUTLEDGE CREEK IOP/BOD REPORT			REVISION NUMBER:
	DRAWN BY: CLP				
	REVIEWED BY: JPC/HFW	TITLE: PLANT FLOW DIAGRAM			FIGURE NUMBER: 2-2
	WWA NUMBER: 240232.07	FILE NAME:	DISCIPLINE:	SCALE: H: V:	DATE:	SHEET NUMBER:

The 10 ft. x 12 ft x 15 ft deep wet well of the Influent Pump Station collects wastewater following preliminary treatment. The pump station consists of three Gorman-Rupp TG A-B suction lift pumps. The pumps are equipped with variable speed drives and 40 HP motors. Each pump is rated for 860 gpm at 88 ft TDH. A 10-inch force main was built from the pump station to the influent distribution box of the D-Ditch. The discharge header located in the pump station building is also provided with an emergency pump connection.

2.3 Secondary Treatment

The secondary treatment process consists of the Kruger D-Ditch. This process is similar to conventional oxidation ditches, excepted for its use of phased isolation ditch (PID) technology. The process is a closed loop reactor where aeration of the mixed liquor takes place. The system is similar to a sequencing batch reactor due to the fact that it does not require secondary clarifiers for settling the mixed liquor or a return activated sludge system. The ditches operate in a series of flow patterns that alternate process conditions within the ditch to perform specific treatment objectives. Although treatment and clarification is carried out in a batch-type operation, influent flow to the ditches and effluent discharge is continuous.

The Rutledge Creek WWTP is provided with a number of components to provide aeration, mixing, and flow control to and from the unit. A partial list of major equipment is provided as follows:

- Influent Distributor
- Four 3.0-meter Horizontal Brush Aerators with 15 HP Motors
- Two 6.0 HP Submersible Mixers
- Two 5.0-meter Motor Actuated Effluent Weirs
- Two Manual Operated Rotating Scum Pipes
- Two Dissolved Oxygen Probes
- Two Ultrasonic Level Transmitters
- Programmable Logic Control (PLC) based Control Panel

The distributor directs wastewater from the Influent Pump Station into the respective ditch, depending on which phase the system is operating. The ambient ditch conditions are alternated between oxic, anoxic, and quiescent to accomplish nitrification, denitrification and clarification. The D-Ditch was not designed to fully denitrify at 0.6 MGD, and is currently operating with additional anoxic stages because it has not reached the design loading. The ability to perform anoxic treatment is due to additional equipment provided beyond what was needed to meet the effluent limits that were in place at the time of construction. As the hydraulic loading of the treatment plant increases, the treatment phases will be adjusted, decreasing the amount of time available for anoxic phases.

The brush aerators (rotors) are operated and controlled by the PLC, and operate during oxic stages. In addition to phased control, the rotors are controlled by dissolved oxygen (DO) levels in the respective ditches. The DO probes monitor oxygen levels during the specific phases and transmit a signal to the PLC that turns the rotors on or off to increase or reduce the DO level in the ditch.

The effluent weirs control the liquid level in the ditches and the flow of effluent from the ditches. The PLC adjusts the weir based on level indicators in the ditches to provide optimal submergence of the rotors. This maximizes oxygen transfer and reduces power consumption.

The theory of operation for the D-Ditch is as follows:

> Phased Isolation Ditch Technology in the D-Ditch mode of operation can be best understood by following the process through one complete 8-hour cycle of operation. One complete cycle set forth in this example consists of eight phases. The phases are labeled B, D, E, F, H, J, K, and L. Please note that Phases H, J, K, and L are simply "mirror images" of Phases B, D, E, and F.
>
> The cycle begins with Phase B followed by Phase D. Note that these phases are exactly the same and in this example the total duration of both phases is 3 hours (1.5 hrs each). If denitrification is desired additional anoxic phases will be incorporated into the system (refer to Table 2.2, phases A-D). In Phases B and D, the influent wastewater is directed to Ditch 1 (See Figure 2.3). Ditch 1 is in the aeration mode of operation. The rotors in Ditch 1 aerate the mixed liquor, resulting in the degradation of the influent BOD and nitrification of ammonia-nitrogen.
>
> In Phases B and D, the influent enters Ditch 1, where the effluent weirs are raised producing a hydraulic gradient that forces the mixed liquor to Ditch 2, where the biosolids settle. The motorized effluent weirs are lowered in Ditch 2 to allow the treated and clarified effluent to continue on to further treatment, such as filtration and disinfection. The process will continue to operate in the mode for 3 hours, before advancing to Phases E and F.

Table 2.2: D-Ditch Operational Phases

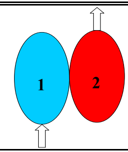
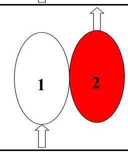
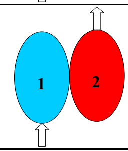
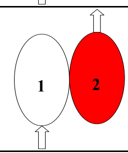
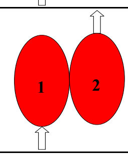
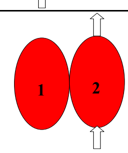
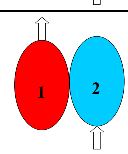
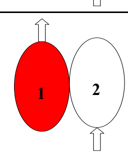
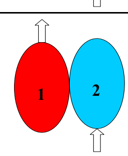
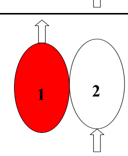
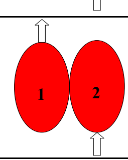
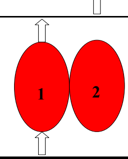
Phase	Flow Pattern/ Process Conditions	Operator Input. Time (min)	Ditch 1	Ditch 2
A		Default: 0 Range: 0-60	• Denitrification • Rotors off • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
B		Default: 90 Range: 0-180	• Nitrification • Rotors on • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
C		Default: 0 Range: 0-60	• Denitrification • Rotors off • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
D		Default: 90 Range: 0-180	• Nitrification • Rotors on • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
E		Default: 30 Range: 0-60	• Settling • Rotors off • Mixers off • Weir up	• Settling • Rotors off • Mixers off • Weir down
F		Default: 30 Range: 0-60	• Settling • Rotors off • Mixers off • Weir up	• Settling • Rotors off • Mixers off • Weir down
G		Default: 0 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down	• Denitrification • Rotors off • Mixers on • Weir up
H		Default: 90 Range: 0-180	• Settling • Rotors off • Mixers off • Weir down	• Nitrification • Rotors on • Mixers on • Weir up
I		Default: 0 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down	• Denitrification • Rotors off • Mixers on • Weir up
J		Default: 90 Range: 0-180	• Settling • Rotors off • Mixers off • Weir down	• Nitrification • Rotors on • Mixers on • Weir up
K		Default: 30 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down	• Settling • Rotors off • Mixers off • Weir up
L		Default: 30 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down	• Settling • Rotors off • Mixers off • Weir up

Figure 2.3: D-Ditch Process Phases B & D.

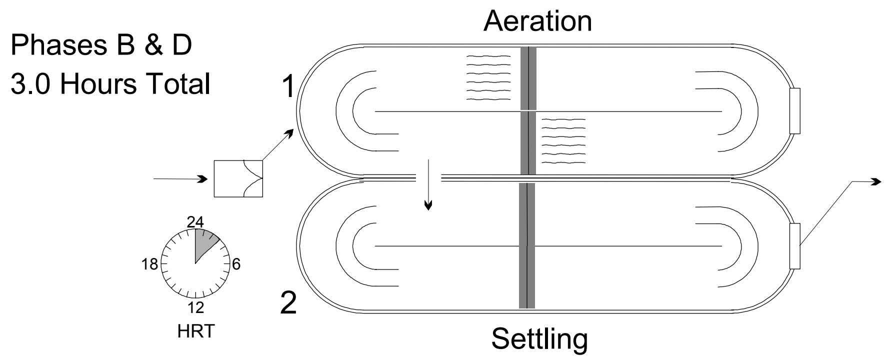
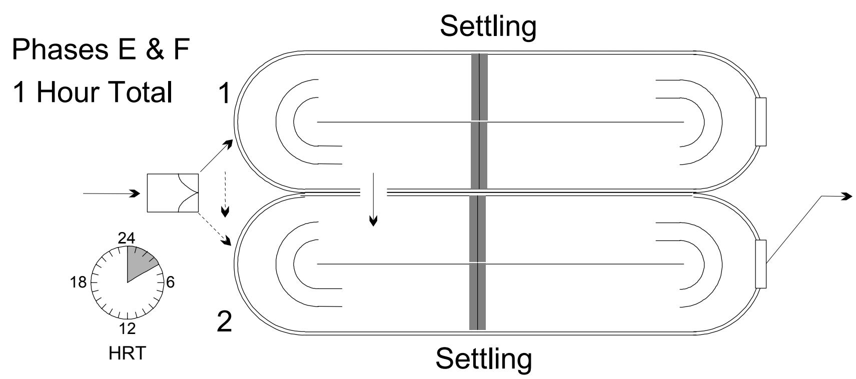


Figure 2.4: D-Ditch Process Phases E & F.



Phases E and F are intermediate phases with a total duration of 1.0 hour (0.5 hrs each), during which quiescent conditions are maintained in both ditches (See Figure 2.4). During these phases, Ditch 2 is still settling from the previous phase, and will continue settling throughout the duration of these phases. In addition, the effluent will continue to be discharged from Ditch 2 through both phases. After thirty minutes the system moves from Phase E to Phase F. The automated flap gate-type flow distributor in the distribution chamber, which was directing the influent to Ditch 1, switches position from the left to the right. This directs the influent to the inlet pipe discharging to Ditch 2, instead of Ditch 1. The purpose of Phase F is to completely isolate Ditch 1 from flow patterns to promote quiescent conditions. The distributor is operated automatically via PLC, however, the unit can also be operated manually in the event of an emergency

In Phases H and J, the effluent weirs in Ditch 2 are raised and the effluent weirs in Ditch 1 are lowered. The hydraulic gradient is now shifted so that the flow direction is from Ditch 2 to Ditch 1, with Ditch 1 discharging effluent (See Figure 2.5). It must be noted that Phases H and J are exactly the same and that anoxic sub-cycles can be included into the phasing by turning all of the rotors off and turning the mixer on. (refer to Table 2.2, phases G-J).

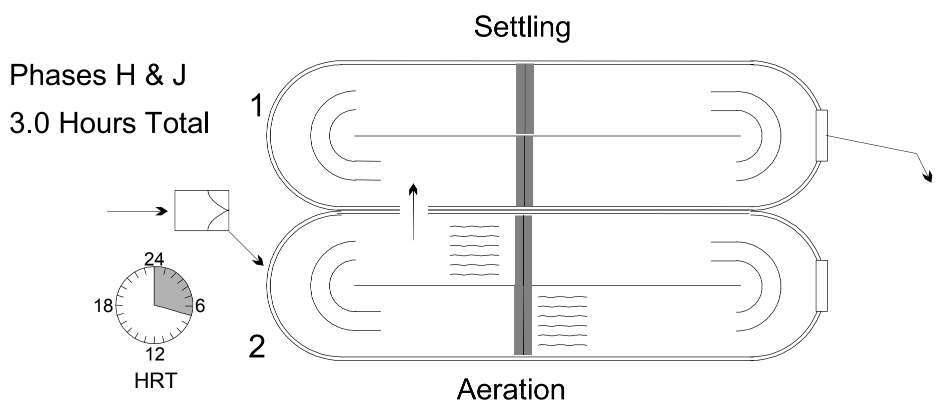


Figure 2.5: D-Ditch Process Phases H & J.

Ditch 1, which was quiescent in Phases E and F, will continue settling during Phases H and J. The rotors in Ditch 2 are turned on, and will maintain oxic conditions in Ditch 2 throughout Phases H & J (3.0 hours).

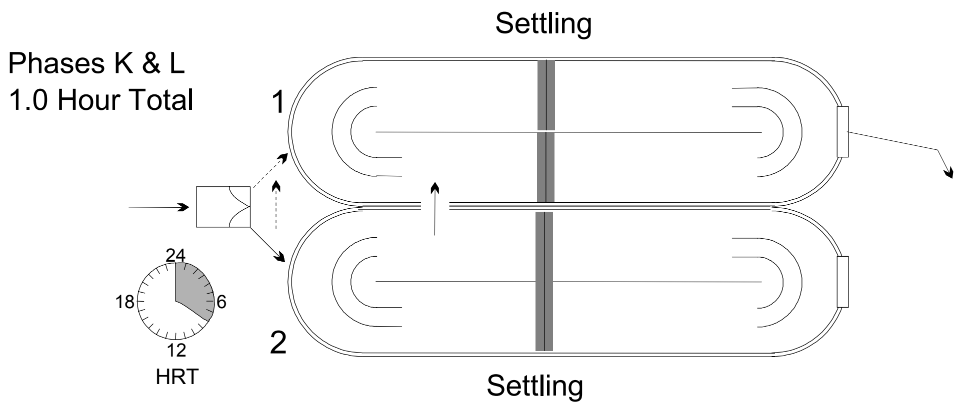


Figure 2.6: D-Ditch Process Phases K & L.

Phases K and L are other intermediate phases with a total duration of 1.0 hour (0.5 hrs each). Phase K is initiated by discontinuing aeration in Ditch 2. Ditch 1 continues to discharge effluent (See Figure 2.6). At the end of Phase K, the influent flow distributor changes position to direct flow back into Ditch 1 signaling the start of Phase L. The purpose of Phase L is to completely isolate Ditch 2 from flow patterns to promote quiescent conditions. At the end of phase L, the entire cycle will have been completed. The weirs in Ditch 1 will be raised, while the weirs in Ditch 2 are lowered and another 8 hour cycle of operation will begin.

One should note that based on a Hydraulic Retention Time (HRT) of 24 hours, one complete 8 hour cycle accounts for 33% of the HRT. In addition, sludge can be wasted from the ditch under oxic conditions as mixed liquor or during settling phases as settled sludge.

A total of twelve (12) phases are programmed into the system. All twelve phases are illustrated in Table 2.2 above. Please note that if the time duration of a phase is set to zero, the system will skip the phase in sequence and move into the following phase. The example provided above illustrates how the system will run based on the default settings.

2.4 Tertiary Filtration

Effluent from the D-Ditch flows by gravity to a Kruger Hydrotech Disc Filter. The Disc Filter is used as a polishing process to enhance TSS and BOD removal. The unit is mounted in a 22-ft. 8-in. square concrete structure with room for a future unit if needed. The structure is completed with an inlet channel, filtered water channel, and emergency bypass channel.

Water flows into the center of the drum of the unit and fills the filter segments. The filter segments are partially submerged. The head of the D-Ditch effluent pushes the water through the filter material, and solids are trapped on the inside of the unit. Filtered water passes through disc to the outside of the filter element. The filter elements are static until a maximum pre-determined head level is reached. When the head increases to approximately 12-inches, the unit initiates a backwash cycle. The filter elements are spun while simultaneously receiving countercurrent backwash from high-pressure spray nozzles. The backwash flow enters the waste channel and is sent to the Influent Pump Station. The filter disc unit is susceptible to iron fouling, and has experienced significant operational problems as a result.

2.5 Disinfection & Post Aeration

Disc Filter effluent flows by gravity to the ultraviolet (UV) disinfection channels. Two 2-ft. channels are provided for UV disinfection. Currently, one channel is used and the second is for future use. The primary UV channel is equipped with two banks of UV lamps. A weir is used to maintain a proper channel depth.

From the UV channel, wastewater flows to the Parshall Flume and Step Aerator. An ultrasonic meter is mounted in the flume to monitor effluent flow rates. The step aerator consists of 12 – 9-inch steps that increase dissolved oxygen levels prior to discharge.

2.6 WWTP Support Systems

The Rutledge Creek Lab/Control Building houses the laboratory, motor control center, the programmable logic controller and operator interface. From this location, the operators can monitor and operate various WWTP functions.

The non-potable water (NPW) system aids in a number of functions around the facility. Primary uses for NPW are for mix water at the Lime Feed

Building, backwash for the disc filter, spray wash for the step screen unit, and slurry wash at the vortex degritter. Yard hydrants around the facility are also provided for wash down purposes. The NPW system derives water from the end of the UV Disinfection Channel. A submersible pump supplies water to the NPW Building. The building is provided with a 116-gallon diaphragm tank and a hypochlorite feed system for disinfection.

2.7 Sludge Treatment and Disposal Facilities

Waste activated sludge from the D-Ditch is sent to the Aerobic Digesters. The digesters are converted aeration basins from the original WWTP. The concrete digesters are capable of holding and treating 219,000 gallons of waste sludge each. The digesters are provided with diffused aeration and mixing equipment. The digesters are also equipped with a septage receiving facility. Following treatment, inert sludge is transferred to the sludge drying beds. A polymer is mixed with the sludge during application to the beds to facilitate dewatering.

Rutledge Creek WWTP is equipped with 8 square sludge drying beds. The beds measure approximately 22-ft x 22-ft. The drying beds are also provided with roof covers to maintain a dry environment. Dried sludge is removed and hauled to a local landfill for final disposal.

3.1 Wastewater Generation and Influent Characteristics

Rutledge Creek WWTP currently receives an average daily flow of approximately 0.35 MGD. This flow is generated by domestic, commercial, and industrial sources located throughout and surrounding the Town of Amherst.

Wastewater treatment plant flow data was collected and analyzed from January – August 2005, and are summarized in Table 3-1. The effluent flows were provided by a flow element at the Parshall flume. Flow rates are transmitted to the Control Building and recorded by the WWTP operational system.

Table 3-1: Rutledge Creek WWTP Flow Rates
(1/05 – 8/05)

Month	Monthly Average Effluent Flow (MGD)	Peak Day Effluent Flow (MGD)
January	0.3320	0.7213
February	0.3483	0.4090
March	0.3865	0.7142
April	0.4379	0.5571
May	0.3369	0.4126
June	0.3291	0.4113
July	0.3420	0.4993
August	0.3292	0.4406
Average	**0.3552**	**0.5207**
Peak:Average Ratio		**1.5**

* Flows as reported on DMRs.

Daily influent flow rates varied between 0.3291 MGD to 0.4379 MGD. Peak flows represented in Table 3-1 were peak day flow rates as recorded on the Monthly Data Review Sheets.

The Rutledge Creek WWTP was designed to treat an average daily flow of 0.6 MGD, and a peak design capacity of 1.2 MGD. The hydraulic design capacity of the treatment plant is 1.8 MGD. The peak:average ratio is 1.5 during this analysis. This is within the design ratio of 2.0 and the hydraulic design ratio of 3.0.

The Rutledge Creek operators collect and test influent wastewater samples on a regular basis, usually two times per week. The collected data from January – August 2005 was analyzed and is presented below in Table 3-2.

Table 3-2: Rutledge Creek WWTP Influent Monitoring Results (1/05 – 8/05)

Month	Average BOD_5 Loading		Average TSS Loading	
	mg/L	Kg/D	mg/L	Kg/D
January	155	340	175	357
February	144	234	144	233
March	206	351	635	1115
April	114	193	142	239
May	154	273	179	314
June	144	218	143	217
July	92	128	109	153
August	100	134	132	177
Averages	**142**	**240**	**223**	**378**
Design Values	**140**	**--**	**170**	**--**

The actual loading presented in Table 3-2 is close to the design criteria presented by the D-Ditch manufacturer's literature. Design information is presented below.

- BOD_5 = 140 mg/L
- TSS = 170 mg/L
- TKN = 40 mg/L

The actual influent TSS loading is slightly higher than target values. This is due to a unusually high loading that occurred in March 2005. Neglecting March, the actual TSS loads were equivalent to the design figures. Design temperatures range from 10-25^{o}C. Actual temperatures ranged from 10-12^{o}C in cold weather months, to 22-24^{o}C in warm weather months. Influent pH typically ranged from 6.9-7.6.

3.2 Effluent Monitoring

Effluent monitoring results from January to August 2005 were obtained and analyzed. Monitoring was completed in accordance with the VPDES permit requirements to ensure compliance with effluent limitations, presented in Table 2-1. In addition to the effluent monitoring required to meet existing permit limits, the facility is required to monitor various nutrients discharged to Rutledge Creek. Complete monitoring requirements are outlined in the VPDES permit. A summary of monitoring results is presented in Table 3-3.

Included in the monthly Discharge Monitoring Report (DMR) are effluent levels of total phosphorus (TP), orthophosphate, total nitrogen (TN), total kjeldahl nitrogen, and nitrite + nitrate. The Rutledge Creek WWTP operators are required to report these constituents twice per month. Analysis of the monitoring shows that the facility, on average, has produced a low nutrient effluent, with a TP of less than 1.0 mg/L and a TN of approximately 5.0 mg/L. The highest effluent TN recordings occurred in January and February at 11.4 mg/L and 8.7 mg/L, respectively. According to plant personnel, the elevated effluent nitrogen levels occurred due to the inability to waste sludge during construction.

Table 3-3: Rutledge Creek WWTP Effluent Monitoring Results (1/05 – 8/05)

Month	BOD5		TSS		Total Phos.		Ortho Phos.		TKN		NO2+NO3		Total N		Ammonia
	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L
Jan*	4.3	5.7	4.4	5.8	1.2	1.4	0.0	0.0	11.1	12.2	0.3	0.3	11.4	12.5	---
Feb*	3.2	4.3	4.1	5.4	0.4	0.5	0.1	0.1	8.1	10.8	0.6	0.8	8.7	11.6	---
Mar	6.5	9.5	5.8	8.8	0.5	0.7	0.0	0.0	2.0	2.9	0.9	1.3	2.9	4.2	---
Apr	5.7	9.1	9.9	15.1	0.4	0.5	0.0	0.0	0.0	0.0	1.0	1.8	1.0	1.8	---
May	3.4	4.6	4.9	6.7	0.7	1.1	0.3	0.4	3.4	1.3	3.9	5.6	4.9	6.9	---
Jun	3.1	3.9	4.3	5.5	1.3	1.7	0.5	0.7	1.1	1.7	4.4	6.0	5.5	7.7	1
Jul	3.1	4.2	6.6	9.2	0.9	1.3	0.4	0.4	1.2	1.7	2.7	4.8	3.8	6.5	0.8
Aug	1.1	1.4	2.6	3.4	1.3	1.7	1.0	1.2	0.3	0.4	1.6	2.0	1.9	2.3	0.2
Averages*	**3.8**	**5.5**	**5.6**	**8.0**	**0.8**	**1.1**	**0.4**	**0.5**	**1.3**	**1.3**	**2.4**	**3.6**	**3.3**	**4.9**	**0.7**

*January/February data not factored into averages due to digester construction activities.

3.3 Additional Testing Protocol

To further understand the waste load entering and leaving the facility a testing protocol was developed and executed in October and November 2005. The sampling protocol called for three consecutive days of testing in October on the influent, effluent, and waste streams of the treatment plant. The following parameters were include in the protocol:

- COD (soluble)
- BOD_5
- $CBOD_5$
- TSS
- Ammonia
- TKN
- Nitrite + Nitrate
- Total Nitrogen
- Orthophosphate
- TP (soluble & particulate)
- Alkalinity
- pH
- DO
- Temperature

The samples were collected as 24-hour composites, with the exception of pH, DO, and temperature, which were grab samples. All waste sludge sampling was obtained as grab samples. The first round of sampling took place October 18-20. A second data set was developed in November. The November testing analyzed the influent conditions only. Results of the October and November testing are presented in Tables 3-4 and 3-5.

Process control testing was performed as part of the sampling protocol to gauge performance of the D-ditch system. These tests were completed to help identify any limiting factors, insufficiencies, and to aide in identifying process adjustments to maximize treatment efficiency. Testing was performed for the parameters listed below; results are presented in Table 3-6.

- Alkalinity
- pH
- DO
- Temperature
- SRT
- MLSS
- MLVSS
- Waste Rates
- SVI
- Lime Addition

Table 3-4: Influent and Effluent Testing Protocol Results

Parameter (mg/L unless otherwise noted)	Influent Testing Results						Effluent Testing Results			
	October			November			October			
	Day 1	Day 2	Day 3	Day 1	Day 2	Influent Avg.	Day 1	Day 2	Day 3	Effluent Avg.
COD	92	91	100	470	2080*	**188.3**	11	84	46	**47.00**
BOD5	153	119	182	194	56*	**162.0**	1.2	1.9	2.7	**1.93**
CBOD5	125	218	155	153	190	**168.2**	nd	2	4	**3.00**
TSS	117	127	178	207	47	**135.2**	0.9	2.4	4	**2.43**
Ammonia	20.4	20	9	20.6	19.4	**17.9**	0.278	0.317	0.302	**0.30**
TKN	27.9	23.2	10.9	24.2	22.3	**21.7**	nd	nd	nd	**nd**
Nitrite+Nitrate	nd	0.49	0.11	nd	0.36	**0.32**	3.35	3.84	3.76	**3.65**
Total Nitrogen	27.9	23.69	11.01	24.2	22.66	**21.9**	3.35	3.84	3.76	**3.65**
Orthophosphate	2.14	5.85	3.1	2.84	1.48	**3.1**	0.31	0.38	0.41	**0.37**
Total Phosphorus	4.25	6.5	3.6	4	6.35	**4.9**	0.35	1.3	1.2	**0.95**
Soluble Phosphorus	1.2	3.1	2.9	1	3.9	**2.42**	0.19	0.55	0.14	**0.29**
Particulate Phosphorus	3.05	3.4	0.7	3	2.45	**2.52**	0.16	0.75	1.06	**0.66**
Alkalinity	195	204	194	181	166	**188**	150	158	160	**156**
pH, (s.u.)	7.3	7.2	7.2	7.2	7.4	**7.26**	7.8	7.8	7.7	**7.8**
D.O.	1	1.8	1.8	1.6	1.9	**1.62**	8.7	8.7	8.6	**8.7**
Temperature (^{0}C)	20.8	20.6	20.8	18.8	16.9	**19.6**	20.7	20.9	21.4	**21.0**
Flow (MGD)	0.3361	0.3155	0.3285	0.3361	0.3103	**0.33**	0.3361	0.3155	0.3285	**0.33**

*Values were disregarded due to inconsistency.

Table 3.5 – Waste Testing Protocol Results

Parameter (mg/L unless otherwise noted)	October			
	Day 1	Day 2	Day 3	Avg.
COD	2950	1650	540	**1713**
BOD5	809	771	780	**786**
CBOD5	1260	1380	1740	**1460**
TSS	13705	11825	10510	**12013**
Ammonia	4.22	0.153	2.26	**2.2**
TKN	6	nd	3.9	**5.0**
Nitrite+Nitrate	nd	0.36	0.59	**0.5**
Total Nitrogen	6	0.36	4.49	**3.6**
Orthophosphate	12.6	27.6	18	**19.4**
Total Phosphorus	14.5	34	20.5	**23.0**
Soluble Phosphorus	2.3	1.9	1.1	**1.8**
Particulate Phosphorus	12.2	32.1	19.4	**21.2**
Alkalinity	566	548	500	**538**
pH, (s.u.)	7.1	7.2	7.2	**7.2**
D.O.	0.4	1.2	0.2	**0.6**
Temperature (^{0}C)	20.8	21.2	20.8	**20.9**

Table 3.6 – Process Control Testing Results

Parameter	Ditch 1			Ditch 2			Avg.
	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	
Alkalinity, (mg/L as $CaCO_3$)	---	236	207	227	---	---	**223**
pH, (s.u.)	7.3	7.2	7.2	7.2	7.2	7.1	**7.2**
D.O., (mg/L)	1	1.4	1.5	1.2	1.2	0.5	**1.1**
Temperature, (^{0}C)	20.5	20.4	20.9	26.6	20.6	21.2	**21.7**
SRT, (d)	11	11	16	11	11	16	**12.7**
MLSS, (mg/L)	3155	3380	3090	3115	3150	3115	**3167**
MLVSS, (mg/L)	2110	2215	2095	2050	2115	2160	**2124**
SVI	65	59	65	74	67	67	**66**
Lime Addition, (lbs/d)	145	145	145	---	---	---	**145**

4.1 Enhanced Nutrient Removal Alternatives

The existing D-Ditch system is a non-conventional oxidation ditch type of reactor, similar to a sequencing batch reactor in the fact that it is a self-contained process that operates in phases without the use of clarifiers. Given the uniqueness of the D-Ditch, the most feasible alternatives for upgrading the process will incorporate the existing treatment technology. The D-Ditch manufacturer (Kruger) assisted in the development of the alternatives for enhanced nutrient removal discussed in this section. Other possible alternatives are discussed at the end of the section.

The identified alternatives are presented below in Table 4-1. The alternatives were identified to achieve the four treatment tiers defined by the Chesapeake Bay Program. A fifth alternative was developed to meet the approved waste load allocation (WLA) of TN = 6 mg/L, TP 0.5 mg/L, for the Rutledge Creek WWTP.

Table 4-1: Alternative Summary

Alternative	Effluent Limits (TN/TP)	Process Improvements/ Additions				
		Online Nitrogen Control System (STAC)	Alum Feed Facilities (Phosphorus Precipitation)	Secondary Clarifiers w/RAS	Upfront Anaerobic Selector Tanks (BioDenipho)	Secondary Anoxic Tanks
Tier 1	8/-	☑				
Tier 2	8/1	☑	☑			
WLA	6/0.5	☑	☑	☑		
Tier 3	4/0.3	☑	☑	☑	☑	☑
Tier 4	3/0.1	☑	☑	☑	☑	☑

4.2 Tier 1 & 2 TN Reduction – STAC System

To provide Tier 1 and Tier 2 (TN = 8.0 mg/L) levels of treatment at the Rutledge Creek WWTP, an online nitrogen control system is proposed to work in conjunction with the existing D-Ditch system. The D-Ditch manufacturer, Kruger, refers to this as the STAC System.

The STAC system allows automatic adjustment of phase length in response to effluent nitrogen concentration and can improve overall plant performance. The system is made up of an on-line analyzer that monitors real time concentrations of ammonia and nitrates in turn sending signals to the PLC to control the D-Ditch phases. During the oxic phases, influent ammonia is oxidized to nitrate (nitrification). The analyzer monitors the ammonia level until it is reduced, at which point the D-Ditch switches to an anoxic phase where nitrate is converted to nitrogen gas (denitrification). The submersible mixers keep the biosolids in suspension during this process and the influent BOD serves as the carbon source. The analyzer then proceeds to monitor the nitrate concentration present in the Ditch until it is also reduced, resulting in a phase change to the next oxic treatment cycle.

The implementation of this system does not require the construction of any new processes. Adding the STAC system consists of adding the analyzer, along with the sampling lines, and other required appurtenances, and adjusting the PLC programming to operate with the new equipment.

It should be noted that at current waste loading, the plant is achieving TN reduction well within 8 mg/L. This is due to plant optimization, which consists of additional anoxic treatment phases programmed into the D-Ditch control system. However, as the flows reach design levels, the facility will not be able to operate the additional phases, and will reduce the amount of time available for anoxic treatment.

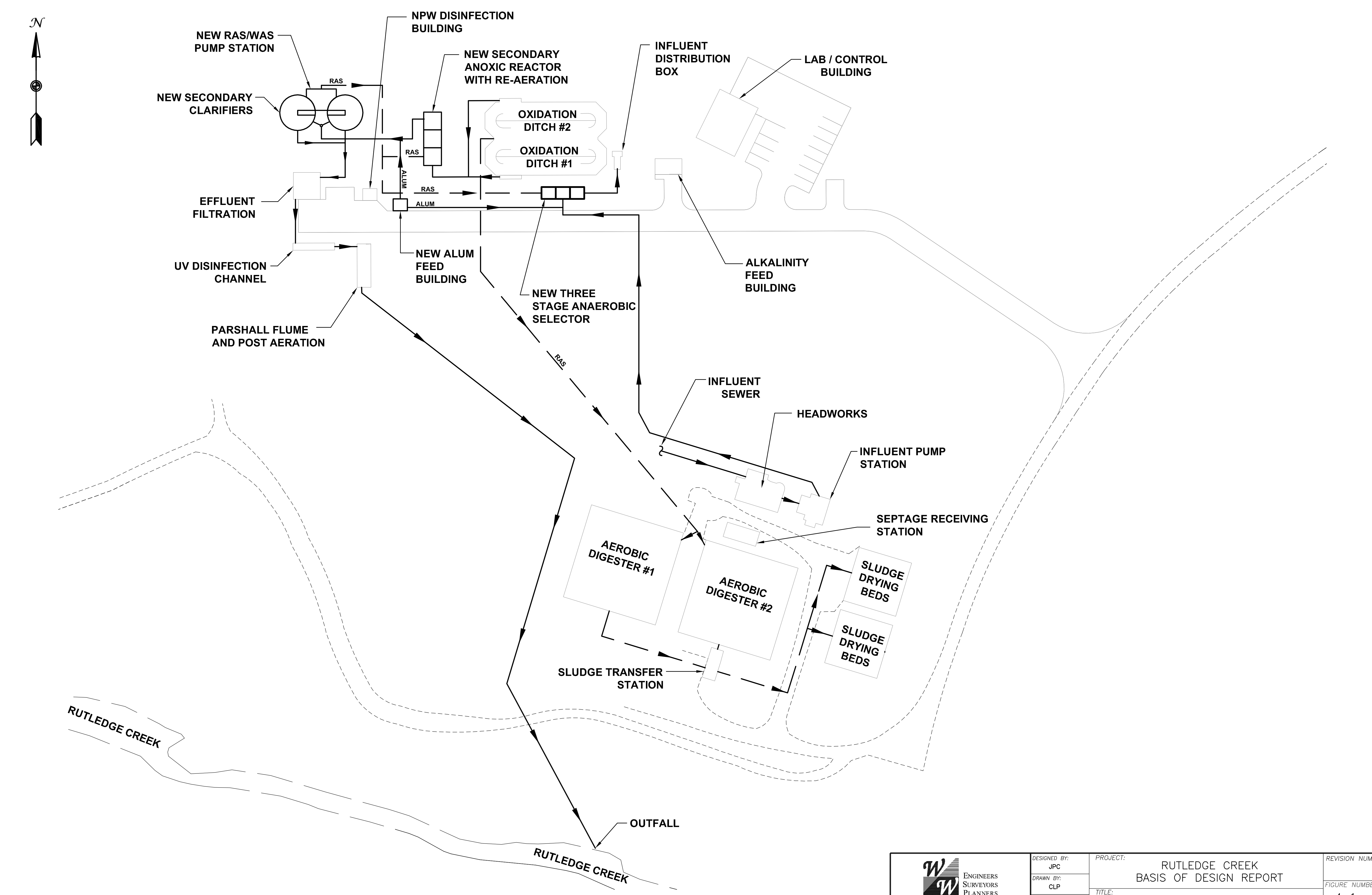
4.3 Tiers 3 & 4 TN Reduction – BioDenipho System w/ Secondary Anoxic Tank

The upgrade to Tier 3 (TN = 4.0 mg/L) and Tier 4 (TN = 3.0 mg/L) for enhanced nutrient removal requires considerable construction improvements at the Rutledge Creek facility. These improvements consist of adding a three-stage anaerobic selector, secondary anoxic tanks with re-aeration, and secondary clarifiers with a return activated sludge (RAS) pump station. The anaerobic selector will be added for biological phosphorus removal discussed later in this section. The other improvements will serve to enhance nitrification and denitrification operations. Refer to Figure 4-1 for a preliminary schematic of the improvements.

The BioDenipho system will act in conjunction with the STAC system discussed above, and the phased isolation ditch technology previously discussed. The process control programming will be modified to remove the current settling phases of the D-Ditch, dedicating the entire treatment cycle to oxic and anoxic phases controlled by a combination of dissolved oxygen input from the existing DO probes, and also relying on the online nitrogen analyzer to properly maintain the balance between nitrification and denitrification. The phases will be reduced to four main operating phases as illustrated in Figure 4-2. Phases are also capable of alternating strictly based on time limits.

A secondary anoxic treatment tank with re-aeration will be constructed between the D-Ditch and the secondary clarifiers as shown in Figure 4-1. The secondary process will consist of three stages with the first two anoxic, followed by a re-aeration stage. This process will require the addition of a carbon source to fuel the denitrification reaction. To accommodate the carbon need, return activated sludge will be blended into the anoxic zone. This process is referred to as RAS bleed.

The total design hydraulic residence time for the secondary process is approximately two hours. Each anoxic tank will be equipped with a submersible mixer. The re-aeration



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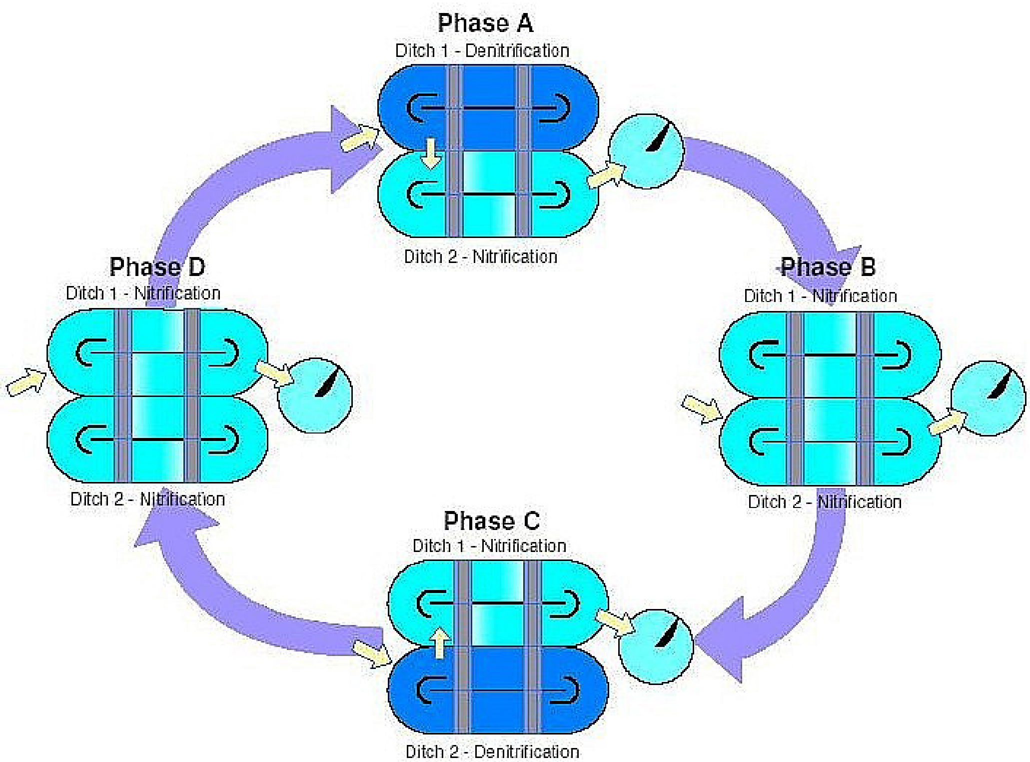
DESIGNED BY: JPC	PROJECT: RUTLEDGE CREEK BASIS OF DESIGN REPORT				REVISION NUMBER:
DRAWN BY: CLP					FIGURE NUMBER: 4–1
REVIEWED BY: JPC/HFW	TITLE: TIER 3 & 4 IMPROVEMENTS				
WWA NUMBER: 240232.07	FILE NAME:	DISCIPLINE:	SCALE: H: V:	DATE:	SHEET NUMBER:

Figure 4-2: BioDenitro/BioDenipho Main Operating Phases



process will consist of mixing and aeration to provide oxic conditions in order to reduce any remaining oxygen demand. Consideration will also be given to provide a supplemental carbon feed system consisting of methanol or acetic acid. This process addition will provide Tier 3 and 4 treatment, effectively equal to the current limits of technology for nitrogen reduction.

Settling will take place in the new clarifiers as shown in Figure 4-1. A splitter box with adjustable weir gates will be provided to evenly distribute wastewater from the oxidation ditch to two circular secondary clarifiers. Each secondary clarifier will be approximately 40 feet in diameter, with a side water depth of about 14 feet. Based on the 0.6 MGD design flow and a mixed liquor suspended solids concentration (MLSS) of 3,500 mg/L, each clarifier will have a solids loading rate of approximately 0.3 lb/ft^{2}-hr and an overflow rate of about 240 GPD/ft^{2}.

Influent wastewater will discharge to each clarifier through a center column. Clarified effluent will flow over a continuous v-notch weir located around the circumference of each clarifier. A suction manifold will be installed on the bottom of each clarifier to remove settled sludge; the manifold will be piped to a return activated sludge/waste activated sludge (RAS/WAS) pump station located between the clarifiers.

Each clarifier will be equipped with a surface scum removal system, consisting of a revolving scum trough, rotating scum collection ring, stationary skimmer blades, and scum pump. Scum will be pumped to the aerobic digesters for disposal. Provisions for foam control will be made for each clarifier as well.

The RAS/WAS Pump Station will share a common reinforced concrete walls with the clarifiers as shown in Figure 4-1. A total of three recessed impeller type pumps will be provided for sludge transfer. Two pumps will be used to return activated sludge to the Anaerobic Selector or to waste sludge to the aerobic digesters for stabilization. The discharge header will be valved to allow these two pumps to discharge to either location. The third pump will be dedicated to waste sludge service. The discharge piping for each pump will be equipped with a magnetic flow meter/motorized pinch valve arrangement to control the return and waste sludge flow rates.

4.4 Tier 1 TP Reduction

The Rutledge Creek WWTP will not require any process modifications to achieve Tier 1 phosphorus reduction requirements, since there is no current phosphorus limit in place for the facility. The facility currently achieves low effluent total phosphorus concentrations, typically around 1.0 mg/L. These concentrations can be attributed to lime addition, and the fact that the facility is not at full hydraulic capacity.

4.5 Tier 2 TP Reduction – Chemical Feed Facilities

To ensure the Tier 2 limit of 1.0 mg/L TP at design flows, additional chemical feed facilities will be required. The addition of lime to the D-Ditch does assist in current phosphorus removal, but is not specifically designed to do so at this facility. More common multivalent metal ions used in phosphorus precipitation are aluminum (Al^{+3}), and iron (Fe^{+3}). For this study, alum (aluminum sulfate) will be the precipitant of choice. Alum is preferred over lime because it produces less sludge and is easier to operate and maintain. Lime is also limited by the degree of phosphorus removal required and the alkalinity of the wastewater. Lime addition will continue to be used for alkalinity control and to optimize pH for precipitation.

Typically, organic phosphorus compounds usually settle out during the sedimentation process, or are transferred to orthophosphates during biological treatment. Likewise, polyphosphate compounds are converted to orthophosphate forms due to biological enzymatic activity during secondary treatment. Since polyphosphate compounds are not converted to orthophosphates until biological treatment, it is more efficient to add metallic salt cations after secondary treatment.

Alum will be added to the D-Ditch during the final treatment phases of the process, to ensure proper blending of the alum and wastewater. The flocculation that happens with alum addition is the formation of aluminum phosphate particles that attach themselves to one another and become heavy and settle to the bottom of the D-Ditch during the settling phase. The aluminum sulfate and phosphorus mixture can then be withdrawn with the waste sludge to the aerobic digester.

For aluminum, the molar ratio required to precipitate phosphorus is approximately 1:1. A typical range can actually be as high as 3 metal ions to 1 phosphorus ion due to competing reactions, and the effects of alkalinity, pH, and ligands found in the wastewater. The alum will be stored in a bulk storage tank located in a new Alum Feed Building. The new fiberglass reinforced plastic tank will be approximately 6,000 gallons to accommodate a 30-day supply plus additional storage for usage. The alum will be fed through metering pumps to the D-Ditch.

4.6 Tiers 3 & 4 TP Reduction – Anaerobic Selector

To reach Tier 3 (TP = 0.3 mg/L) and Tier 4 (TP = 0.1 mg/L) phosphorus limits, biological phosphorus removal will be required. The addition of a three stage upfront anaerobic selector will reduce TP levels prior to alum precipitation, resulting in less chemical usage and the associated costs.

The anaerobic selector will be constructed adjacent to the D-Ditch as shown in Figure 4-1. Refer to Table 4-2 for a summary of the process design. Other Tier 3 & 4 improvements include the construction of secondary clarifiers and a RAS pump station, as previously discussed. The RAS will be pumped into the first cell of the selector. Wastewater from the Influent Pump Station will be re-routed from the D-Ditch distribution box to the second cell of the Anaerobic Selector. The effluent from the third cell will flow by gravity to the existing D-Ditch distribution box. Each cell will be provided with a 3 horsepower submersible mixer.

Biological phosphorus removal is achieved by creating an anaerobic zone upstream of an aerobic treatment process. Various microorganisms present in wastewater utilize phosphorus for cell maintenance, synthesis, energy transport, and is stored for subsequent use. The primary organisms responsible are *Acinetobacter.* During anaerobic conditions, the microorganisms release stored phosphorus in the presence of volatile fatty acids.

Table 4-2: Anaerobic Selector Process Summary

Process Description	Values
Number of Trains	1
Number of Stages per Train	3
HRT, hours	2
Volume per Stage, ft^3	2,200
Length/Stage, ft	10
Width /Stage, ft	14
Side Water Depth, ft	15.5
Number of Mixers per Stage	1
Mixer Power, HP	2.7

Following the anaerobic process, the waste stream is subjected to an aerobic phase (oxic) where the microorganisms then uptake phosphorus above normal levels. When settling occurs, the sludge containing the excess phosphorus is wasted, resulting in biological phosphorus removal.

Since Tier 3 and Tier 4 improvements include secondary clarifier improvements, additional alum feed points will be provided upstream of the clarifiers. Multiple alum addition points will provide flexibility in managing when and where the chemical is added. It should also be noted that while the above discussed improvements apply to Tier 3 and Tier 4, the Tier 4 level of phosphorus reduction of 0.1 mg/L on a consistent basis may be difficult due to technology considerations.

4.7 Improvements for WLA Compliance

The final waste load allocations (WLA) were adopted by the State Water Control Board during the generation of this report. The final nutrient limits for the Rutledge Creek

WWTP are TN = 6 mg/L and TP = 0.5 mg/L. This WLA is consistent with most dischargers to the Upper James, above the fall line. This limit falls between Tiers 2 and 3 identified above. Because of this, a fifth alternative was identified to meet WLA compliance.

The WLA compliance alternative will be similar to the Tier 3 improvements, without the upfront anaerobic selector. The addition of Alum feed facilities, and secondary clarifier improvements will provide the WWTP with the means to remove TP to 0.5 mg/L. Secondary clarifiers and the RAS/WAS pump station will be identical to those discussed above for Tiers 2 and 3. The return activated sludge will be sent directly to the D-Ditch, instead of passing through an anaerobic selector.

4.8 Other Enhanced Nutrient Removal Alternatives

As mentioned previously, the most feasible alternatives for enhanced nutrient removal at the Rutledge Creek WWTP revolve around using the existing D-Ditch. Other alternatives considered in the preparation of this report include the denitrification filters and membrane bioreactor (MBR) technology.

Denitrification filters are capable of producing Tier 4 levels of nitrogen reduction through fixed film biological denitrification. These filters typically have a deeper bed than conventional filters, made up of various types of media supported by a gravel under drain. Media depths are usually 5 ft or more. The filters are usually equipped with an air scour system and backwash equipment. An upflow version of the denitrification filter is also available. These systems do require a supplemental carbon feed source to facilitate the denitrification reaction. Methanol feed systems are more common for larger facilities. In smaller wastewater plants, acetic acid feed systems can be considered. Methanol is preferred on a cost basis, but is more hazardous to handle, store, and maintain. Careful control over the supplemental carbon feed systems is required to ensure proper treatment.

In addition to the cost associated with denitrification filters and carbon feed systems, other factors such as the operation and control required and occupational safety challenges associated with this alternative were considered to eliminate this treatment technology.

Membrane bioreactors (MBR) are a developing treatment technology. Various forms of membranes treatment options are available. The most common are hollow fiber, or flat plate membranes. Typically the membranes are submerged in reactors with high (>10,000 mg/L) mixed liquor concentrations. The filtered product, or permeate, either flows by gravity from the membranes, or is pumped. This technology is capable of providing Tier 3 to Tier 4 nutrient reduction. Possible drawbacks, or unproven points, associated with MBRs include, maintenance concerns, membrane life expectancy, membrane replacement costs, and need for fine screening upstream of the process. Although some installations have been constructed recently, none are currently operational in the Commonwealth of Virginia. Given the developing nature of the technology, the associated costs, and previously mentioned concerns, MBRs were not considered a viable option for the Rutledge Creek WWTP at this time.

4.9 Alternative Cost Summary

Capital costs for the various improvements discussed were generated and are summarized below in Table 4-3. The reported costs represent the price to reach the respective tier, or level, at the 0.6 MGD design flow for the treatment plant. In addition to the capital expenditures, the operations and maintenance (O&M) costs will increase when improvements are implemented. The estimated increase in O&M costs are also presented below in Table 4-3 and are based on the WWTP operating at full design capacity.

Table 4-3: Alternative Cost Summary

Alternative	WWTP Improvements					Effluent Limits (TN/TP)	Estimated Capital Cost	Estimated O&M Cost Increase ($/year)
	STAC	Alum	Clarifiers	Anaerobic Selector	Secondary Anoxic			
Tier 1	☑					8/-	$250,000	$18,000
Tier 2	☑	☑				8/1	$500,000	$80,000
WLA	☑	☑	☑			6/0.5	$2,500,000	$96,000
Tier 3	☑	☑	☑	☑	☑	4/0.3	$3,500,000	$126,000
Tier 4	☑	☑	☑	☑	☑	3/0.1	$3,500,000	$126,000

4.10 WLA Implementation & Conclusions

At a minimum, the Town of Amherst will be required to design and construct the WLA Alternative identified above to comply with the effluent nutrient requirements recently adopted. This alternative consists of the following improvements:

- Online Nitrogen Control System (STAC)
- Secondary Clarifiers w/ RAS Pump Station
- Alum Feed Facilities

The total estimated cost of complying with the WLA is presented as $2,500,000. This total cost represents the implementation of all the improvements at the design flow rate of 0.6 MGD. The current flow rate was stated in Section 3 as approximately 0.35 MGD. At the current flow rates, and given the effluent monitoring results reported to this date, it is likely that the Rutledge Creek WWTP will continue to produce average effluent TN concentration below 6 mg/L. However, since the existing effluent TP concentrations are approximately 1.0 mg/L, the facility will need the upgrade as soon as the 0.5 mg/L limit for TP is put into place.

Consideration should be given to the design and construction of the Tier 3 Improvements. The same treatment processes have been identified to meet Tier 3 and Tier 4 nutrient limits. From a permit perspective we believe the identified improvements will consistently meet the Tier 3 limits. Tier 4 limits, specifically TP (0.1 mg/L), will be more difficult to meet on a consistent basis since they are considered the limits of technology. The construction of Tier 3 improvements may provide opportunities in the form of nutrient exchange with other facilities located in the Upper James River Basin (based on current developing rules), or could provide higher levels of treatment necessary to the Town of Amherst in the future.

Recent developments by the Department of Environmental Quality indicate that the new limits will be placed into existing permits through the Watershed General Permit. This will likely be enacted in 2006, and will supercede any existing schedules or requirements. Final schedules have not been released to date, however preliminary discussions indicate that the Rutledge Creek WWTP will be required to meet the WLAs by December 2010.

The Water Quality Improvement Fund (WQIF) was established as a result of action taken by the Virginia General Assembly in 1997. The fund was established in response to the need to finance nutrient reduction projects in the Chesapeake Bay Watershed. In July 2005, the fund received $65.7 million in appropriations for point source nutrient reduction implementation. The 2006 allocation is estimated to be $54.4 million. It is recommended that the Town of Amherst pursue financial assistance through the WQIF for the Tier 3 improvements identified above. Grant applications for WQIF are due by January 27, 2006 for facilities located in the James River Basin. Guidelines for the WQIF are attached in Appendix A of this report.

Based on discussions with DEQ, it is apparent that if grant money is approved and used for Tier 3 improvements, then the Rutledge Creek WWTP will be required through a technical performance standpoint to comply with Tier 3 effluent nutrient requirements (TN = 4mg/L, TP = 0.3 mg/L). These effluent nutrient requirements would then be incorporated into the VPDES permit during the next renewal cycle.

INTERIM OPTIMIZATION PLAN

RUTLEDGE CREEK
WASTEWATER TREATMENT PLANT

TOWN OF AMHERST, VIRGINIA

PREPARED BY

WW ASSOCIATES
ENGINEERS
SURVEYORS
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January 5, 2005
WWA Project No. 204232.09

EXECUTIVE SUMMARY

The Virginia State Water Control Board's approval of new Water Quality Standards for the Chesapeake Bay and passage of legislation establishing the Chesapeake Bay Watershed Nutrient Credit Exchange Program has created new requirements for significant dischargers in the Chesapeake Bay's watershed.

The Town of Amherst owns and operates the Rutledge Creek Wastewater Treatment Plant (VPDES No. VA0031321). The facility is identified as a significant discharger to the James River Basin. According to the approved Water Quality Management Program Regulations, the Rutledge Creek WWTP has an allocated total nitrogen concentration of 6 mg/L and a total phosphorus allocation of 0.5 mg/L at its current design capacity of 0.6 MGD. At full capacity, this equates to Waste Load Allocation (WLA) of 10,964 lbs/yr of total nitrogen, and 913 lbs/yr of total phosphorus.

These limits have not been incorporated into individual Virginia Pollutant Discharge Elimination System (VPDES) permits, but it is anticipated they will be in place by 2006 through general permit. According to its existing VPDES permit, the Rutledge Creek WWTP is required to monitor nutrients and submit an Interim Optimization Plan (IOP) to DEQ by January 10, 2006.

The purpose of the Interim Optimization Plan is as follows:

- The IOP will evaluate the ability of the existing Rutledge Creek WWTP to remove nutrients.
- The IOP will investigate and propose operational or process adjustments that can be utilized to reduce nutrient levels in the final effluent.
- The IOP explores minor process modifications that could improve nutrient removal without significant capital expense.

The Town of Amherst completed a facility upgrade in 2005 increasing the plant capacity from 0.4 MGD to 0.6 MGD. The upgrade consisted of installing a Kruger Double Ditch system. The ditches operate in a series of flow patterns that alternate process conditions within the ditch to perform specific treatment objectives.

The ambient ditch conditions are alternated between oxic, anoxic, and quiescent to accomplish nitrification, denitrification and clarification. The D-Ditch was not designed to fully denitrify at 0.6 MGD, and is currently operating with additional anoxic stages because it has not reached the design hydraulic loading. The ability to perform anoxic treatment is due to additional equipment provided beyond what was needed to meet the effluent limits that were in place at the time of construction.

Rutledge Creek WWTP currently receives an average daily flow of approximately 0.35 MGD. The Rutledge Creek WWTP was designed to treat an average daily flow of 0.6 MGD.

Effluent monitoring results from January to August 2005 were obtained and analyzed as part of the IOP. Also, a testing protocol was developed and executed in October and November 2005 to further understand the waste load entering and leaving the facility. The sampling protocol called for consecutive days of testing in October and November on the influent, effluent, and waste streams of the treatment plant.

Process control testing was performed as part of the sampling protocol to gauge performance of the D-ditch system. These tests were completed to help identify any limiting factors, insufficiencies, and to aide in identifying process adjustments to maximize treatment efficiency.

Analysis of the monitoring results and testing protocol shows that the facility, on average, has produced a low nutrient effluent, with a TP of less than 1.0 mg/L and a TN of approximately 4.0 mg/L.

Decisions were made during the design phase leading up to the 2005 facility upgrade to prepare for future nutrient removal requirements. The Kruger D-Ditch system was selected in part because of its ability to be easily retrofitted in order to meet nutrient removal requirements once established. The D-Ditch system was provided with two important options that promote conditions needed for nutrient reduction. The dissolved oxygen (DO) control system and submersible mixers are specific additions that were not required to meet their current permit limits. These improvements allow the facility to operate anoxic stages and perform denitrification.

Given the preemptive nutrient reduction efforts and the effluent monitoring results, it is apparent that the Rutledge Creek WWTP is operating at near optimal nutrient removal conditions. This is due to the current hydraulic loading of 0.35 MGD and can also be attributed to the additional equipment and phasing added to the WWTP during the 2005 improvements project. The plant discharges on average effluent with total nitrogen concentrations of less than 4 mg/L and total phosphorus concentrations of less than 1.0 mg/L. The following is a summary of optimization strategies implemented to date:

- The addition of mixers and dissolved oxygen control system during design and construction that allows for anoxic phasing of the D-Ditch to enhance nutrient removal.
- The Rutledge Creek WWTP currently incorporates additional D-Ditch phases into its treatment regime to take advantage of the ability to nitrify/denitrify. This is due to the fact that the plant is not currently operating at design hydraulic loading.
- The operators currently store I&I flows in a stand-by empty aerobic digester to alleviate the effects of intense hydraulic loading on the treatment system.

The following improvements will help to optimize overall plant performance:

- Lime addition to the D-Ditch should be flow paced to ensure proper alkalinity control in the ditch and to maintain hardness requirements.

- The iron fouling problems with the disc filter should continue to be addressed and resolved by the disc manufacturer. Additional cleaning equipment installation will provide for reliable tertiary filtration.

- Install and incorporate the 24-hour composite sampler into the regular sampling practices to more accurately determine effluent nutrient loads.

SECTION 1 – INTRODUCTION

1.1 Background

A large portion of the Chesapeake Bay and its tributaries are listed as impaired on Virginia's 303(d) list. These waters are cited for not meeting the aquatic life use support goal. One of the main reasons for this is the number of nutrient (nitrogen and phosphorus) rich tributaries flowing into the Bay.

The Virginia State Water Control Board's approval of new Water Quality Standards for the Chesapeake Bay and passage of legislation establishing the Chesapeake Bay Watershed Nutrient Credit Exchange Program has created new requirements for significant dischargers in the Chesapeake Bay's watershed. Final limits for the Upper James River Basin are established as 6 mg/L for total nitrogen (TN) and 0.5 mg/L of total phosphorus (TP) for most dischargers on the significant discharger list. These limits have not been incorporated into individual Virginia Pollutant Discharge Elimination System (VPDES) permits, but it is anticipated they will be in place by 2006 through general permit. Even though not all requirements of the new legislation have been established, significant dischargers in the watershed are required to monitor nutrients, and are required to submit a Basis of Design (BoD) Report and an Interim Optimization Plan (IOP).

The Town of Amherst owns and operates the Rutledge Creek Wastewater Treatment Plant (VPDES No. VA0031321). The facility completed an upgrade from 0.4 MGD to 0.6 MGD in 2005. The treatment facility is equipped with the following unit processes:

- Screening & Grit Removal
- Influent Pump Station
- Phased Isolation Oxidation Ditch Secondary Treatment
- Disc Filter Tertiary Treatment
- UV Disinfection
- Post Aeration
- Aerobic Digestion & Sludge Drying Bed
- Septage Receiving Facilities

Rutledge Creek is a tributary of the James River, and the treatment plant is listed as part on the significant discharger list. According to the approved Water Quality Management Program Regulations, the Rutledge Creek WWTP has an allocated total nitrogen concentration of 6 mg/L and a total phosphorus allocation of 0.5 mg/L at its current design capacity of 0.6 MGD. At full capacity, this equates to Waste Load Allocation (WLA) of 10,964 lbs/yr of total nitrogen, and 913 lbs/yr of total phosphorus.

1.2 Purpose

The purpose of the Interim Optimization Plan is as follows:

- The IOP will evaluate the ability of the existing Rutledge Creek WWTP to remove nutrients.
- The IOP will investigate and propose operational or process adjustments that can be utilized to reduce nutrient levels in the final effluent.
- The IOP explores minor process modifications that could improve nutrient removal without significant capital expense.

The IOP is required by the Rutledge Creek VPDES permit (No. VA0031321) and is to be submitted to the Department of Environmental Quality (DEQ) no later than January 10, 2006.

SECTION 2 – FACILITY DESCRIPTION

2.1 General WWTP Description

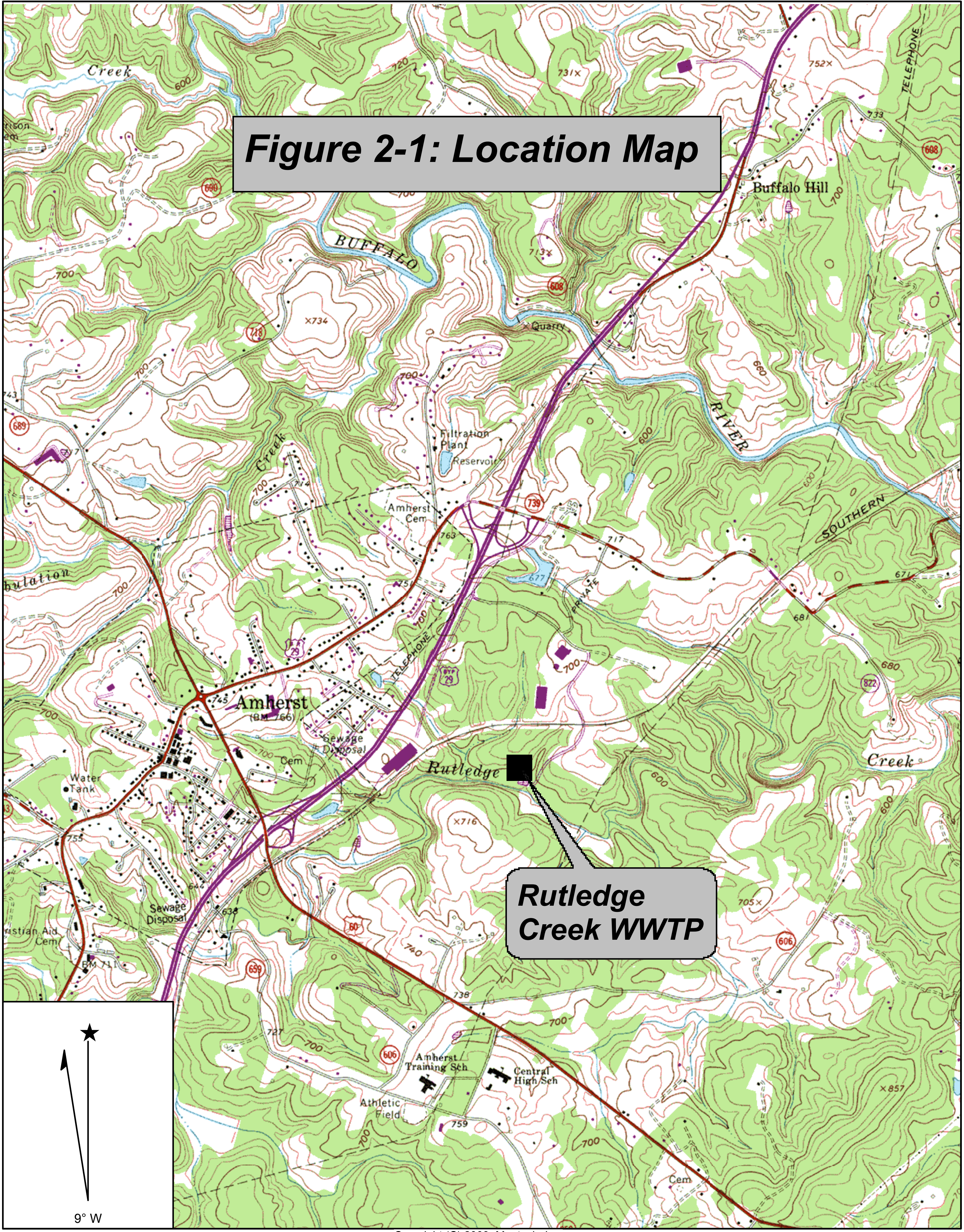
The Rutledge Creek WWTP (VPDES No. VA0031321) is located at the end of Industrial Drive in the Town of Amherst. See Figure 2-1 for a location map. The treatment plant is owned and operated by the Town of Amherst, and receives wastewater from the Town, nearby industrial parks, and Sweet Briar College. The VPDES permit has an effective date of December 28, 2004, and expires December 27, 2009. Current VPDES permit limits are summarized below in Table 2-1.

Table 2-1: Rutledge Creek WWTP Current VPDES Effluent Limits

Parameter	Q < 0.38 MGD		Q > 0.38 MGD	
	Monthly Avg.	Avg.	Monthly Avg.	Weekly Avg.
BOD_5	11.1 mg/L	16.7 mg/L	7.4 mg/L	11.1 mg/L
TSS	30 mg/L	45 mg/L	30 mg/L	45 mg/L
Ammonia-N (Jun-Nov)	14.7 mg/L	14.7 mg/L	12.1 mg/L	12.1 mg/L
Fecal Coliform	200 N/Cml	---	200 N/Cml	---
Total Hardness	120 mg/L (minimum)	---	120 mg/L (minimum)	---

The Town of Amherst completed a facility upgrade in 2005 increasing the plant capacity from 0.4 MGD to 0.6 MGD. The upgrade consisted of installing a Kruger Double Ditch system. In addition to the Kruger D-Ditch, the upgrade included the following new facilities: Lab/Control Building, Headworks and Influent Pump Station,

Figure 2-1: Location Map

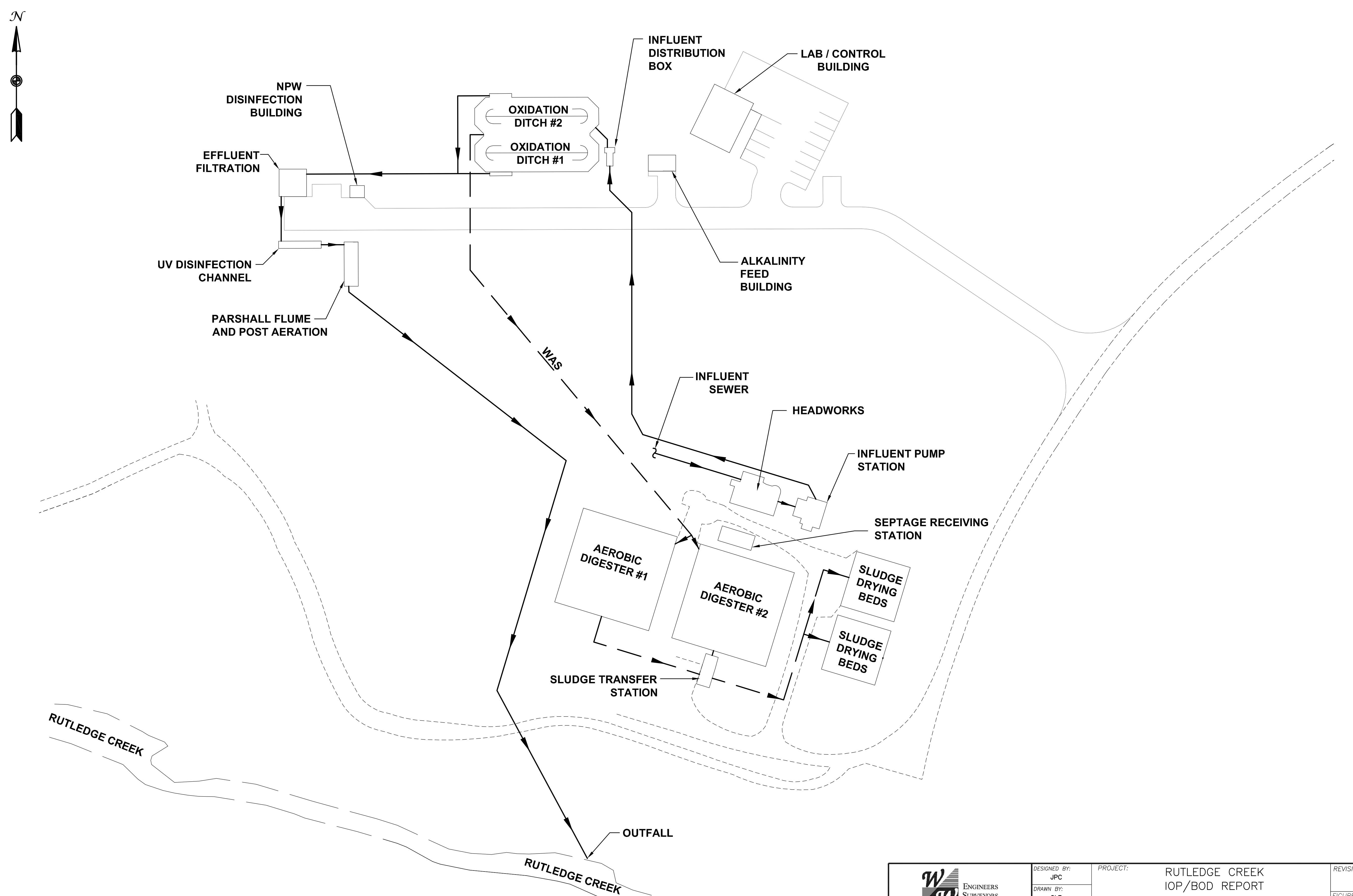


Lime Feed Building, Disc Filter, UV disinfection, Post Aeration, Non-Potable Water System, and Septage Receiving Station. Elements of the original WWTP were converted for use as aerobic sludge digesters. Sludge drying beds are used to dewater sludge, which is disposed of in the local landfill. Effluent is discharged to Rutledge Creek, a tributary of the James River and part of the Chesapeake Bay Watershed.

2.2 Preliminary Treatment

Influent wastewater flows into the WWTP through a 24-inch sewer that enters the headworks operation in the southern area of the facility. Refer to Figure 2-2 for a plant flow diagram. The influent sewer discharges to a 4-ft. deep dual concrete channel. The primary channel consists of a mechanical step screen with ¼-inch openings. The secondary channel is provided with a manual bar screen with 1 ½-inch bar spacing. Screenings are washed and compacted, then discharged and stored in a nearby dumpster for offsite disposal at the landfill.

After screening, wastewater flows into a 7-ft. diameter vortex grit unit. De-gritted raw sewage then flows through a 24-inch sewer to the Influent Pump Station Wet Well. Grit is pumped from the bottom of the vortex unit to a classifier, and then discharges to a dumpster for offsite disposal. The headworks channel is provided with a 12-inch overflow pipe that transfers influent wastewater to the aerobic digesters if necessary. This operation is used to control infiltration and inflow (I&I) by sending excessive



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DESIGNED BY: JPC	PROJECT: RUTLEDGE CREEK IOP/BOD REPORT				REVISION NUMBER:
DRAWN BY: CLP					
REVIEWED BY: JPC/HFW	TITLE: PLANT FLOW DIAGRAM				FIGURE NUMBER: 2–2
WWA NUMBER: 240232.07	FILE NAME:	DISCIPLINE:	SCALE: H: V:	DATE:	SHEET NUMBER:

influent flow to the aerobic digesters during wet weather flows. The held volume can later be decanted from the digester to the headworks.

The 10 ft. x 12 ft x 15 ft deep wet well of the Influent Pump Station collects wastewater following preliminary treatment. The pump station consists of three Gorman-Rupp TG A-B suction lift pumps. The pumps are equipped with variable speed drives and 40 HP motors. Each pump is rated for 860 gpm at 88 ft TDH. A 10-inch force main was built from the pump station to the influent distribution box of the D-Ditch. The discharge header located in the pump station building is also provided with an emergency pump connection.

2.3 Secondary Treatment

The secondary treatment process consists of the Kruger D-Ditch. This process is similar to conventional oxidation ditches, excepted for its use of phased isolation ditch (PID) technology. The process is a closed loop reactor where aeration of the mixed liquor takes place. The system is similar to a sequencing batch reactor due to the fact that it does not require secondary clarifiers for settling the mixed liquor or a return activated sludge system. The ditches operate in a series of flow patterns that alternate process conditions within the ditch to perform specific treatment objectives. Although treatment and clarification is carried out in a batch-type operation, influent flow to the ditches and effluent discharge is continuous.

The Rutledge Creek WWTP is provided with a number of components to provide aeration, mixing, and flow control to and from the unit. A partial list of major equipment is provided as follows:

- Influent Distributor
- Four 3.0-meter Horizontal Brush Aerators with 15 HP Motors
- Two 6.0 HP Submersible Mixers
- Two 5.0-meter Motor Actuated Effluent Weirs
- Two Manual Operated Rotating Scum Pipes
- Two Dissolved Oxygen Probes
- Two Ultrasonic Level Transmitters
- Programmable Logic Control (PLC) based Control Panel

The distributor directs wastewater from the Influent Pump Station into the respective ditch, depending on which phase the system is operating. The ambient ditch conditions are alternated between oxic, anoxic, and quiescent to accomplish nitrification, denitrification and clarification. The D-Ditch was not designed to fully denitrify at 0.6 MGD, and is currently operating with additional anoxic stages because it has not reached the design loading. The ability to perform anoxic treatment is due to additional equipment provided beyond what was needed to meet the effluent limits that were in place at the time of construction. Section 4 of this report will discuss these preemptive nutrient reduction efforts. As the hydraulic loading of the treatment plant increases, the treatment phases will be adjusted, decreasing the amount of time available for anoxic phases.

The brush aerators (rotors) are operated and controlled by the PLC, and operate during oxic stages. In addition to phased control, the rotors are controlled by dissolved oxygen (DO) levels in the respective ditches. The DO probes monitor oxygen levels during the specific phases and transmit a signal to the PLC that turns the rotors on or off to increase or reduce the DO level in the ditch.

The effluent weirs control the liquid level in the ditches and the flow of effluent from the ditches. The PLC adjusts the weir based on level indicators in the ditches to provide optimal submergence of the rotors. This maximizes oxygen transfer and reduces power consumption.

The theory of operation for the D-Ditch is as follows:

> Phased Isolation Ditch Technology in the D-Ditch mode of operation can be best understood by following the process through one complete 8-hour cycle of operation. One complete cycle set forth in this example consists of eight phases. The phases are labeled B, D, E, F, H, J, K, and L. Please note that Phases H, J, K, and L are simply "mirror images" of Phases B, D, E, and F.
>
> The cycle begins with Phase B followed by Phase D. Note that these phases are exactly the same and in this example the total duration of both phases is 3 hours (1.5 hrs each). If denitrification is desired additional anoxic phases will be incorporated into the system (refer to Table 2.2, phases A-D). In Phases B and D, the influent wastewater is directed to Ditch 1 (See Figure 2.3). Ditch 1 is in the aeration mode of operation. The rotors in Ditch 1 aerate the mixed liquor, resulting in the degradation of the influent BOD and nitrification of ammonia-nitrogen.
>
> In Phases B and D, the influent enters Ditch 1, where the effluent weirs are raised producing a hydraulic gradient that forces the mixed liquor to Ditch 2, where the biosolids settle. The motorized effluent weirs are lowered in Ditch 2 to allow the treated and clarified effluent to continue on to further treatment, such as filtration and disinfection. The process will continue to operate in the mode for 3 hours, before advancing to Phases E and F.

Table 2.2: D-Ditch Operational Phases

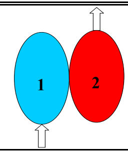
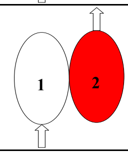
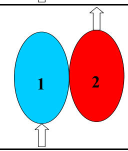
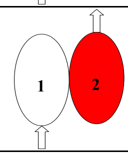
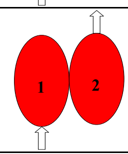
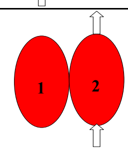
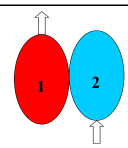
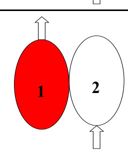
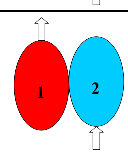
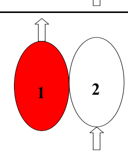
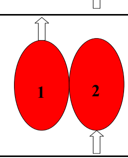
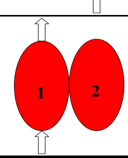
Phase	Flow Pattern/ Process Conditions	Operator Input. Time (min)	Ditch 1	Ditch 2
A		Default: 0 Range: 0-60	• Denitrification • Rotors off • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
B		Default: 90 Range: 0-180	• Nitrification • Rotors on • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
C		Default: 0 Range: 0-60	• Denitrification • Rotors off • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
D		Default: 90 Range: 0-180	• Nitrification • Rotors on • Mixers on • Weir up	• Settling • Rotors off • Mixers off • Weir down
E		Default: 30 Range: 0-60	• Settling • Rotors off • Mixers off • Weir up	• Settling • Rotors off • Mixers off • Weir down
F		Default: 30 Range: 0-60	• Settling • Rotors off • Mixers off • Weir up	• Settling • Rotors off • Mixers off • Weir down
G		Default: 0 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down	• Denitrification • Rotors off • Mixers on • Weir up
H		Default: 90 Range: 0-180	• Settling • Rotors off • Mixers off • Weir down	• Nitrification • Rotors on • Mixers on • Weir up
I		Default: 0 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down	• Denitrification • Rotors off • Mixers on • Weir up
J		Default: 90 Range: 0-180	• Settling • Rotors off • Mixers off • Weir down	• Nitrification • Rotors on • Mixers on • Weir up
K		Default: 30 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down	• Settling • Rotors off • Mixers off • Weir up
L		Default: 30 Range: 0-60	• Settling • Rotors off • Mixers off • Weir down	• Settling • Rotors off • Mixers off • Weir up

Figure 2.3: D-Ditch Process Phases B & D.

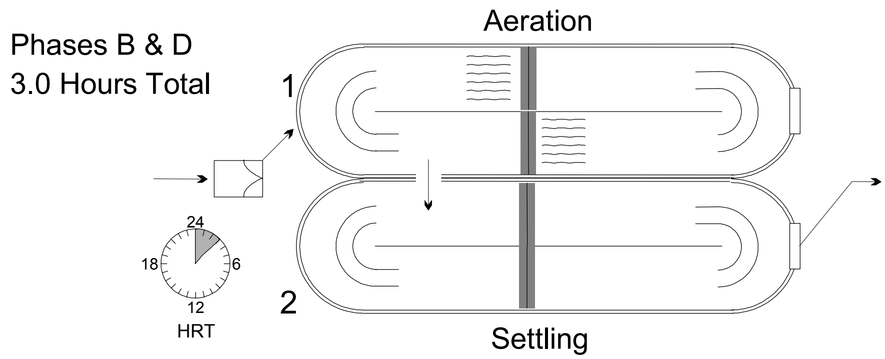
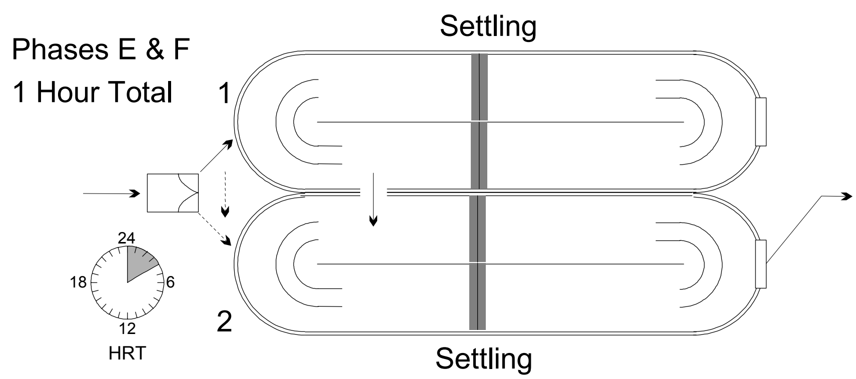


Figure 2.4: D-Ditch Process Phases E & F.



Phases E and F are intermediate phases with a total duration of 1.0 hour (0.5 hrs each), during which quiescent conditions are maintained in both ditches (See Figure 2.4). During these phases, Ditch 2 is still settling from the previous phase, and will continue settling throughout the duration of these phases. In addition, the effluent will continue to be discharged from Ditch 2 through both phases. After thirty minutes the system moves from Phase E to Phase F. The automated flap gate-type flow distributor in the distribution chamber, which was directing the influent to Ditch 1, switches position from the left to the right. This directs the influent to the inlet pipe discharging to Ditch 2, instead of Ditch 1. The purpose of Phase F is to completely isolate Ditch 1 from flow patterns to promote quiescent conditions. The distributor is operated automatically via PLC, however, the unit can also be operated manually in the event of an emergency

In Phases H and J, the effluent weirs in Ditch 2 are raised and the effluent weirs in Ditch 1 are lowered. The hydraulic gradient is now shifted so that the flow direction is from Ditch 2 to Ditch 1, with Ditch 1 discharging effluent (See Figure 2.5). It must be noted that Phases H and J are exactly the same and that anoxic sub-cycles can be included into the phasing by turning all of the rotors off and turning the mixer on. (refer to Table 2.2, phases G-J).

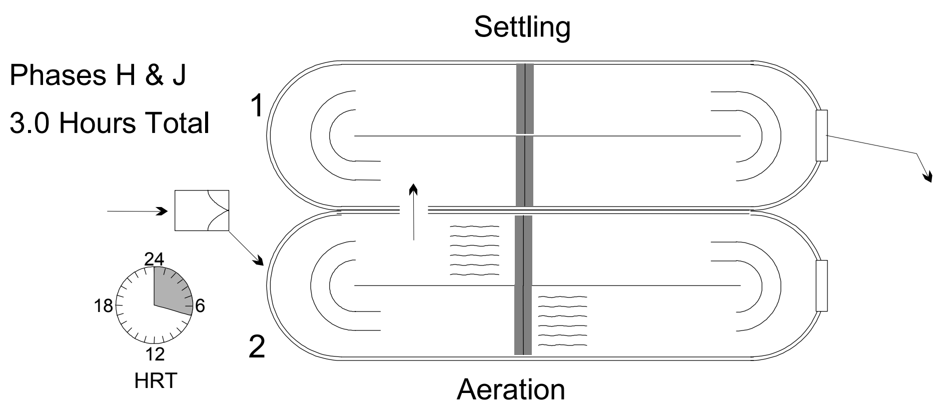


Figure 2.5: D-Ditch Process Phases H & J.

Ditch 1, which was quiescent in Phases E and F, will continue settling during Phases H and J. The rotors in Ditch 2 are turned on, and will maintain oxic conditions in Ditch 2 throughout Phases H & J (3.0 hours).

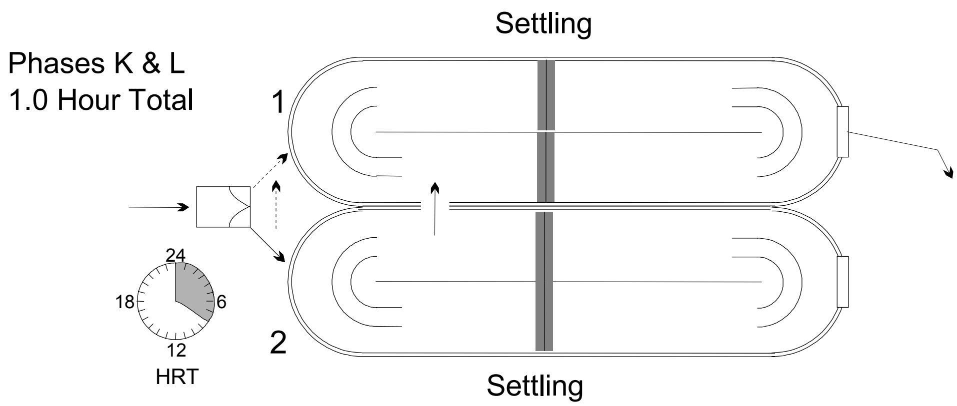


Figure 2.6: D-Ditch Process Phases K & L.

Phases K and L are other intermediate phases with a total duration of 1.0 hour (0.5 hrs each). Phase K is initiated by discontinuing aeration in Ditch 2. Ditch 1 continues to discharge effluent (See Figure 2.6). At the end of Phase K, the influent flow distributor changes position to direct flow back into Ditch 1 signaling the start of Phase L. The purpose of Phase L is to completely isolate Ditch 2 from flow patterns to promote quiescent conditions. At the end of phase L, the entire cycle will have been completed. The weirs in Ditch 1 will be raised, while the weirs in Ditch 2 are lowered and another 8 hour cycle of operation will begin.

One should note that based on a Hydraulic Retention Time (HRT) of 24 hours, one complete 8 hour cycle accounts for 33% of the HRT. In addition, sludge can be wasted from the ditch under oxic conditions as mixed liquor or during settling phases as settled sludge.

A total of twelve (12) phases are programmed into the system. All twelve phases are illustrated in Table 2.2 above. Please note that if the time duration of a phase is set to zero, the system will skip the phase in sequence and move into the following phase. The example provided above illustrates how the system will run based on the default settings.

2.4 Tertiary Filtration

Effluent from the D-Ditch flows by gravity to a Kruger Hydrotech Disc Filter. The Disc Filter is used as a polishing process to enhance TSS and BOD removal. The unit is mounted in a 22-ft. 8-in. square concrete structure with room for a future unit if needed. The structure is completed with an inlet channel, filtered water channel, and emergency bypass channel.

Water flows into the center of the drum of the unit and fills the filter segments. The filter segments are partially submerged. The head of the D-Ditch effluent pushes the water through the filter material, and solids are trapped on the inside of the unit. Filtered water passes through disc to the outside of the filter element. The filter elements are static until a maximum pre-determined head level is reached. When the head increases to approximately 12-inches, the unit initiates a backwash cycle. The filter elements are spun while simultaneously receiving countercurrent backwash from high-pressure spray nozzles. The backwash flow enters the waste channel and is sent to the Influent Pump Station. The filter disc unit is susceptible to iron fouling, and has experienced significant operational problems as a result.

2.5 Disinfection & Post Aeration

Disc Filter effluent flows by gravity to the ultraviolet (UV) disinfection channels. Two 2-ft. channels are provided for UV disinfection. Currently, one channel is used and the second is for future use. The primary UV channel is equipped with two banks of UV lamps. A weir is used to maintain a proper channel depth.

From the UV channel, wastewater flows to the Parshall Flume and Step Aerator. An ultrasonic meter is mounted in the flume to monitor effluent flow rates. The step aerator consists of 12 – 9-inch steps that increase dissolved oxygen levels prior to discharge.

2.6 WWTP Support Systems

The Rutledge Creek Lab/Control Building houses the laboratory, motor control center, the programmable logic controller and operator interface. From this location, the operators can monitor and operate various WWTP functions.

The non-potable water (NPW) system aids in a number of functions around the facility. Primary uses for NPW are for mix water at the Lime Feed

Building, backwash for the disc filter, spray wash for the step screen unit, and slurry wash at the vortex degritter. Yard hydrants around the facility are also provided for wash down purposes. The NPW system derives water from the end of the UV Disinfection Channel. A submersible pump supplies water to the NPW Building. The building is provided with a 116-gallon diaphragm tank and a hypochlorite feed system for disinfection.

2.7 Sludge Treatment and Disposal Facilities

Waste activated sludge from the D-Ditch is sent to the Aerobic Digesters. The digesters are converted aeration basins from the original WWTP. The concrete digesters are capable of holding and treating 219,000 gallons of waste sludge each. The digesters are provided with diffused aeration and mixing equipment. The digesters are also equipped with a septage receiving facility. Following treatment, inert sludge is transferred to the sludge drying beds. A polymer is mixed with the sludge during application to the beds to facilitate dewatering.

Rutledge Creek WWTP is equipped with 8 square sludge drying beds. The beds measure approximately 22-ft x 22-ft. The drying beds are also provided with roof covers to maintain a dry environment. Dried sludge is removed and hauled to a local landfill for final disposal.

SECTION 3 – WASTE CHARACTERIZATION

3.1 Wastewater Generation and Influent Characteristics

Rutledge Creek WWTP currently receives an average daily flow of approximately 0.35 MGD. This flow is generated by domestic, commercial, and industrial sources located throughout and surrounding the Town of Amherst.

Wastewater treatment plant flow data was collected and analyzed from January – August 2005, and are summarized in Table 3-1. The effluent flows were provided by a flow element at the Parshall flume. Flow rates are transmitted to the Control Building and recorded by the WWTP operational system.

Table 3-1: Rutledge Creek WWTP Flow Rates
(1/05 – 8/05)

Month	Monthly Average Effluent Flow (MGD)	Peak Day Effluent Flow (MGD)
January	0.3320	0.7213
February	0.3483	0.4090
March	0.3865	0.7142
April	0.4379	0.5571
May	0.3369	0.4126
June	0.3291	0.4113
July	0.3420	0.4993
August	0.3292	0.4406
Average	**0.3552**	**0.5207**
Peak:Average Ratio		**1.5**

* Flows as reported on DMRs.

Daily influent flow rates varied between 0.3291 MGD to 0.4379 MGD. Peak flows represented in Table 3-1 were peak day flow rates as recorded on the Monthly Data Review Sheets.

The Rutledge Creek WWTP was designed to treat an average daily flow of 0.6 MGD, and a peak design capacity of 1.2 MGD. The hydraulic design capacity of the treatment plant is 1.8 MGD. The peak:average ratio is 1.5 during this analysis. This is within the design ratio of 2.0 and the hydraulic design ratio of 3.0.

The Rutledge Creek operators collect and test influent wastewater samples on a regular basis, usually two times per week. The collected data from January – August 2005 was analyzed and is presented below in Table 3-2.

Table 3-2: Rutledge Creek WWTP Influent Monitoring Results (1/05 – 8/05)

Month	Average BOD_5 Loading		Average TSS Loading	
	mg/L	Kg/D	mg/L	Kg/D
January	155	340	175	357
February	144	234	144	233
March	206	351	635	1115
April	114	193	142	239
May	154	273	179	314
June	144	218	143	217
July	92	128	109	153
August	100	134	132	177
Averages	**142**	**240**	**223**	**378**
Design Values	**140**	**--**	**170**	**--**

The actual loading presented in Table 3-2 is close to the design criteria presented by the D-Ditch manufacturer's literature. Design information is presented below.

- BOD_5 = 140 mg/L
- TSS = 170 mg/L
- TKN = 40 mg/L

The actual influent TSS loading is slightly higher than target values. This is due to a unusually high loading that occurred in March 2005. Neglecting March, the actual TSS loads were equivalent to the design figures. Design temperatures range from 10-25^oC. Actual temperatures ranged from 10-12^oC in cold weather months, to 22-24^oC in warm weather months. Influent pH typically ranged from 6.9-7.6.

3.2 Effluent Monitoring

Effluent monitoring results from January to August 2005 were obtained and analyzed. Monitoring was completed in accordance with the VPDES permit requirements to ensure compliance with effluent limitations, presented in Table 2-1. In addition to the effluent monitoring required to meet existing permit limits, the facility is required to monitor various nutrients discharged to Rutledge Creek. Complete monitoring requirements are outlined in the VPDES permit provided in Appendix A. A summary of monitoring results is presented in Table 3-3.

Included in the monthly Discharge Monitoring Report (DMR) are effluent levels of total phosphorus (TP), orthophosphate, total nitrogen (TN), total kjeldahl nitrogen, and nitrite + nitrate. The Rutledge Creek WWTP operators are required to report these constituents twice per month. Analysis of the monitoring shows that the facility, on average, has produced a low nutrient effluent, with a TP of less than 1.0 mg/L and a TN of approximately 4.0 mg/L. The highest effluent TN recordings occurred in January and February at 11.4 mg/L and 8.7 mg/L, respectively. According to plant personnel, the elevated effluent nitrogen levels occurred due to the inability to waste sludge during construction. The January and February data should be disregarded.

Table 3-3: Rutledge Creek WWTP Effluent Monitoring Results (1/05 – 8/05)

Month	BOD5		TSS		Total Phos.		Ortho Phos.		TKN		NO2+NO3		Total N		Ammonia
	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L	Kg/D	mg/L
Jan*	4.3	5.7	4.4	5.8	1.2	1.4	0.0	0.0	11.1	12.2	0.3	0.3	11.4	12.5	---
Feb*	3.2	4.3	4.1	5.4	0.4	0.5	0.1	0.1	8.1	10.8	0.6	0.8	8.7	11.6	---
Mar	6.5	9.5	5.8	8.8	0.5	0.7	0.0	0.0	2.0	2.9	0.9	1.3	2.9	4.2	---
Apr	5.7	9.1	9.9	15.1	0.4	0.5	0.0	0.0	0.0	0.0	1.0	1.8	1.0	1.8	---
May	3.4	4.6	4.9	6.7	0.7	1.1	0.3	0.4	3.4	1.3	3.9	5.6	4.9	6.9	---
Jun	3.1	3.9	4.3	5.5	1.3	1.7	0.5	0.7	1.1	1.7	4.4	6.0	5.5	7.7	1
Jul	3.1	4.2	6.6	9.2	0.9	1.3	0.4	0.4	1.2	1.7	2.7	4.8	3.8	6.5	0.8
Aug	1.1	1.4	2.6	3.4	1.3	1.7	1.0	1.2	0.3	0.4	1.6	2.0	1.9	2.3	0.2
Averages*	**3.8**	**5.5**	**5.6**	**8.0**	**0.8**	**1.1**	**0.4**	**0.5**	**1.3**	**1.3**	**2.4**	**3.6**	**3.3**	**4.9**	**0.7**

*January/February data not factored into averages due to digester construction activities.

3.3 Additional Testing Protocol

To further understand the waste load entering and leaving the facility a testing protocol was developed and executed in October and November 2005. The sampling protocol called for three consecutive days of testing in October on the influent, effluent, and waste streams of the treatment plant. The following parameters were include in the protocol:

- COD (soluble)
- BOD_5
- $CBOD_5$
- TSS
- Ammonia
- TKN
- Nitrite + Nitrate
- Total Nitrogen
- Orthophosphate
- TP (soluble & particulate)
- Alkalinity
- pH
- DO
- Temperature

The samples were collected as 24-hour composites, with the exception of pH, DO, and temperature, which were grab samples. All waste sludge sampling was obtained as grab samples. The first round of sampling took place October 18-20. A second data set was developed in November. The November testing analyzed the influent conditions only. Results of the October and November testing are presented in Tables 3-4 and 3-5.

Process control testing was performed as part of the sampling protocol to gauge performance of the D-ditch system. These tests were completed to help identify any limiting factors, insufficiencies, and to aide in identifying process adjustments to maximize treatment efficiency. Testing was performed for the parameters listed below; results are presented in Table 3-6.

- Alkalinity
- pH
- DO
- Temperature
- SRT
- MLSS
- MLVSS
- Waste Rates
- SVI
- Lime Addition

Table 3-4: Influent and Effluent Testing Protocol Results

Parameter (mg/L unless otherwise noted)	Influent Testing Results						Effluent Testing Results			
	October			November			October			
	Day 1	Day 2	Day 3	Day 1	Day 2	Influent Avg.	Day 1	Day 2	Day 3	Effluent Avg.
COD	92	91	100	470	--	**188.3**	11	84	46	**47.00**
BOD5	153	119	182	194	--	**162.0**	1.2	1.9	2.7	**1.93**
CBOD5	125	218	155	153	190	**168.2**	nd	2	4	**3.00**
TSS	117	127	178	207	47	**135.2**	0.9	2.4	4	**2.43**
Ammonia	20.4	20	9	20.6	19.4	**17.9**	0.278	0.317	0.302	**0.30**
TKN	27.9	23.2	10.9	24.2	22.3	**21.7**	nd	nd	nd	**nd**
Nitrite+Nitrate	nd	0.49	0.11	nd	0.36	**0.32**	3.35	3.84	3.76	**3.65**
Total Nitrogen	27.9	23.69	11.01	24.2	22.66	**21.9**	3.35	3.84	3.76	**3.65**
Orthophosphate	2.14	5.85	3.1	2.84	1.48	**3.1**	0.31	0.38	0.41	**0.37**
Total Phosphorus	4.25	6.5	3.6	4	6.35	**4.9**	0.35	1.3	1.2	**0.95**
Soluble Phosphorus	1.2	3.1	2.9	1	3.9	**2.42**	0.19	0.55	0.14	**0.29**
Particulate Phosphorus	3.05	3.4	0.7	3	2.45	**2.52**	0.16	0.75	1.06	**0.66**
Alkalinity	195	204	194	181	166	**188**	150	158	160	**156**
pH, (s.u.)	7.3	7.2	7.2	7.2	7.4	**7.26**	7.8	7.8	7.7	**7.8**
D.O.	1	1.8	1.8	1.6	1.9	**1.62**	8.7	8.7	8.6	**8.7**
Temperature (^{0}C)	20.8	20.6	20.8	18.8	16.9	**19.6**	20.7	20.9	21.4	**21.0**
Flow (MGD)	0.3361	0.3155	0.3285	0.3361	0.3103	**0.33**	0.3361	0.3155	0.3285	**0.33**

Table 3.5 – Waste Testing Protocol Results

Parameter (mg/L unless otherwise noted)	October			
	Day 1	Day 2	Day 3	Avg.
COD	2950	1650	540	**1713**
BOD5	809	771	780	**786**
CBOD5	1260	1380	1740	**1460**
TSS	13705	11825	10510	**12013**
Ammonia	4.22	0.153	2.26	**2.2**
TKN	6	nd	3.9	**5.0**
Nitrite+Nitrate	nd	0.36	0.59	**0.5**
Total Nitrogen	6	0.36	4.49	**3.6**
Orthophosphate	12.6	27.6	18	**19.4**
Total Phosphorus	14.5	34	20.5	**23.0**
Soluble Phosphorus	2.3	1.9	1.1	**1.8**
Particulate Phosphorus	12.2	32.1	19.4	**21.2**
Alkalinity	566	548	500	**538**
pH, (s.u.)	7.1	7.2	7.2	**7.2**
D.O.	0.4	1.2	0.2	**0.6**
Temperature (^{0}C)	20.8	21.2	20.8	**20.9**

Table 3.6 – Process Control Testing Results

Parameter	Ditch 1			Ditch 2			Avg.
	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	
Alkalinity, (mg/L as $CaCO_3$)	---	236	207	227	---	---	**223**
pH, (s.u.)	7.3	7.2	7.2	7.2	7.2	7.1	**7.2**
D.O., (mg/L)	1	1.4	1.5	1.2	1.2	0.5	**1.1**
Temperature, (^{0}C)	20.5	20.4	20.9	26.6	20.6	21.2	**21.7**
SRT, (d)	11	11	16	11	11	16	**12.7**
MLSS, (mg/L)	3155	3380	3090	3115	3150	3115	**3167**
MLVSS, (mg/L)	2110	2215	2095	2050	2115	2160	**2124**
SVI	65	59	65	74	67	67	**66**
Lime Addition, (lbs/d)	145	145	145	---	---	---	**145**

SECTION 4 – INTERIM OPTIMIZATION

4.1 Preemptive Nutrient Reduction Actions

Decisions were made during the design phase leading up to the 2005 facility upgrade to prepare for future nutrient removal requirements. The Kruger D-Ditch system was selected in part because of its ability to be easily retrofitted in order to meet nutrient removal requirements once established. Furthermore, during the WWTP improvements project, the core treatment units were relocated out of the flood plain as a measure to prevent damage and to help prevent the release of untreated wastewater to the environment.

The D-Ditch system was provided with two important options that promote conditions needed for nutrient reduction. The dissolved oxygen (DO) control system and submersible mixers were specific additions that were not required to meet their current permit limits.

DO control provides a setpoint for dissolved oxygen concentration during oxic phases of treatment. The system is PLC controlled and receives its input from two DO probes located in the respective ditches. A deadband width is used in the programming to allow fluctuations over a set target range. The setpoint design value is 1.0 mg/L with a dead-band of 0.5 mg/L. During aeration, when the DO concentration reaches 1.5 mg/L, one rotor in the ditch would be turned off. Likewise, if the DO concentration falls to 0.5 mg/L, a rotor would be turned back on. Automatic DO control provides optimal conditions for denitrification by decreasing DO during anoxic phases of operation and maximizing simultaneous denitrification during oxic phases. This control also reduces rotor operating times and results in energy savings.

Each ditch is provided with a 6.0-HP submersible mixer. The addition of the mixers to the treatment system allows for denitrification by providing anoxic conditions. An anoxic condition is defined by the lack of free oxygen, but the presence of chemically bound oxygen, such as nitrates and nitrites. During these stages, the mixers are operational and the rotors are turned off, resulting in a DO concentration of less than 0.1 mg/L. The denitrification stage is optional at the Rutledge Creek WWTP, however the operators currently utilize the anoxic phase to take advantage of the nutrient reduction capabilities that the Rutledge Creek D-Ditch offers.

During wet weather periods, the Rutledge Creek facility receives higher than usual flows that are attributed to infiltration and inflow (I&I). The operators at the facility have initiated a policy to discharge excess flow to a stand-by aerobic digester, that is empty in anticipation of wet weather. This alleviates the effects of I&I on the treatment process. The excess I&I is eventually pumped out of the digester to the treatment process once flows recede.

Sampling requirements of the VPDES permit indicate that eight-hour composites are required for nutrient monitoring. During the testing protocol outlined in Section 3, an ISCO automated sampler was utilized to draw composite samples. The operators configured the sampler to draw 24-hour composite samples in lieu of the 8-hour sample to provide a better representation of the effluent stream. The operators plan to continue collecting 24-hour composites as part of their discharge monitoring reporting.

4.2 Process Optimization Analysis

This section will compare actual vs. design operating conditions for the D-Ditch using testing results of Section 3. Refer to Table 4-1. The actual measured operating parameters are within acceptable ranges according to the manufacturer's recommendations.

Although the facility is not designed to denitrify at the design capacity, it is currently operating in a fashion to achieve enhanced nutrient removal. This is evident by the low

Table 4-1: Rutledge Creek D-Ditch Design vs. Actual Operating Parameters

Parameter	Design Value	Range	Actual Value	Units
Hydraulic Retention Time	24	---	40	Hours
Mixed Liquor Suspended Solids, MLSS	4,000	2,500-4,200	3167	mg/L
MLVSS/MLSS	70	65-75	67	%
Sludge Retention Time, SRT (Oxic)	12	6-18	12.7	Days
Total F/M, kgBOD/kgMLSS/d	0.05	0.04-0.06	0.044	lbs/lbs/lbs
Dissolved Oxygen, DO	1.0	0.5-2.0	1.1	mg/L

total nitrogen and total phosphorus loads measured in the effluent. Currently, the Rutledge Creek WWTP is achieving an average effluent TN of less than 4 mg/L, and a TP of approximately 1 mg/L.

Given the preemptive nutrient reduction efforts, and the effluent monitoring results, it is apparent that the D-Ditch is operating at a high level of efficiency. This is due to the current hydraulic loading of 0.35 MGD and the advantages of anoxic treatment phases available in the D-Ditch. It is unlikely that any changes to the phasing, operating parameters, or treatment techniques will result in any further optimization. As the hydraulic loading increases to the design flow of 0.6 MGD, the treatment phases will be adjusted to shorten the amount of time available for anoxic treatment.

4.3 Other Facility Improvements

The Hydrotech Disc Filter has experienced operational problems that appear to be from iron oxidizing on the filter elements. When this occurs, the elements clog, and filtration cannot take place. The backwash process is functional, but does not fully remedy the situation. Supplemental manual washing of the elements is required by the operators to keep the units clean. The disc manufacturer is in the process of remedying the filter deficiencies. Recent discussions have indicated that a chemical feed system is proposed to operate automatically with the existing unit. A proposal from the manufacturer regarding the proposed equipment is scheduled for delivery in January 2006.

Lime addition at the treatment plant is utilized to maintain a minimum hardness as required by the VPDES permit. The Lime Feed Building provides storage and houses the lime mixing and feed equipment. The NPW system supplies feed water and pressure for the lime system. At its current configuration, the NPW system is not providing the required pressure to properly feed the lime mixture through the lime feed ejector.

The lime mixture is added at the headworks of the D-ditch system. The lime feed system is currently controlled manually. The equipment for flow-paced control of the lime system is in place, but the proper programming is not available. By providing automatic control, will prevent the over usage of chemical and ensure enough lime is added to meet hardness requirements.

4.4 Optimization Summary

From the above analysis, it is apparent that the Rutledge Creek WWTP is operating at near optimal nutrient removal conditions. This can be attributed primarily to the additional equipment added during the upgrade, and D-Ditch phasing that was instituted during the 2004-2005 facility improvements project. The plant discharges on average effluent with total nitrogen concentrations of less than 4 mg/L and total phosphorus concentrations of less than 1.0 mg/L. The following is a summary of optimization strategies implemented to date:

- The addition of mixers and dissolved oxygen control system during design and construction that allows for anoxic phasing of the D-Ditch to enhance nutrient removal.

- The Rutledge Creek WWTP currently incorporates additional D-Ditch phases into its treatment regime to take advantage of the ability to nitrify/denitrify. This is due to the fact that the plant is not currently operating at design hydraulic loading.

- The operators currently store I&I flows in a stand-by empty aerobic digester to alleviate the effects of intense hydraulic loading on the treatment system.

The following improvements will help to optimize overall plant performance:

- Lime addition to the D-Ditch should be flow paced to ensure proper alkalinity control in the ditch and to maintain hardness requirements.

- The iron fouling problems with the disc filter should continue to be addressed and resolved by the disc manufacturer. Additional cleaning equipment installation will provide for reliable tertiary filtration.

- Install and incorporate the 24-hour composite sampler into the regular sampling practices to more accurately determine effluent nutrient loads.

APPENDIX 13
RECOMMENDED SPARE PARTS INVENTORY

Process Component	**Qty**	**Description**
Centrifugal Pump Control	1	Control Panel (Keypad) Connector
	1	Control Panel (Keypad)
	1	Control Panel Extension Cable 8ft.
	1	DeviceNet Fieldbus Module
	1	Fan Kit, R1 Frame Size, Aquavar CPC
	1	Fan Kit, R2 Frame Size, Aquavar CPC
	1	Fan Kit, R3 Frame Size, Aquavar CPC
	1	Fan Kit, R4 Frame Size, Aquavar CPC
	1	Fan Kit, R5 Frame Size, Aquavar CPC
	1	Fan Kit, R6 Frame Size, Aquavar CPC
	1	Fan Kit, R7 Frame Size, Aquavar CPC
	1	Fan Kit, R8 Frame Size, Aquavar CPC
UniMag Flowmeters	1	Calibrated UniMAg sensor pair for up to 6 flowmeters of each flowmeter size
ChemMag Flowmeters	1	One spare ChemMag is recommended for up to six flowmeters for each flowmeter size
Chain Hoist	1	Pawl
	1	Pawl Bushing
	1	Pawl Retaining Washer
	1	Pawl Stud Snap Ring
	1	Pawl Spring
	2	Friction Washers
	1	Gear Cover Gasket (1/4, ½ & 1T.)
	1	Gear Cover Gasket (1-1/2 – 10T.)
	1	Gear Cover Gasket (Trolley Hoist)
HVAC System	1	Power Converter
	1	Keypad Display
	2	Control Fuses Primary
	1	Control Fuses Secondary
	1	Pilot Light Red
	1	Pilot Light Yellow
	1	Pilot Light Green
	1	Pilot Light Mounting Collar w/ Light Module

Process Component	Qty	Description
HVAC System (continued)	1	Analog I/O Board
	1	LONWORKS TO MODBUS Module
	1	MODBUS
	1	METASYS N2
	1	24 Vdc supply
	2	3R Hood Filter Material
	1	3R Space Heater
	1	3R Ventilation Fan
	1	User termination to D-shell interface device
	1	Stirring Fan Assembly
	1	Heatsink Fan Assembly
W105Z Volumetric Feeder	1	Motor
	1	Gear-reducer
	1	Gearbox (complete with seal housing assembly and all components thereof)
	1	Conditioning Auger
	1	Metering Auger
	1	“A” Drive Gear
	1	“A” Driven Gear
	1	“B” Drive Gear
	1	“B” Driven Gear
Oxidation Ditch Equipment	1	Rotor Gearbox Oil Pump
	1	Bearing Set (per mixer)
	1	Mechanical Seal Set (per mixer)
	1	O-ring Set (per mixer)
UV Disinfection	12	UV Lamps
	6	Quartz Jackets
	6	Double Lip Seal assembly
	1	Lamp Module Assembly
	3	Ballast Assembly
Digester Blowers	1	Bearing Set
	1	Inlet Filter Medium
Digester Mixers	1	Bearing Set

APPENDIX 14

LABORATORY CHEMICALS AND REAGENTS

The following chemicals and reagents should be included in the Rutledge Creek WWTP laboratory.

Description	Quantity
Buffer, Reference, pH 4, cc 500 ml	1 Ea
Buffer, Reference, pH 7, cc 500 ml	1 Ea
Buffer, Reference, pH 10, cc 500 ml	1 Ea
Buffer, Phosphate, for BOD, 500 ml	1 Ea
Nutrient Buffer Pillows (BOD), 50/pack	1 Pack
Sodium Hydroxide (NaOH) Solution, 2N, 1 L	1 Ea
Nitrification Inhibitor, Formula 2533, 35 g, with Dispenser Cap	1 Ea
BOD Seed Inoculum (Polyseed), 50/pack	1 Pack
Coated PVC Chem Wipes, 25/pack	1 Pack
BOD Standard Solution, 16 ampules/pack	1 Pack
Potassium chloride, 4M, 2 oz., with silver chloride	1 Ea
Drierite, No. 8 mesh, Indicating, 1 lb	1 Ea

APPENDIX 14
LABORATORY EQUIPMENT

The following equipment are recommended items to be included in the Rutledge Creek WWTP laboratory.

Description	*Quantity*
Scale, 0.1 mg Sensitivity, Digital Readout	1 Ea
BOD Incubator with Thermometer	1 Ea
Refrigerator for Samples	1 Ea
Beaker, 100 ml	2 Ea
Beaker, 250 ml	10 Ea
Beaker, 1000 m, Plastic	3 Ea
Settlometer, Glass, 2L	1 Ea
Bottle, BOD, 300 ml, with Ground Glass Stopper	50 Ea
Cylinder, Graduated, 10 ml	2 Ea
Cylinder, Graduated, 100 ml	1 Ea
Cylinder, Graduated, 250 ml	3 Ea
Cylinder, Graduated, 500 ml	2 Ea
Cylinder, Graduated, 1000 ml	2 Ea
Dessicator	1 Ea
Filter, Glass Fiber, 2.1 cm, 100/Pack	1 Pack
Flask, Erlenmeyer, 250 ml	5 Ea
Flask, Erlenmeyer, 500 ml	6 Ea
Flask, Filtering, 1000 ml	6 Ea
Hot Plate	1 Ea

Description	*Quantity*
Furnace, Drying	1 Ea
Oven, drying, large	1 Ea
Portable pH/ISE Meter, 0-14 pH Units, with pH electrode, batteries, buffers, beakers, and manual	1 Ea
Spare pH Electrode	1 Ea
Electrode Stirrer	1 Ea
Electrode Washer	1 Ea
Pipette, Volumetric, 2 ml, 12/Pack	1 Pack
Pipette, Volumetric, 3 ml, 12/Pack	1 Pack
Pipette, Volumetric, 5 ml, 12/Pack	1 Pack
Pipette, Volumetric, 6 ml, 12/Pack	1 Pack
Pipette, Volumetric, 9 ml, 12/Pack	1 Pack
Pipette, Volumetric, 10 ml, 12/Pack	1 Pack
Pipette Bulb	2 Ea
Pipette Support Rack	1 Ea
Stirrer, Magnetic, with 2 Stirring Bars	1 Ea
Thermometer, with Case, -35º to 50º C Calibration	2 Ea
Thermometer, -10º to 110º C	1 Ea
Tubing, Glass, 6 mm	2 Ft
Tubing, Poly, ¼-inch O.D.	10 Ft
Tubing, Poly, ⅜-inch O.D.	10 Ft
Tubing, Rubber, ¼-inch O.D.	12 Ft

Description	*Quantity*
Distilled Water, 1 gallon	5 Ea
Vacuum Pressure Pump	1 Ea
Benchtop DO Meter, 115 V power supply, with electrode, cable, (2) membranes, sample containers, electrolyte filling solution, and manual	1 Ea
Portable DO Meter, with 3-meter cable probe, (2) membranes, batteries, sample containers, electrolyte filling solution, and manual	1 Ea
HACH DO Probe Service Kit	1 Ea
Timer with Battery	1 Ea
Alkalinity Test Kit	1 Ea
Turbidmeter	1 Ea
Sample bottle, 125 ml, plastic	10 Ea
Sample bottle, 25 ml, plastic	5 Ea
Sample bottle, 1000 ml, plastic	10 Ea
Sample bottle, 2000 ml, plastic	2 Ea
Sample bottle, 10 ml, plastic	5 Ea
Filter flask, 500 ml, glass	5 Ea
Microscope	1 Ea
Sample bottles, sulfuric acid preservative	30 Ea
Sample bottles, nitric acid preservative	30 Ea
E.Coli sample kits	30 Ea
DO sample bottles	20 Ea
Sample bottle, hydrochloric acid preservative	2 Ea

Description	*Quantity*
Sample bottle, 10 L	1 Ea
Sample bottle, 15 L	1 Ea
Portable Automatic Sampler	1 Ea
Standard Methods, Current Edition	1 Ea
Blank Log Book	1 Ea

Appendix 15
Equipment Warranty Summary

Equipment Description	Warranty Page Number
Effluent Filter	1
HVAC System	2-5
Bubbler Flow Meter	6
Battery Backed Power Packs	6
Refrigerator Composite Sampler	7
Multi parameter Water Quality Monitor	7
Diesel Generator	8-9
Grit Pump	10
Centrifugal Pump Control	11
Oxidation Ditch Equipment	12-17
Submersible Solids Handling Pumps	18-21
Hydrated Lime Feed System	22-23
UV Disinfection	24
Magnetic Flowmeters	25-28
Telescoping Valve	28
Hoist & Trolley	30-31
NPW Disinfection Equipment	26
Mechanical Step Screen	32
Washpress	32
Polymer Feed System	33-38

LIMITED WARRANTY

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos products from which it was purchased together with proof of purchase and installation date, failure data, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact the Grundfos factory or authorized service station for instructions. Any defective product to be returned to the factory or service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

GRUNDFOS®
Leaders in Pump Technology

Grundfos Pumps Corporation • 3131 N. Business Park Avenue • Fresno, CA 93727
Customer Service Centers: Allentown, PA • Fresno, CA
Phone: (559) 292-8000 • Fax: (559) 291-1357
Canada: Oakville, Ontario • Mexico: Apodaca, N.L.

Visit our website at www.us.grundfos.com

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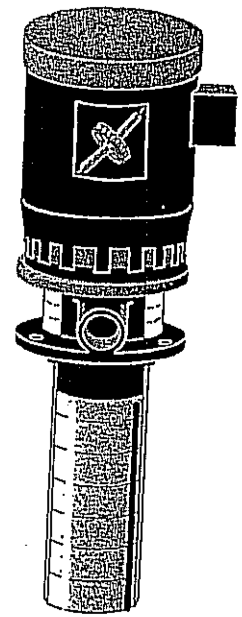
PRINTED IN USA

SPK/CRK/MTR COOLANT PUMPS

Installation and Operating Instructions

CONTENTS



Please leave these instructions with the pump for future reference

GRUNDFOS®
Leaders in Pump Technology

Warranty
Central Air Conditioner

TTA, TTN, TTP, TTR, TTB, TTX, TTY and TTZ (Parts Only)

This warranty is extended by American Standard to the original purchaser and to any succeeding owner of the real property to which the Air Conditioner is originally affixed, and applies to products purchased and retained for use within the U.S.A. and Canada. There is no warranty against corrosion, erosion or deterioration.

If any part of your Air Conditioner fails because of a manufacturing defect within one year from the date of original purchase, Warrantor will furnish without charge the required replacement part.

In addition, if the sealed motor-compressor(s) fail(s) because of a manufacturing defect within the second through fifth year from the date of original purchase, Warrantor will furnish without charge a replacement compressor(s). Warrantor's obligations and liabilities under this warranty are limited to furnishing F.O.B. Warrantor factory or warehouse replacement parts for Warrantor's products covered under this warranty. Warrantor shall not be obligated to pay for the cost of lost refrigerant. No liability shall attach to Warrantor until products have been paid for and then liability shall be limited solely to the purchase price of the equipment under warranty shown to be defective.

THE WARRANTY AND LIABILITY SET FORTH HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, WHETHER IN CONTRACT OR IN NEGLIGENCE, EXPRESS OR IMPLIED, IN LAW OR IN FACT, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR USE, AND IN NO EVENT SHALL WARRANTOR BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

American Standard Inc.
2701 Wilma Rudolph Blvd.
Clarksville, TN 37040-1008
Attention: Manager, Product Service

TW-338-0597

* This warranty is for commercial usage of said equipment and not applicable when the equipment is used for a residential application. Commercial use is any application where the end purchaser uses the product for other than personal, family or household purposes.

Warranty

Commercial Equipment Rated 20 Tons and Larger and Related Accessories

(Parts Only)

PRODUCTS COVERED —This warranty is extended by American Standard Inc., and applies only to commercial equipment rated 20 tons and larger and related accessories purchased and retained for use within the U.S.A. and Canada.

Warrantor warrants for a period of 12 months from initial start-up or 18 months from date of shipment, whichever is less, that the products covered by this warranty (1) are free from defects in material and manufacture, and (2) have the capacities and ratings set forth in catalogs and bulletins; provided, that no warranty is made against corrosion, erosion or deterioration. Warrantor's obligations and liabilities under this warranty are limited to furnishing, F.O.B. factory replacement parts (or equipment at the option of Warrantor) for all Warrantor's products not conforming to this warranty. Warrantor shall not be obligated to pay for the cost of lost refrigerant. No liability whatever shall attach to Warrantor until said products have been paid for and then said liability shall be limited to the purchase price of the equipment shown to be defective.

THE WARRANTY AND LIABILITY SET FORTH HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, WHETHER IN CONTRACT OR IN NEGLIGENCE, EXPRESS OR IMPLIED, IN LAW OR IN FACT, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR USE, AND IN NO EVENT SHALL WARRANTOR BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

American Standard Inc.—Warrantor
2701 Wilma Rudolph Blvd.
Clarksville, TN 37040

GW-598-4799

TERMS AND CONDITIONS

DESIGN CHANGES The Company reserves the right to make changes in design, improvements and additions in and to its products any time without imposing any liability or obligations to itself to apply or install the same in any product manufactured by it.

TITLE The title and right of possession of the equipment sold herein shall remain with the Company and such equipment shall remain personal property until all payments herein (including deferred payments whether evidenced by notes or otherwise) shall have been made in full in cash and the Purchaser agrees to do all acts necessary to perfect and maintain such right and title in the Company.

SAFETY ACCESSORIES The Company manufactures equipment designed to serve multiple applications and offers a wide range of safety equipment, including guards and other devices, as may be required to meet customer specifications. Without exception, the Company recommends that all orders include applicable safety devices. Equipment ordered without applicable safety devices is clearly the responsibility of the Purchaser. Further, the Purchaser warrants that he has determined and acquired any and all safety devices required for equipment sold by the Company. Weather covers and guards for motor and V-belt drives, couplings, shafts and bearings, along with inlet and outlet screens, are optional accessories noted in the price list.

These instructions cover the usual installation, operation and maintenance methods for which the product(s) was designed. They do not purport to cover all details or variations in the product(s) nor to provide for every possible contingency that might be met in connection with the installation, operation and maintenance. For any departures from these instructions, or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the Company.

WARNING The Company products are designed and manufactured to provide reliable performance but they are not guaranteed to be 100% free of defects. Even reliable products will experience occasional failures and this possibility should be recognized by the User. If these products are used in a life support ventilation system where failure could result in loss or injury, the User should provide adequate back-up ventilation, supplementary natural ventilation or failure alarm system, or acknowledge willingness to accept the risk of such loss or injury.

WARNING DO NOT use in HAZARDOUS ENVIRONMENTS where fan's electrical system could provide ignition to combustible or flammable materials unless unit is specifically built for hazardous environments. Comply with all local and national safety codes including the National Electrical Code (NEC) and National Fire Protection Act (NFPA).

CAUTION Guards must be installed when fan is within reach of personnel or within seven (7) feet (2.134 m) of working level or when deemed advisable for safety.

DISCLAIMER The Company has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions or dimension.

LIMITED WARRANTY

WARRANTY AND DISCLAIMER: The Company extends this limited warranty to the original buyer and warrants that products supplied by the Company, shall be free from original defects in workmanship and materials for two years from date of shipment (except for the warranty periods noted for products listed below), provided same have been properly handled, stored, installed, serviced, maintained and operated. This warranty shall not apply to products which have been altered or repaired without the Company's express authorization, or altered or repaired in any way so as, in the Company's judgment, to affect its performance or reliability, nor which have been improperly installed or subjected to misuse, negligence, or accident, or incorrectly used in combination with other substances. The Buyer assumes all risks and liability for results of use of all products.

Evaporative cooling pads are warranted to be free of defects in materials and workmanship for a period of two years from date of shipment provided same have been properly handled, stored, installed, serviced, maintained and operated; and further, not subjected to excessive heat, corrosive agents or chemicals, or mechanical abuse that may cause tearing, crushing or undue deterioration, nor used on a system or in a manner other than that for which it was designed as explained in the product literature.

The following products are warranted to be free of defects in materials and workmanship for the periods shown from date of shipment: The Company's exclusive duplex split pillow block bearings and shaft five years, belts one year, Polyethylene tubing 90 days, AIR40 Heater warranty one year, AIR40 Emitter warranty three years and DDP fan lifetime warranty on its propeller, cone, and housing.

LIMITATION OF REMEDY AND DAMAGES: All claims under this warranty must be made in writing and delivered to P. O. Box 978, Muskogee, Oklahoma, 74402, within 15 days after discovery of the defect and prior to the expiration of two years from the date of shipment by the Company of the product claimed defective, and Buyer shall be barred from any remedy if Buyer fails to make such claim within such period.

Within 30 days after receipt of a timely claim, the Company shall have the option either to inspect the product while in Buyer's possession or to request Buyer to return the product to the Company at Buyer's expense for inspection by the Company. The Company shall replace, or at its option repair, free of charge, any product it determines to be defective, and it shall ship the repaired or replacement product to Buyer F.O.B. point of shipment; provided, however, if circumstances are such as in the Company's judgment to prohibit repair or replacement to remedy the warranted defects, the Buyer's sole and exclusive remedy shall be a refund to the Buyer of any part of the invoice price, paid to the Company, for the defective product or part.

The Company is not responsible for the cost of removal of the defective product or part, damages due to removal, or any expenses incurred in shipping the product or part to or from the Company's plant, or the installation of the repaired or replaced product or part.

Implied warranties, when applicable, shall commence upon the same date as the express warranty provided above, and shall, except for warranties of title, extend only for the duration of the express warranty. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. The only remedy provided to you under an applicable implied warranty and the express warranty shall be the remedy provided under the express warranty, subject to the terms and conditions contained therein. The Company shall not be liable for incidental and consequential losses and damages under the express warranty, any applicable implied warranty, or claims for negligence, except to the extent that this limitation is found to be unenforceable under applicable state law. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

No employee, agent, dealer, or other person is authorized to give any warranties on behalf of the Company or to assume for the Company any other liability in connection with any of its products except in writing and signed by an officer of the Company.

REPLACEMENT PARTS If replacement parts are ordered, buyer warrants that the original components in which these replacement parts will be placed are in satisfactory working condition, and when said replacement parts are installed, the resultant installation will operate in a safe manner, at speeds and temperatures for which the original equipment was purchased.

TECHNICAL ADVICE AND RECOMMENDATIONS, DISCLAIMER: Notwithstanding any past practice or dealings or any custom of the trade, sales shall not include the furnishing of technical advice or assistance or system design. Any such assistance shall be at the Company's sole option and may be subject to additional charge.

The Company assumes no obligation or liability on account of any recommendations, opinions or advice as to the choice, installation or use of products. Any such recommendations, opinions or advice are given and shall be accepted at your own risk and shall not constitute any warranty or guarantee of such products or their performance.

GENERAL In no event shall any claim for consequential damages be made by either party. The Company will comply with all applicable Federal, State, and local laws.

MAINTENANCE INSTRUCTIONS

In order to maintain the efficiency of the unit heat, it should be ected periodically and any dirt that may have accumulated uld be removed from the heating element, fan blades and motor using a soft brush or a vacuum cleaner.

5 kw & 7.5 kw Heaters: The heating element is accessible by removing the louvered bezel, front section of the heater. Loosen, but do not remove, 4 recessed head screws located to the rear of louvers (Figure 4). Grasp bezel on both sides, lift up and pull out, disengaging bezel. After servicing the unit, reverse this procedure to replace bezel.

To service the motor, remove the rear wire safety grille (Figure 5).

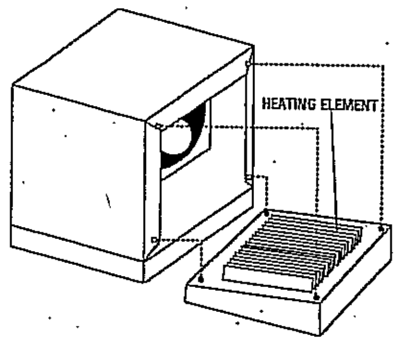


Figure 4

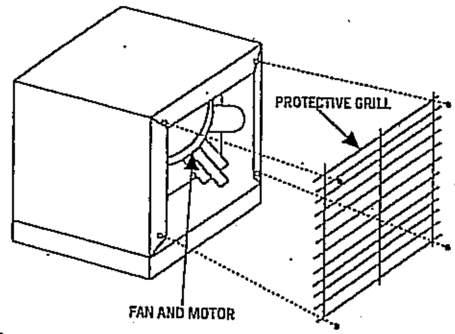


Figure 5

10 kw through 30 kw Heaters: The heating element surface and fan motor area are accessible by removing the left or right side panel of heater. To do this, open the hinged control box cover, and then remove the two screws that hold the bottom of the side panel. Lift out that end of the side panel and then pull down for removal. After servicing the unit, reverse the unit, reverse this procedure to replace the side panel.

NOTE: When a new heater is first energized, a light smoking may be noticeable. This is caused by burning off any residue oil left on the heating element during manufacturing. This condition will disappear in a few minutes after heater is put into operation.

LIMITED WARRANTY

products manufactured by Marley Engineered Products are warranted against defects in workmanship and materials for one year from date of installation, except heating elements which are warranted against defects in workmanship and materials for ten years from date of installation. This warranty does not apply to damage from accident, misuse, or alteration; nor where the connected voltage is more than 5% above the nameplate voltage; nor to equipment improperly installed or wired or maintained in violation of the product's installation instructions. All claims for warranty work must be accompanied by proof of the date of installation.

The customer shall be responsible for all costs incurred in the removal or reinstallation of products, including labor costs, and shipping costs incurred to return products to Marley Engineered Products Service Center. Within the limitations of this warranty, inoperative units should be returned to the nearest Marley authorized service center or the Marley Engineered Products Service Center, and we will repair or replace, at our option, at no charge to you with return freight paid by Marley. It is agreed that such repair or replacement is the exclusive remedy available from Marley Engineered Products.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED. AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT. MARLEY ENGINEERED PRODUCTS SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES ARISING WITH RESPECT TO THE PRODUCT, WHETHER BASED UPON NEGLIGENCE, TORT, STRICT LIABILITY, OR CONTRACT.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

For the address of your nearest authorized service center, contact Marley Engineered Products in Bennettsville, SC, at 1-800-642-4328. Merchandise returned to the factory must be accompanied by a return authorization and service identification tag, both available from Marley Engineered Products. When requesting return authorization, include all catalog numbers shown on the products.

HOW TO ORDER REPAIR PARTS

In order to obtain any needed repair or replacement parts, warranty service or technical information, please contact Marley Engineered Products Service Center toll-free by calling 1-800-642-HEAT.

When ordering repair parts, always give the information listed as follows:

1. The Part Number
2. The Model Number
3. The Part Description
4. Date of Manufacture

Marley Engineered Products

SPX Corporation
470 Beauty Spot Rd. East
Bennettsville, SC 29512 USA

Part No. 5200-2237-002

SWO 276
8/95

Isco One Year Limited Factory Service Warranty *

Isco warrants covered products against failure due to faulty parts or workmanship for a period of one year (365 days) from their shipping date, or from the date of installation by an authorized Isco Service Engineer, as may be appropriate.

During the warranty period, repairs, replacements, and labor shall be provided at no charge. Isco's liability is strictly limited to repair and/or replacement, at Isco's sole discretion.

Failure of expendable items (e.g., charts, ribbon, tubing, glassware, seals and filters), or from normal wear, accident, misuse, corrosion, or lack of proper maintenance, is not covered. Isco assumes no liability for any consequential damages.

Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

This warranty applies only to products sold under the Isco trademark and is made in lieu of any other warranty, written or expressed.

No items may be returned for warranty service without a return authorization number issued from Isco.

This warranty does not apply to the following products: Process Analyzers, SFX 3560 SFE Extractor, 6100 VOC Sampler.

The warrantor is Isco, Inc. 4700 Superior, Lincoln, NE 68504, U.S.A.

* This warranty applies to USA customers. Customers in other countries should contact their Isco dealer for warranty service.

In the event of instrument problems, always contact the Isco Service Department, as problems can often be diagnosed and corrected without requiring an on-site visit. In the U.S.A., contact Isco Service at the numbers listed below. International customers should contact their local Isco agent or Isco International Customer Service.

Return Authorization

A return authorization number must be issued prior to shipping. Following authorization, Isco will pay for surface transportation (excluding packing/crating) both ways for 30 days from the beginning of the warranty period. After 30 days, expense for warranty shipments will be the responsibility of the customer.

Shipping Address: Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

Mailing address: Isco, Inc.
PO Box 82531
Lincoln NE 68501 USA

Phone: Repair service: (800)775-2965 (lab instruments)
(800)228-4373 (samplers & flow meters)
Sales & General Information (800)228-4373 (USA & Canada)

Fax: (402) 465-3001

Email: service@isco.com

SECTION 8 WARRANTY AND SERVICE INFORMATION

The sondes are warranted for two years and the 650 MDS for three years against defects in workmanship and materials when used for their intended purposes and maintained according to instructions. All cables are warranted for one year. The depth, dissolved oxygen, temperature/conductivity, turbidity, chlorophyll, rhodamine WT, pH, pH/ORP, and chloride probes are warranted for 1 year. Ammonium and nitrate probes are warranted for six months. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

8.1 LIMITATION OF WARRANTY

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

Carter Machinery Company, Inc.

Carter CAT

CARTER WARRANTIES AND DISCLAIMERS

NEW PRODUCTS AND COMPONENTS ASSEMBLED OR RECONDITIONED BY OTHERS

All new products, and all components and exchange assemblies that have been assembled, reconditioned or remanufactured by other than Carter, are sold subject to the applicable manufacturer's or supplier's warranties and disclaimers. Carter makes no warranties with respect to these items unless it expressly does so in writing at the time of sale. Carter will provide services to replace warranted items without charge to Customer only at any one of Carter's facilities, or, at Carter's option, at the job site.

PRODUCTS ASSEMBLED, OVERHAULED OR RECONDITIONED BY CARTER

Unless a different warranty is expressly given in a writing, signed by Carter, at the time of sale, Carter warrants components, exchange assemblies and other products that have been assembled, overhauled, reconditioned, manufactured or remanufactured by Carter to be free from defects in material or workmanship discovered during the first 6 months or the first 1000 hours (or 25,000 miles) of use after sale or overhaul, whichever first occurs, subject to the provisions hereof. Existence of the defect must be expressly brought to Carter's attention during the warranty period, and the defect must have existed at the time of sale or overhaul. Carter agrees to provide labor and materials as needed to repair or replace with new or repaired parts, at its option, defects covered by this warranty. Materials and labor provided under this warranty are warranted only for the remainder of the original warranty period. Carter will repair or replace defective items covered by warranties under this paragraph only at any one of its facilities or, at Carter's option, at the job site. With respect to such items not installed by Carter, the following provision will also apply: (a) Carter shall have no obligation to repair or replace any defect in an overhauled engine unless the radiator or coolers were delivered to Carter and expressly found by it to be in satisfactory condition prior to installation; and (b) Carter shall have no obligation to repair or replace any defect in transmissions, torque dividers, torque converters and engines unless an oil sample was taken by customer and found satisfactory by Carter at the time of installation and also, in the case of engines, again taken and found satisfactory upon the earlier of the first oil change or 30 days after installation.

USED PRODUCTS

Unless a warranty is expressly given in a writing, signed by Carter, at the time of sale, all used products are sold "as is" and "with all faults."

REPAIRS, MAINTENANCE OR SERVICE BY CARTER

Carter warrants items repaired, maintained or serviced by Carter against defects resulting directly and solely from defects in its workmanship discovered within 6 months after such defective workmanship is rendered subject to the provisions hereof. Existence of the defect must be brought to Carter's attention during the warranty period. Carter agrees to provide labor and materials at the place where the work was originally performed as needed to repair or replace with new or repaired parts, at its option, defects covered by this warranty. Items not repaired, maintained or serviced originally by Carter but damaged solely due to defects in its workmanship may be reviewed for warranty consideration based on usage received. Materials and labor provided under this warranty are warranted only for the remainder of the original warranty period.

CUSTOMER'S RESPONSIBILITIES

Although Carter will endeavor to provide warranty service at convenient times, it only agrees to do so during regular weekday working hours. The overtime or premium time rate differential will be charged to Customer for warranty service provided at other times. All consumable items, such as lubricants, fuels and filters, necessary to complete a warranty service will be charged to Customer. Customer shall provide at its expense labor and lifting equipment required to minimize job time and downtime in making repairs at the job site. Customer will not subject warranted products to extraordinary uses and will at all times operate and maintain them in accordance with the instructions outlined in any maintenance and operation instruction information furnished at time of purchase. Any damage that results from Customer's continued operation after a defect has been recognized by Customer is Customer's sole responsibility and Carter has no responsibility to repair or correct any damage that results from Customer's continued operation after a defect has been recognized by Customer. This warranty does not apply to any item which has been repaired or altered by Customer or others. Customer shall be liable to Carter for all expenses incurred by Carter if servicemen are called to the job by Customer and Customer refuses to permit the requested work to be done or if it is determined by Carter that no work is appropriate.

DISCLAIMER OF WARRANTIES

THE WARRANTIES AND AGREEMENTS HEREIN SET FORTH ARE EXCLUSIVE AND ARE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES AND AGREEMENTS, EXPRESS, IMPLIED OR STATUTORY. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

DISCLAIMER OF TORT LIABILITY

Carter, its agents and employees, shall not be liable in tort — whether based on negligence, strict liability or other theory — for any act or omission in connection with the service, delivery, sale, lease, preparation, assembly, repair, recondition, or remanufacture of products sold, leased or handled by it.

LIMITATION OF REMEDIES AND DAMAGES

Customer's sole and exclusive remedies and causes of action are limited to those set forth herein. Carter shall have no liability for incidental, special, consequential or punitive damages or other economic loss.

Rev. 9/92

Effective with sales to the first user on or after [illegible]

CATERPILLAR LIMITED WARRANTY

Industrial Engine Products and
Electric Power Generation Products
Worldwide
(Excluding the Commonwealth of Independent States)

Caterpillar Inc. or any of its subsidiaries ("Caterpillar") warrants new and Remanufactured engines and electric power generation products sold by it (including any products of other manufacturers packaged and sold by Caterpillar) and operating outside the Commonwealth of Independent States (formerly USSR) to be free from defects in material and workmanship.

A different warranty statement applies to products operating in the Commonwealth of Independent States. Copies of this warranty may be obtained by writing Caterpillar Inc., 100 N.E. Adams St., Peoria, IL USA 61629.

This warranty does not apply to Caterpillar Motoren (CM) products, engines sold for use in on-highway vehicle or marine applications, engines in machines manufactured by or for Caterpillar, 3500 and 3600 Family engines used in locomotive applications, 3000 Family engines, or Caterpillar brand batteries. These products are covered by other Caterpillar warranties.

This warranty is subject to the following:

Warranty Period

- For Uninterruptible Power Systems (UPS), the warranty period is 12 months after date of delivery to the first user.
- For new industrial engines and electric power generation products (excluding UPS), the warranty period is 12 months (24 months for Automatic Transfer Switch (ATS) product, mobile, agricultural, and standby electric power generation applications) after date of delivery to the first user.
- For all Remanufactured engines, the warranty period is 6 months (12 months for mobile, agricultural, and standby electric power generation applications) after date of delivery to the first user.

Caterpillar Responsibilities

If a defect in material or workmanship is found during the warranty period, Caterpillar will, during normal working hours and through a place of business of a Caterpillar dealer or other source approved by Caterpillar:

- Provide (at Caterpillar's choice) new, Remanufactured or Caterpillar approved repaired parts or assembled components needed to correct the defect.

  Note: Items replaced under this warranty become the property of Caterpillar.
- Replace lubricating oil, filters, coolant and other service items made unusable by the defect.
- Provide reasonable or customary labor needed to correct the defect, including labor to disconnect the product from and reconnect the product to its attached equipment, mounting and support systems, if required.

For new 3114, 3116 and 3126 engines and electric power generation products (including any new products of other manufacturers packaged and sold by Caterpillar):

- Provide travel labor, up to four hours round trip, if in the opinion of Caterpillar, the product cannot reasonably be transported to a place of business of a Caterpillar dealer or other source approved by Caterpillar (travel labor in excess of four hours round trip, and any meals, mileage, lodging, etc. is the user's responsibility).

For all other products:

- Provide reasonable travel expenses for authorized mechanics, including meals, mileage, and lodging, when Caterpillar chooses to make the repair on-site.

User Responsibilities

The user is responsible for:

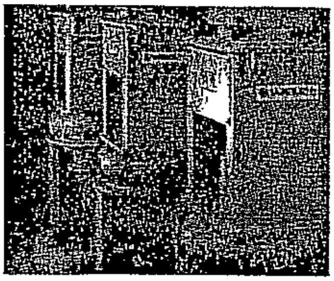
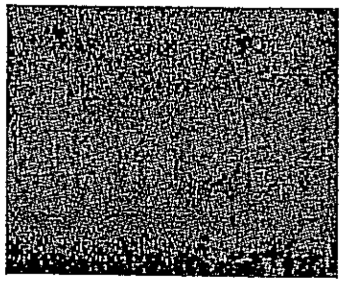
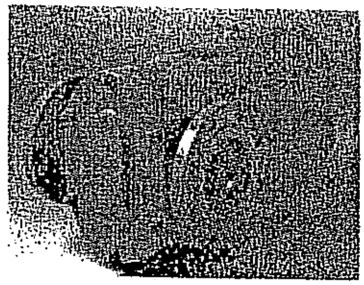
- Providing proof of the delivery date to the first user.
- Labor costs, except as stated under "Caterpillar Responsibilities," including costs beyond those required to disconnect the product from and reconnect the product to its attached equipment, mounting and support systems.
- Travel expenses not covered under "Caterpillar Responsibilities."
- All costs associated with transporting the product to and from the place of business of a Caterpillar dealer or other source approved by Caterpillar.
- Premium or overtime labor costs.
- Parts shipping charges in excess of those which are usual and customary.
- Local taxes, if applicable.
- Costs to investigate complaints, unless the problem is caused by a defect in Caterpillar material or workmanship.
- Giving timely notice of a warrantable failure and promptly making the product available for repair.
- Performance of the required maintenance (including use of proper fuel, oil, lubricants and coolant) and items replaced due to normal wear and tear.
- Allowing Caterpillar access to all electronically stored data.

Limitations

Caterpillar is not responsible for:

- Failures resulting from any use or installation which Caterpillar judges improper.

(continued on reverse side)

WARRANTY

WEMCO PUMP™

WEMCO® pumps and pump equipment are backed by the following warranty:

For the benefit of the original user, WEMCO PUMP™ warrants all new equipment to be free from defects in workmanship; and will replace or repair, at its discretion and F.O.B. its factories or other location designated by it, any part or parts returned to it which WEMCO PUMP's™ examination shall show to have failed under normal use and service by the original user within one year following initial shipment to the purchaser. Such repair or replacement shall be free of charge for all items except for those items that are consumable and normally replaced during maintenance. Repair or replacement of such consumable items shall be subject to pro-rata charge based upon WEMCO PUMP's™ estimate of the percentage of normal service life realized from the item. WEMCO PUMP's™ obligation under this Warranty is conditioned upon its receiving prompt notice of claimed defects which shall in no event be later than thirty (30) days following expiration of the above warranty period and is limited to repair or replacement as aforesaid.

THIS WARRANTY IS EXPRESSLY MADE BY WEMCO PUMP™ AND ACCEPTED BY PURCHASER IN LIEU OF ALL OTHER WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, WHETHER WRITTEN, ORAL, EXPRESS, IMPLIED, OR STATUTORY. WEMCO PUMP™ NEITHER ASSUMES, NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT, ANY OTHER LIABILITIES WITH RESPECT TO ITS EQUIPMENT INCLUDING NEGLIGENCE IN DESIGN OR MANUFACTURE. WEMCO PUMP™ SHALL NOT BE LIABLE FOR NORMAL WEAR AND TEAR NOR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGE DUE TO USE OR IN OPERABILITY OF ITS EQUIPMENT FOR ANY REASON WHATSOEVER.

This Warranty shall not apply to equipment or parts thereof which have been altered or repaired outside of an authorized WEMCO PUMP™ facility or factory, or damaged by improper installation or application, or subject to misuse, abuse, neglect or accident.

This Warranty applies only to WEMCO® pumps and pump equipment manufactured and sold by Weir Specialty Pumps.

WEMCO PUMP™ makes no warranty with respect to parts, coatings, accessories, or components manufactured by others. The warranty which applies to such items is offered by their respective manufacturers except that WEMCO PUMP™ does warrant that any special coatings have been applied in accordance with their respective manufacturer's recommendations.

WEMCO PUMP™

WEMCO PUMP

G&L Pumps

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all Aquavar CPC units manufactured by G&L Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twenty-four (24) months from date of installation or thirty (30) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.

(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.

(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

Goulds Pumps is a brand of ITT Water Technology, Inc.
- a subsidiary of ITT Industries, Inc.

Goulds Pumps, G&L Pumps, Aquavar and the ITT Engineered Blocks Symbol are registered trademarks and tradenames of ITT Industries.

Specifications subject to change without notice.

Printed in U.S.A.
July, 2004

1 Goulds Drive
Auburn, NY 13021

www.goulds.com

Goulds Pumps
ITT Industries

KRUGER PRODUCTS WARRANTY

Installation Site:	Rutledge WWTP Amherst VA	Equipment Delivery:	TBD
Equipment Type:	Oxidation Ditch	Warranty Begins:	TBD
Owner:	Town of Amherst, VA	Warranty Ends:	TBD

Length of Warranty:
The system is warranted against defects in material and workmanship for twelve months from beneficial use or eighteen months from shipment, whichever occurs first. Unless stated otherwise in the contract documents.

Warranty Coverage:
Kruger's sole obligation under this warranty is limited to repairing or replacing, at its option, any item covered under this warranty. All equipment or parts covered by this warranty are guaranteed to be free from defective material and workmanship, under normal use and service and maintained in accordance with Kruger Products' instructions. This guarantee does not cover failure of normal wearing parts unless failure of such part has resulted from defective material and workmanship. The warranty also does not apply to parts or equipment damaged from improper operation or misuse, neglect, accident, improper wiring or installation, or alterations and repairs made by any one other than Kruger or its authorized representative.

No Implied Warranties:
ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXCLUDED.

Conditions:
In the event of any defects developing within the warranty period, under normal and proper use, Kruger Products is to be notified promptly in writing within 30 days of when the defect was discovered or should have been discovered. Kruger must be given prompt and reasonable opportunity to inspect the defective equipment or parts and be given access to the Owner's logs and records to establish proper operation and maintenance. Kruger will make all repairs at the manufacture's facility when practical. It is the owner's responsibility for all removal, outward-bound shipping, and re-installation charges.

Claims:
Kruger Products does not accept liability for any corrective or other work or expenditures of any kind that have not been authorized by Kruger Products in writing prior to the commencement of such work. Service calls, when requested and where no evidence of defective material or workmanship is found, will be at the expense of the Purchaser. In no event shall Kruger Products be liable for special, indirect, incidental or consequential damages, including but not limited to, loss of profits or revenue, loss of use of equipment or any associated equipment, cost of capital, cost of substitute equipment, facilities or services, down time cost, or claims of customers of the Purchaser for such other damages. Kruger Products will only be responsible for damages from proven negligent acts of its direct employees only.

III.2 WARRANTY

Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from acceptance, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

Krüger

I.Krüger, Inc.
401 Harrison Oaks Boulevard- Suite 100
Cary, NC 27513

TELEPHONE 919-677-8310
FACSIMILE 919-677-0082

I.KRÜGER, INC. - STANDARD TERMS OF SALE

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from acceptance, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such

Section 1
General Information

Overview This manual contains general procedures that apply to Baldor Motor products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the Warning and Caution statements. A Warning statement indicates a possible unsafe condition that can cause harm to personnel. A Caution statement indicates a condition that can cause damage to equipment.

Important: **This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.**

Before you install, operate or perform maintenance, become familiar with the following:

- NEMA Publication MG-2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators.
- The National Electrical Code
- Local codes and Practices

Limited Warranty

1. Baldor Electric motors are warranted for a period of one (1) year, from date of shipment from the factory or factory warehouse against defects in material and workmanship. To allow for stocking and/or fabrication period and to provide one year of actual service, the warranty period is extended for an additional period of six (6) months for a total of eighteen (18) months from the original date of shipment from the factory or factory warehouse stock. In no case will the warranty period be extended for a longer period. Baldor extends this limited warranty to each buyer of the electric motor for the purpose of resale and to the original purchaser for use.
2. Baldor will, at its option repair or replace a motor which fails due to defects in material or workmanship during the warranty period if:
   a. the purchaser presents the defective motor at or ships it prepaid to, the Baldor plant in Fort Smith, Arkansas or one of the Baldor Authorized Service Centers and
   b. the purchaser gives written notification concerning the motor and the claimed defect including the date purchased, the task performed by the Baldor motor and the problem encountered.
3. Baldor will not pay the cost of removal of any electric motor from any equipment, the cost of delivery to Fort Smith, Arkansas or a Baldor Authorized Service Center, or the cost of any incidental or consequential damages resulting from the claimed defects. (Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you.) Any implied warranty given by laws shall be limited to the duration of the warranty period hereunder. (Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.)
4. Baldor Authorized Service Centers, when convinced to their satisfaction that a Baldor motor developed defects in material or workmanship within the warranty period, are authorized to proceed with the required repairs to fulfill Baldor's warranty when the cost of such repairs to be paid by Baldor does not exceed Baldor's warranty repair allowance. Baldor will not pay overtime premium repair charges without prior written authorization.
5. The cost of warranty repairs made by centers other than Baldor Authorized Service Centers **WILL NOT** be paid unless first authorized in writing by Baldor.
6. Claims by a purchaser that a motor is defective even when a failure results within one hour after being placed into service are not always justified. Therefore, Baldor Authorized Service Centers must determine from the condition of the motor as delivered to the center whether or not the motor is defective. If in the opinion of a Baldor Authorized Service Center, a motor did not fail as a result of defects in material or workmanship, the center is to proceed with repairs only if the purchaser agrees to pay for such repairs. If the decision is in dispute, the purchaser should still pay for the repairs and submit the paid invoice and the Authorized Service Center's signed service report to Baldor for further consideration.
7. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

   Note that **Baldor Super–E® Premium Efficiency** electric motors are warranted for a period of three (3) years. All other terms and conditions of the Limited Warranty statement apply.

2.8 Operation in an explosive atmosphere

Products marked as explosion-proof are suitable for operation in an explosive atmosphere. The products must meet certain guidelines for this type of use. Certain rules of conduct and guidelines must be adhered to by the operator as well.

Products that have been approved for operation in an explosive atmosphere are labeled as explosion-protected. In addition, an appropriate symbol must is attached to the type plate! When used in an explosive atmosphere, the chapter entitled "Explosion protection according to the ...standard" must be observed!

It is absolutely prohibited to pump explosive liquids (e.g. gasoline, kerosene, etc.). The products are not designed for these liquids!

2.9 Sound pressure

Depending on the size and capacity (kW), the products produce a sound pressure of approximately 70dB (A) and 110dB (A).

The actual sound pressure, however, depends on several factors. These include, for example, the installation type (wet, dry, transportable), fastening of accessories (e.g. suspension unit) and pipeline, operating site, immersion depth, etc.

Once the product has been installed, we recommend that the operator makes additional measurements under all operating conditions.

In accordance with the laws in effect, guidelines, standards and regulations, ear protection must be worn if the sound pressure is greater than 85dB (A). The operator is responsible for ensuring that this is observed!

2.10 Warranty

This chapter contains the general information on the warranty. Contractual agreements have the highest priority and are not superseded by the information in this chapter!

The manufacturer is obliged to correct any defects found in the products it sells, provided that the following requirements have been fulfilled:

General information

- The defects are caused by the materials used or the way the product was manufactured or designed.
- The defects were reported in writing to the manufacter within the agreed warranty period.
- The product was used only as prescribed.
- All safety and control devices were connected and inspected by authorized personnel.

Warranty period

If no other provisions have been made, the warranty period applies to the first 12 months after initial start-up or to a max. of 18 months after the delivery date. Other agreements must be made in writing in the order confirmation. They will remain valid at least until the agreed warranty period of the product has expired.

Spare parts, add-ons and conversions

Only original spare parts as supplied by the manufacturer may be used for repairs, replacements, add-ons and conversions. Only these parts guarantee a long working life and the highest level of safety. These parts have been specially designed for our products. Self-made add-ons and conversions or the use of non-original spare parts can seriously damage the product and/or injure personnel.

Maintenance

The prescribed maintenance and inspection work should be carried out regularly. This work may only be carried out by qualified, trained and authorized personnel. **The maintenance and inspection log supplied must be properly updated.** This enables you to monitor the status of inspections and maintenance work. Quick repairs not listed in this operation and maintenance manual and all types of repair work may only be performed by the manufacturer and its authorized service centers.

List of machine operators

The machine operator list **must** be filled out completely. By signing this list, all persons working on or with the product confirms that they have received, read and understood this operating and maintenance manual.

Damage to the product

Damage as well as malfunctions that endanger safety must be eliminated immediately by authorized personnel. The product should only be operated if it is in proper working order. During the agreed warranty period, the product may only be repaired by the manufacturer or an authorized service workshop. The manufacturer reserved the right to recall the damaged product to the factory fort inspection.

Exclusion from liability

No liability will be assumed for product damage if one or more of the following points applies:

- Incorrect design on our part due to faulty and/or incorrect information provided by the operator or customer.
- Non-compliance with the safety instructions, the regulations and the requirements set forth by German Law and this operating and maintenance manual.
- improper assembly/dismantling
- improper maintenance
- unqualified repairs
- faulty construction site and/or construction work
- chemical, electrochemical and electrical influences
- wear

WARRANTY HIGHLIGHTS

1) Seller warrants products of its own manufacture against defects in materials and workmanship under normal use and service for: five (5) years, prorated, from date of shipment for permanent Public Works installations; 15 months, prorated, for permanent Industrial installations; and 9 months for portable Construction/Mining installations.

2) Accessories and components not manufactured by seller are warranted only to the extent of the original manufacturer's warranty.

3) No allowances will be made for repairs or alterations effected without specific written authorization from Seller.

4) The equipment as manufactured by Fairbanks Morse Pump is precision machinery. Proper care can give a lifetime of satisfactory service. Warranties of performance are based on the use of original equipment manufactured (OEM) replacement parts. Fairbanks Morse Pump shall assume no responsibility when alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated.

5) This warranty is VOID unless the purchaser provides protective storage, installs and maintains the equipment in accordance with manufacturer's instructions.

6) Under the terms of this warranty, Seller shall not be responsible nor liable for:
   a) Consequential, collateral or special losses or damages.
   b) Equipment conditions caused by fair wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment.
   c) In-shop labor charges after the first 12 months from installation.
   d) Loss or damage resulting from supplying of defective part(s) or improper repairs by unauthorized person(s).
   e) Damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage or mishandling.
   f) Labor charges for installation, removal or reinstallation of equipment.

7) The above listed warranty highlights do not constitute our total terms and conditions regarding warranty. For complete warranty information please refer to complete warranty statement herein.

LOSS OR DAMAGE IN TRANSIT

Immediately upon receipt, a complete inspection and accounting against the packing list should be made of all major components, and accompanying boxes or pallets. All material is shipped F.O.B. our factory, or our vendor's shipping point unless optional contractual arrangements are made. Under these terms, any claims for loss or damage in transit should be immediately directed to the delivering freight carrier. Fairbanks Morse will assist the customer in receiving fair compensation, but assumes no responsibility to mediate such claims. This policy includes shipments wherein Fairbanks Morse pays freight costs as part of the sales terms.

If there is any indication of oil leakage from the motor oil chamber, advise the factory immediately and request instructions for proper handling.

5 YEAR WARRANTY

FAIRBANKS MORSE SUBMERSIBLE PUMPS AND MOTORS FOR USE IN MUNICIPAL SEWAGE COLLECTION: PERMANENT INSTALLATION

Fairbanks Morse Pump ("Seller") extends a five (5) year prorated limited warranty from date of shipment on submersible pumps and motors of its own manufacture against defects in materials and workmanship. The Buyer must give written notice of any alleged defect covered by this warranty within a reasonable time after the claim arises which time shall not exceed thirty (30) days. No claim made after the expiration of the warranty shall be valid. Seller does not warrant accessories or components that are not manufactured by Seller. However, to the extent possible, Seller agrees to assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller.

Guarantees of performance and warranties are based on the use of original equipment, manufactured (OEM) replacement parts. Seller assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated.

This warranty shall run for a period of five (5) years from the date of shipment for pumps and motors, permanently installed, maintained and operated in accordance with the Fairbanks Morse Pump Installation, Operation and Maintenance Manuals in use at the time of sale and as amended from time to time to the extent the Buyer has notice of such amendments. Warranty is void if moisture detectors and thermostats are not properly wired and if electrical cable between motor control panel and motor is spliced.

If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller prior to any attempted repair, or sent to an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit, nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B, Seller's factory. Underwriters Laboratories Listed motors must be repaired at a certified UL repair Facility, otherwise the UL Listing is void. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing.

Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and service. This warranty applies to the replacement parts, and labor to replace those parts, and is not extended to the product or any other component of the product being repaired.

THIS WARRANTY IS THE SOLE WARRANTY OF FAIRBANKS MORSE PUMP AND FAIRBANKS MORSE PUMP EXPRESSLY DISCLAIMS AND [illegible] WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF [illegible]ANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. This warranty does not apply to parts that fail due to abuse or normal wear (including, but not limited to impeller, wearing rings, seals and bearings). Under the terms of this warranty, Fairbanks Morse Pump shall not be liable for: (a) consequential, incidental, collateral, special or liquidated losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, improper operation, acts of God, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than those authorized by Fairbanks Morse Pump; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage, mishandling, or other similar conditions; (e) any loss, damage or expense relating to or resulting from installation, removal or reinstallation of equipment; (f) any expense of shipment of equipment or repaired or replacement parts; or (g) any other loss damage or expense of any nature. The liability of Fairbanks Morse Pump shall in no event exceed the purchase price of the individual unit of equipment paid by the original Buyer.

The Buyer's exclusive remedy under this warranty shall be for Fairbanks Morse Pump to repair on an adjusted basis the parts failing due to defects in materials, workmanship and labor to replace those parts during the warranty period. The Buyer will be invoiced for such repairs at the prorated percentage rate in the table below:

Repair Parts Price Factor

Months After Shipment	Sell Price Factor
0-18*	No Charge
Thru 36	.50
37 - 48	.70
49 - 60	.80

* Or not to exceed 12 months after installation, whichever comes first.

All repairs or service which are not covered by this warranty will be charged in accordance with standard prices in effect. In-shop labor for motor or pump repairs for the first 12 months after installation will be at no charge. After this period, labor charges for repair are the responsibility of the Buyer. Charges for removal, transportation, reinstallation and all associated additional cost, are not covered under warranty. Fairbanks Morse Pump shall have the option, but shall not be obligated, to provide in lieu of repair a replacement for any equipment that is defective.

CONDITION TO WARRANTY WORK: If Buyer is in default (including, but not limited to, the failure of Buyer to maintain a current account with Seller) under the Order or any other agreement between Buyer and Seller, Buyer's rights under the warranty shall be suspended and the original warranty period will not be extended.

[illegible]RMANCE: Equipment performance is not warranted or guaranteed unless separately agreed to by Seller in accordance with its guarantee po[illegible]y. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy.. KC685/0393 (Revised)

15 MONTH PRORATED WARRANTY

FAIRBANKS MORSE SUBMERSIBLE PUMPS AND MOTORS FOR USE IN INDUSTRIAL: PERMANENT INSTALLATION

Fairbanks Morse Pump ("Seller") warrants Submersible Pumps & Motors of its own manufacture against defects in materials and workmanship under normal use and service for 15 months from the date of shipment. Seller does not warrant accessories or components that are not manufactured by Seller. However, to the extent possible, Seller agrees to assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller. Buyer must give Seller notice in writing of any alleged defect covered by this warranty (together with all identifying details, including the serial number, the type of equipment, and the date of purchase) within thirty (30) days of the discovery of such defect during the warranty period. No claim made more than 30 days after the expiration of the warranty period shall be valid.

The Buyer's exclusive remedy under this warranty shall be for Seller to repair on an adjusted basis the parts failing due to defects in materials and workmanship during the warranty period. The Buyer will be invoiced for such repairs at the prorated percentage rate in the table below:

Repair Parts Price Factor

Months After Shipment	Sell Price Factor
0 - 7-1/2	No Charge
7-1/2 - 15	.50

Guarantees of performance and warranties are based on the use of original equipment manufactured (OEM) replacement parts. Fairbanks Morse Pump assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated.

Warranty is void if moisture detectors and thermostats are not properly wired and if electrical cables between motor control panel and motor is spliced.

If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller prior to any attempted repair, or sent to an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit, nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B, Seller's factory. Underwriters Laboratories Listed motors must be repaired at a certified UL repair Facility, otherwise the UL Listing is void. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing.

The warranty extends to repaired or replaced parts of Seller's manufacture for ninety (90) days or for the remainder of the original warranty period applicable to the equipment or parts being repaired or replaced. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired.

Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and service. This warranty applies to the replacement part only and is not extended to the product or any other component of the product being repaired.

Seller may substitute new equipment or improve part(s) of any equipment judged defective without further liability. All repairs or services performed by Seller, which are not covered by this warranty, will be charged in accordance with Seller's standard prices then in effect.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND SELLER HEREBY EXPRESSLY DISCLAIMS AND BUYER WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's sole obligation under this warranty shall be, at its option, to repair or replace any equipment (or its component parts) which has a defect covered by this warranty, or to refund the purchase price of such equipment or part. Under the terms of this warranty, Seller shall not be liable for (a) consequential, collateral, special or liquidated
losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than the Seller; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage, mishandling, or other similar conditions; (e) any loss, damage, or expense relating to or resulting from installation, removal or reinstallation of equipment; (f) any expense of shipment of equipment or repaired or replacement parts; or (g) any other loss, damage or expense of any nature. The liability of Fairbanks Morse Pump shall in no event exceed the purchase price of the individual unit of equipment paid by the original Buyer.

All repairs or service which are not covered by this warranty will be charged in accordance with standard prices in effect. In-shop labor for motor or pump repairs for the first 7-1/2 months after shipment will be at no charge. In-shop labor for motor or pump repairs between 7-1/2 months and 15 months after shipment will be covered 50% by this warranty. After this period, labor charges for repair are the responsibility of the Buyer.

CONDITION TO WARRANTY WORK: If Buyer is in default (including, but not limited to, the failure of Buyer to maintain a current account with Seller) under the Order or any other agreement between Buyer and Seller, Buyer's rights under the warranty shall be suspended and the original warranty period will not be extended.

PERFORMANCE: Equipment performance is not warranted or guaranteed unless separately agreed to by Seller in accordance with its guarantee policy. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy.

KC885/0393

9 MONTH WARRANTY

FAIRBANKS MORSE SUBMERSIBLE PUMPS AND MOTORS FOR USE IN CONSTRUCTION/MINING: PORTABLE INSTALLATION

Fairbanks Morse Pump ("Seller") warrants Submersible Pumps & Motors of its own manufacture against defects in materials and workmanship under normal use and service for 9 months from the date of shipment. Seller does not warrant accessories or components that are not manufactured by Seller. However, to the extent possible, Seller agrees to assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller. Buyer must give Seller notice in writing of any alleged defect covered by this warranty (together with all identifying details, including the serial number, the type of equipment, and the date of purchase) within thirty (30) days of the discovery of such defect during the warranty period. No claim made more than 30 days after the expiration of the warranty period shall be valid.

Guarantees of performance and warranties are based on the use of original equipment manufactured (OEM) replacement parts. Seller assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated.

Warranty is void if moisture detectors and thermostats are not properly wired and if electrical cables between motor control panel and motor is spliced.

If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller prior to any attempted repair, or sent to an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit, nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B, Seller's factory. Underwriters Laboratories Listed motors must be repaired at a certified UL repair Facility, otherwise the UL Listing is void. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing.

The warranty extends to repaired or replaced parts of Seller's manufacture for ninety (90) days or for the remainder of the original warranty period applicable to the equipment or parts being repaired or replaced. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired.

Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and service. This warranty applies to the replacement part only and is not extended to the product or any other component of the product being repaired.

nay substitute new equipment or improve part(s) of any equipment judged defective without further liability. All repairs or services performed by which are not covered by this warranty, will be charged in accordance with Seller's standard prices then in effect.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND SELLER HEREBY EXPRESSLY DISCLAIMS AND BUYER WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's sole obligation under this warranty shall be, at its option, to repair or replace any equipment (or its component parts) which has a defect covered by this warranty, or to refund the purchase price of such equipment or part. Under the terms of this warranty, Seller shall not be liable for (a) consequential, collateral, special or liquidated losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than the Seller; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage, mishandling, or other similar conditions; (e) any loss, damage, or expense relating to or resulting from installation, removal or reinstallation of equipment; (f) any expense of shipment of equipment or repaired or replacement parts; or (g) any other loss, damage or expense of any nature. The liability of Fairbanks Morse Pump Corporation shall in no event exceed the purchase price of the individual unit of equipment paid by the original Buyer.

All repairs or service which are not covered by this warranty will be charged in accordance with standard prices in effect. In-shop labor for motor or pump repairs for the first 9 months after shipment will be at no charge. After this period, labor charges for repair are the responsibility of the Buyer.
by this warranty. After this period, labor charges for repair are the responsibility of the Buyer.

CONDITION TO WARRANTY WORK: If Buyer is in default (including, but not limited to, the failure of Buyer to maintain a current account with Seller) under the Order or any other agreement between Buyer and Seller, Buyer's rights under the warranty shall be suspended and the original warranty period will not be extended.

PERFORMANCE: Equipment performance is not warranted or guaranteed unless separately agreed to by Seller in accordance with its guarantee policy. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy.

KC985/0393

EQUIPMENT WARRANTY

ACRISON, INC., (hereinafter referred to as ACRISON) warrants the equipment (complete new equipment) to be free from defects in material and workmanship for a period of one (1) year from the date of shipment to or for the buyer. The obligation of ACRISON under this warranty is expressly limited to the repairing or replacing of any part or parts that are proved to the satisfaction of ACRISON to be defective due to a fault in workmanship or materials. Any replacement part(s) shall be shipped F.O.B. ACRISON'S plant; this warranty does not include the installation or freight charges of any such replacement part(s).

Parts replaced under ACRISON'S new equipment warranty automatically fall into the new equipment warranty period for that of the original (new) equipment which is one (1) year from the date of shipment of the original (new) equipment, not the shipment date of replacement parts covered under ACRISON'S new equipment warranty.

ACRISON warrants spare and replacement parts (not parts replaced under its new equipment warranty) for a period of ninety (90) days from the date of shipment of the parts, whether or not such parts are shipped with the original (new) equipment.

ACRISON warrants repaired parts (not parts replaced under its new equipment warranty) for a period of thirty (30) days from the date of shipment of such repaired parts.

ACRISON shall not be liable for any inconvenience, loss of use, or any other consequential loss, damage or injury arising from any cause whatsoever associated with the equipment. Back-charges of any nature relative to work performed on the equipment at any time by the buyer, user, or a contractor authorized by the buyer or user will not, under any circumstances, be accepted without the prior written consent of ACRISON.

ACRISON warrants that all the equipment being shipped herewith has been manufactured in accordance with all applicable federal laws, rules and regulations. In addition, ACRISON reserves the right to correct and/or modify any area of design or construction which is considered not to be in accordance with any specific safety ordinance unbeknown to ACRISON within sixty (60 days) of notification in writing by the user, with any costs for such work at the user's expense.

ACRISON shall have no obligation under this warranty for any equipment or parts which have not received proper maintenance, service, or which have been subject to any misuse, abuse, negligence, accident, improper installation, deterioration by chemical action, act of God, repair or alteration in any way, so as in the final judgment of ACRISON, to adversely affect the performance or reliability of the equipment or parts.

NOTE: In order for precision weighing equipment to operate properly, the supporting structure for same must be designed and constructed in accordance with sound engineering practices and be sufficiently rigid to not only adequately support the equipment, but also, to ensure that the effects of rotating or vibrating machinery, operating in close proximity to the weighing equipment, remain within tolerable levels so as not to adversely affect performance.

No employee, agent or representative of ACRISON shall have any right or authority to vary or alter the terms of this warranty.

This warranty does not include any representation that the equipment shipped herewith is fit for the particular purpose intended by the buyer, unless ACRISON agrees in writing that: (a) the equipment is based on the recommendation of ACRISON for a specific particular purpose, (b) the buyer is relying on the expertise of ACRISON in making the recommendation and, (c) the equipment is, in fact, used for the specified purpose, in which event ACRISON warrants that the equipment is fit for that specified particular purpose.

EQUIPMENT SAFETY: With respect to operation of ACRISON equipment, it is the buyer's or user's responsibility to define and provide any safety device(s) or associated safety device(s) - (other than that which is furnished by ACRISON as standard) - which may be necessary and/or required, and to establish safety procedures and operational instructions to safeguard the operator(s) during maintenance, cleaning, or any use of the equipment whatsoever, and to subsequently ensure that the equipment is operated in conformance with all applicable safety procedures, laws, regulations and instructions. It is also the buyer's or user's responsibility to enforce all safety regulations and operational instructions and to maintain the equipment in a safe condition (guards in place, "warning", "caution" and/or "important" labels affixed, electrical boxes secure, interlocks operational, etc.). In particular, all warning, caution and/or important labels must be maintained in a readable condition, and if necessary, replaced with new labels. Additionally, and because the nature of the equipment does not always make it possible to fully prevent operator access from rotating components, maintenance or cleaning of any nature must not be performed on the equipment without first disconnecting all power.

OPERATOR SAFETY: Buyer or user warrants and agrees that because it has sole control over the equipment, it shall be solely responsible for safety compliance. Operator access and use of equipment, and full compliance with all provisions of the Operator Safety section of ACRISON'S Instruction Manuals are essential and the user's responsibility, the provisions of that section being incorporated herein expressly.

CLAIMS: Buyer or user shall defend, indemnify and hold ACRISON and/or seller harmless from all product liability claims involving the equipment, unless such liability is proven to be due solely to negligence on the part of ACRISON.

acrison® INC.

The Donaldson Torit Warranty

Donaldson Company, Inc. warrants to the original purchaser that for a period of ten (10) years from the date of shipment, the product described herein shall be free from defects in materials and workmanship if properly installed, maintained and operated under normal conditions. Donaldson Company makes no warranty against damage due to corrosion, abrasion, normal wear and tear, modification or misapplication and makes no warranty whatsoever as to any goods manufactured or supplied by others. After Donaldson Company has been given adequate opportunity to remedy any defects in material or workmanship, Donaldson Company retains the option to accept the return of the product, with return freight paid by the purchaser, and to refund the purchase price for the product after confirming the product is returned undamaged and in usable condition. Such a refund will be the full extent of Donaldson Company's liability and Donaldson Company shall not be liable for any other costs, expenses or damages whether direct, indirect, consequential or otherwise. The terms of this warranty may be modified only by a special warranty document signed by a Director, General Manager or Vice President of Donaldson Company. Failure to use genuine Donaldson replacement parts will cancel this warranty. THERE EXIST NO OTHER REPRESENTATIONS, WARRANTIES OR GUARANTEES EXCEPT AS STATED IN THIS PARAGRAPH AND ALL OTHER WARRANTIES INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHETHER EXPRESS OR IMPLIED ARE HEREBY EXPRESSLY EXCLUDED AND DISCLAIMED.

Parts and Service

For genuine Donaldson Torit replacement filters
and parts, call the Parts Express Line

800-365-1331

www.donaldsontorit.com

For faster service, have unit's model and serial number, part number, description, and quantity available.

Donaldson.
Filtration Solutions

Donaldson Company, Inc.
Industrial Air Filtration
P.O. Box 1299
Minneapolis, MN 55440-1299
dustmktg@mail.donaldson.com

Donaldson Company, Inc. is the leading designer and manufacturer of dust, mist, and fume collection equipment used to control industrial-air pollutants. Our equipment is designed to help reduce occupational hazards, lengthen machine life, reduce in-plant maintenance requirements, and improve product quality.

IOM-75094-01 Revision 4
Printed in USA
August 2002

10. REPLACEMENT PARTS

Prints and parts lists for the equipment are included in these instructions.

When replacement parts are required, please write to:

ONDEO DEGREMONT INC.
Attention: Parts Sales Department
P. O. Box 71390
Richmond VA 23255-1390

or call 1-800-446-1150 for ordering only.

The following information should be given:

1. Name and address of original purchaser and/or user of equipment.
2. Ondeo Degremont, Inc. contract number.
3. All information appearing on the nameplate attached to the equipment.
4. Reference number and assembly drawing number. Part numbers and description from Bill of Material in Operation and Maintenance Manual
5. Complete description of the part and equipment component on which it is used.

11. SERVICE/WARRANTY

When startup, service or warranty work is required, please contact our main office at 1-804-756-7600.

ONDEO DEGREMONT INC.
Attention: Service Department
P. O. Box 71390
Richmond VA 23255-1390

T836.800-40
3/17/03

one year, limited
WARRANTY

Please read before instrument setup.

ISCO INSTRUMENTS HAVE A ONE YEAR LIMITED WARRANTY COVERING BOTH PARTS AND LABOR. Should any instrument become defective due to faulty parts or workmanship within the guarantee period, it will be repaired at the factory at no charge to the customer. Isco will pay **SURFACE** transportation charges both ways within the contiguous United States if the instrument proves to be defective **WITHIN 30 DAYS** from the date of shipment. Throughout the remainder of the guarantee period, the customer will pay transportation charges to return the defective instrument to Isco, and Isco will pay **SURFACE** transportation charges to return the repaired instrument to the customer. Isco will not pay air freight or packing and crating charges. The warranty period begins with the shipping date of the instrument to the original purchaser. All requests for warranty service must be received within the warranty period.

At the convenience of Isco, Isco may reimburse the customer to have the repairs performed by a qualified technician in the customer's locality. Authorization must be granted prior to the time any repair is performed.

Isco's liability is limited to repair or replacement of defective instruments. **UNDER NO CIRCUMSTANCES IS ISCO LIABLE FOR CONSEQUENTIAL DAMAGES.** The following are not covered by this warranty: Expendable items such as charts, pens, suction and pump tubing, and glassware; damage due to corrosion, abuse, accident, or alteration; and suitability for any specific purpose. This warranty is expressly in lieu of other warranties and obligations, and no person has authority to change it.

OUTSIDE THE WARRANTY PERIOD, REPLACEMENT PARTS AND REPAIR LABOR ARE GUARANTEED FOR 90 DAYS.

The warrantor is Isco, Inc., Lincoln, Nebraska.

INSTRUCTIONS FOR RETURNING INSTRUMENTS FOR REPAIR.

Before returning any instrument for repair, call or write our service department for instructions. Simple difficulties can often be diagnosed over the phone.

Pack the instruments carefully, preferably in its original carton, and ship to the attention of the service department. U.P.S. or motor freight is generally the best method except for very small, non-fragile items which can be sent by insured parcel post. **BE SURE TO ENCLOSE A NOTE EXPLAINING THE DEFECT AND A PURCHASE ORDER AUTHORIZING THE REPAIR.**

Isco, Inc.
4700 Superior Street
Lincoln, NE 68504-1398
Phone: (800) 228-4373
Fax: (402) 465-3091
Website: www.isco.com

ISCO

February, 1988

Limited Warranty *

For Isco Water/Waste/Sewage Applications

Isco warrants its magnetic flow meters to be free from defects in material and workmanship under normal use and service for the following periods from the date of purchase:

- UniMag flowtubes only: 10 years
- UniMag sensors: 5 years
- ChemMags: 1 year
- 4411 and 4412 transmitters: 2 years

The customer must give notice of any defect to Isco within the warranty period, thoroughly sanitize the product, return the product intact, and prepay transportation charges. The obligation of Isco under this warranty is limited to repair at its factory or replacement. This warranty shall not apply to any product which is repaired or altered outside of the Isco factory without authorization by Isco, or which has been subject to misuse, negligence, accident, or incorrect wiring by others. This warranty applies only if the user has followed the application and installation recommendations set forth by Isco.

Note: (1) Isco may recommend materials that come in contact with the media; however, Isco does not guarantee their compatibility for any specific application. The customer, in the end, is responsible for compatibility of all solutions that will come in contact with the flow tubes and sensors. (2) For accuracy of calibrated spare UniMag sensors, see Recommended Spare Parts in the UniMag Instruction Manual, or consult Isco.

This warranty is expressly in lieu of all other warranties and obligations and Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose. Any changes in this warranty must be in writing and signed by a corporate officer.

The warrantor is Isco, Inc. 4700 Superior, Lincoln, NE 68504, U.S.A.

* This warranty applies to USA customers. Customers in other countries should contact their Isco dealer for warranty service.

In the event of problems with an Isco magnetic flow meter, the first step should be to contact the Isco Service Department at the toll-free Repair Service number (800) 775-2965. No-charge service support is available at this number at any time. Many problems can be diagnosed and corrected over the phone, or by e-mail, more quickly than by an on-site service call. Before returning a product, contact Isco for a Return Authorization Number (RAN#) and shipping instructions.

Phone: Repair service: **(800) 775-2965** (7 days a week, 24 hours a day)
Sales & General Information (800) 228-4373 (USA & Canada)

E-mail: service@isco.com **Web site:** www.isco.com

Fax: (402) 465-3001

Shipping Address: Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

Mailing address: Isco, Inc.
PO Box 82531
Lincoln NE 68501 USA

Isco, Inc.
www.isco.com

Isco Limited Warranty *

For Isco Electromagnetic Flow Meters

Isco warrants its electromagnetic flow meters to be free from defects in material and workman-ship under normal use and service for the following periods from the date of purchase:

UniMag flow tubes only:	10 years
UniMag sensors:	5 years
ChemMags and WizMags:	1 year
4411 and 4412 transmitters:	2 years
4430 Flow Meter: (in non-full pipe system)	2 years

The customer must give notice of any defect to Isco within the warranty period, thoroughly sanitize the product, return the product intact, and prepay transportation charges. The obligation of Isco under this warranty is limited to repair at its factory or replacement. This warranty shall not apply to any product which is repaired or altered outside of the Isco factory without authorization by Isco, or which has been subject to misuse, negligence, accident, or incorrect wiring by others. This warranty applies only if the user has followed the application and installation recommendations set forth by Isco.

Note: (1) Isco may recommend materials that come in contact with the media; however, Isco does not guarantee their compatibility for any specific application. The customer, in the end, is responsible for compatibility of all solutions that will come in contact with the flow tubes and sensors. (2) For accuracy of calibrated spare UniMag sensors, see Recommended Spare Parts in the UniMag Instruction Manual, or consult Isco.

This warranty is expressly in lieu of all other warranties and obligations and Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose. Any changes in this warranty must be in writing and signed by a corporate officer.

The warrantor is Isco, Inc. 4700 Superior, Lincoln, NE 68504, U.S.A.

* This warranty applies to USA customers. Customers in other countries should contact their Isco dealer for warranty service.

In the event of problems with an Isco electromagnetic flow meter, the first step should be to contact the Isco Service Department at the toll-free Repair Service number (800) 228-4373. Many problems can be diagnosed and corrected over the phone, or by e-mail, more quickly than by an on-site service call. Before returning a product, contact Isco for a Return Authorization Number (RAN#) and shipping instructions.

Phone: Repair service: (800) 228-4373 (samplers and flow meters)
Sales & General Information (800) 228-4373 (USA and Canada)

E-mail: service@isco.com **Web site:** www.isco.com

Fax: (402) 465-3001

Shipping Address: Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

Mailing address: Isco, Inc.
PO Box 82531
Lincoln NE 68501 USA

September 2002, Rev A P/N 60-4402-001

Isco, Inc.
www.isco.com

LIMITED WARRANTY

Every effort is made to assure the highest quality merchandise, free of any defects. Merchandise is warranted against defects in material and workmanship when used in accordance with the standards and/or instructions recommended by this catalog or other written quotation of this firm. No warranty, expressed or implied, is made other than as follows:

Products manufactured by **WATERMAN INDUSTRIES, INC.** are warranted against defects in materials and workmanship for eighteen (18) months after shipment or twelve (12) months after installation, whichever occurs first-such warranty can only be enforced by the original consumer purchaser.
During the warranty period, the product will be repaired or replaced at **WATERMAN INDUSTRIES, INC.'S** option with no cost to the purchaser.

Measure of damage is the price of defective material only. No charges for labor or expense required to remove or to replace defective material or for any consequential damages will be allowed. Warranty excludes damage due to misuse, neglect or misapplication.

Any implied warranty of merchantability of fitness is limited to the duration of this written warranty. To the extent allowed by law, neither **WATERMAN INDUSTRIES, INC.** nor its selling dealer or agent shall have any responsibility for loss of use of the product, loss of time, commercial loss or consequential damages.

In the event a warranted product is believed defective, notify your Waterman Sales Office and furnish date purchased, copy of invoice or shipping documents. **DO NOT** attempt repairs or returns without authorization from **WATERMAN INDUSTRIES, INC.** Unauthorized repairs may void warranty, and costs for unauthorized repairs performed or replacement parts purchased within the warranty period will not be reimbursed. A return authorization number must be obtained from **WATERMAN INDUSTRIES, INC.** prior to returning any merchandise.

Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of consequential damages, therefore the above limitation may not apply.

This warranty gives you specific legal rights. You may also have other rights, which may vary from state to state.

It is the policy of this company to encourage the settlement of disputes in an informal manner. If such disputes arise over a warranty claim an informal dispute settlement mechanism can be agreed upon at that time.

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer; (b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment; (d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.

(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.

(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

GARANTÍA LIMITADA DE GOULDS PUMPS

Esta garantía es aplicable a todas las bombas para sistemas de agua fabricadas por Goulds Pumps.

Toda parte o partes que resulten defectuosas dentro del período de garantía serán reemplazadas sin cargo para el comerciante durante dicho período de garantía. Tal período de garantía se extiende por doce (12) meses a partir de la fecha de instalación, o dieciocho (18) meses a partir de la fecha de fabricación, cualquiera se cumpla primero.

Todo comerciante que considere que existe lugar a un reclamo de garantía deberá ponerse en contacto con el distribuidor autorizado de Goulds Pumps del cual adquiriera la bomba, y ofrecer información detallada con respecto al reclamo. El distribuidor está autorizado a liquidar todos los reclamos por garantía a través del Departamento de Servicios a Clientes de Goulds Pumps.

La presente garantía excluye:

(a) La mano de obra, el transporte y los costos relacionados en los que incurra el comerciante;
(b) los costos de reinstalación del equipo reparado; (c) los costos de reinstalación del equipo reemplazado;
(d) daños emergentes de cualquier naturaleza; y
(e) el reembolso de cualquier pérdida causada por la interrupción del servicio.

A los fines de esta garantía, los términos "Distribuidor", "Comerciante" y "Cliente" se definen como sigue:

(1) "Distribuidor" es aquel individuo, sociedad, corporación, asociación u otra entidad jurídica que opera entre Goulds Pumps y el comerciante para la compra, consignación o contratos de venta de las bombas en cuestión.

(2) "Comerciante" es todo individuo, sociedad, corporación, asociación u otra entidad jurídica que realiza negocios de venta o alquiler-venta (leasing) de bombas a clientes.

(3) "Cliente" es toda entidad que compra o que adquiere bajo la modalidad de leasing las bombas en cuestión de un comerciante. El término "cliente" puede significar un individuo, una sociedad, una corporación, una sociedad de responsabilidad limitada, una asociación o cualquier otra entidad jurídica con actividades en cualquier tipo de negocios.

LA PRESENTE GARANTÍA SE EXTIENDE AL COMERCIANTE ÚNICAMENTE

GARANTIE LIMITÉE DE GOULDS PUMPS

La présente garantie s'applique à chaque pompe de système d'alimentation en eau fabriquée par Goulds Pumps.

Toute pièce se révélant défectueuse sera remplacée sans frais pour le détaillant durant la période de garantie suivante expirant la première : douze (12) mois à compter de la date d'installation ou dix-huit (18) mois à partir de la date de fabrication.

Le détaillant qui, aux termes de cette garantie, désire effectuer une demande de règlement doit s'adresser au distributeur Goulds Pumps agréé chez lequel la pompe a été achetée et fournir tous les détails à l'appui de sa demande. Le distributeur est autorisé à régler toute demande par le biais du service à la clientèle de Goulds Pumps.

La garantie ne couvre pas :

a) les frais de main-d'œuvre ou de transport ni les frais connexes encourus par le détaillant ;
b) les frais de réinstallation de l'équipement réparé ; c) les frais de réinstallation de l'équipement de remplacement ;
d) les dommages indirects de quelque nature que ce soit ; e) ni les pertes découlant de la panne.

Aux fins de la présente garantie, les termes ci-dessous sont définis comme suit :

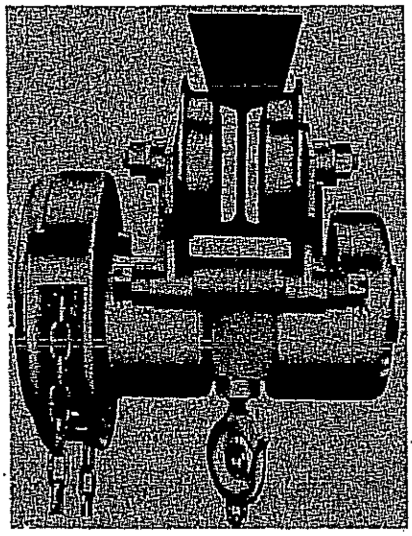
1) « Distributeur » signifie une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique servant d'intermédiaire entre Goulds Pumps et le détaillant pour les achats, les consignations ou les contrats de vente des pompes en question.

2) « Détaillant » veut dire une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique dont les activités commerciales sont la vente ou la location de pompes à des clients.

3) « Client » signifie une entité qui achète ou loue les pompes en question chez un détaillant. Un « client » peut être une personne, une société de personnes, une société de capitaux, une société à responsabilité limitée, une association ou autre entité juridique se livrant à quelque activité que ce soit.

CETTE GARANTIE SE RAPPORTE AU DÉTAILLANT SEULEMENT.

With Plain Trolley



With Geared Trolley

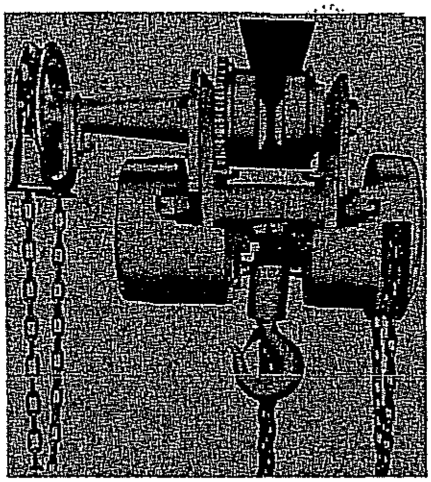
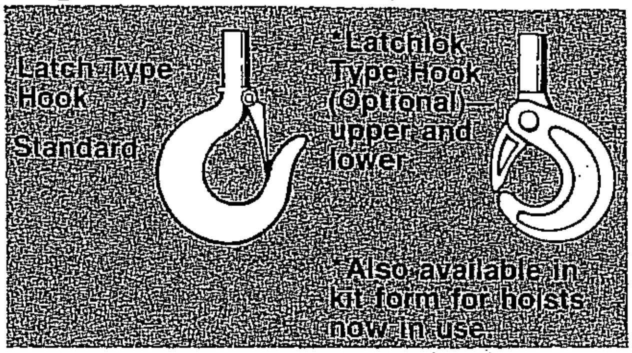


Figure 2.
Yale Low Headroom Trolley Hoists

HOOKS

Type of hooks supplied on the Yale Hoists are shown in Figure 3.



YALE REPAIR/REPLACEMENT POLICY

All Yale LH2 Hand Hoists and Low Headroom Trolley Hoists are thoroughly inspected and performance tested prior to shipment. If any properly maintained Yale Hoist develops a performance problem due to a material or workmanship defect, as verified by Yale or an authorized service station, repair or replacement of the unit will be made to the original purchaser without charge. This repair/replacement policy applies only to Yale Hoists installed, maintained and operated as outlined in this manual, and specifically excludes parts subject to normal wear, abuse, improper installation, improper or inadequate maintenance, hostile environmental effects, and unauthorized repairs/ modifications.

We reserve the right to change materials or design if in our opinion, such changes will improve our product. Abuse, repair by an unauthorized person, or use of non-Yale replacement parts voids the guarantee and could lead to dangerous operation. For full Terms of Sale, see Sales Order Acknowledgement. Also, refer to the back cover for Limitations of Warranties, Remedies and Damages and, Indemnification and Safe Operation.

OPERATION AND INSTALLATION

UNPACKING INFORMATION

After removing the hoist from the carton, check to be sure there has been no damage in shipment. Before cutting the cord ties on multiple-reeved units, be sure that all strands of chain are straight with no twist (due to a capsized hook block). If length of lift is to be modified, follow disassembly and assembly instructions for correct procedure.

OPERATING INSTRUCTIONS

After mounting and before placing in service, check the hoist for proper operation. On multi-reeved units, be sure that all strands of chain are straight with no twist (due to a capsized hook block).

The Yale Hand Hoist must always be rigged to lift in a straight line from hook to hook (see Figure 4). The hoist must always be free to swivel on the upper hook. Under no condition should the hoist be allowed to bear on any support when in use as this would cause bending of the hook or frame and damage the unit.

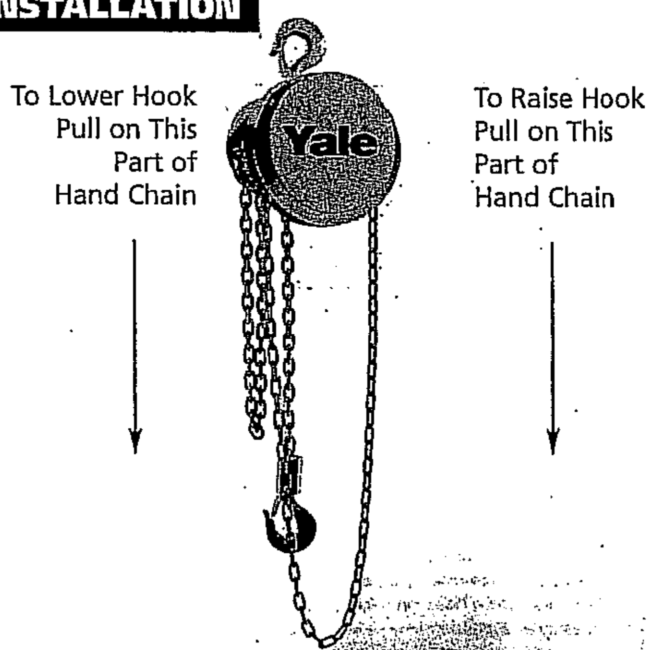


Figure 4. Raising and Lowering Hook

SPECIFICATIONS

The Yale Hand Hoist has been expanded to include trolley suspended units. The Yale Army Type Trolley Hoist consists of the lightweight, durable Yale Hand Hoist rigidly suspended from a four wheel trolley. To suspend the hoist from the trolley, the upper hook is replaced by a pair of load bars. As a result, the components of the hoist including the lower hook parts are shown and described in Manual No. Y646. The manual should also be used for operating instructions, safety procedures, inspections and maintenance procedures, lubrication information, troubleshooting, hoist exploded view, parts list and load chain reeving information.

YALE REPAIR/REPLACEMENT POLICY

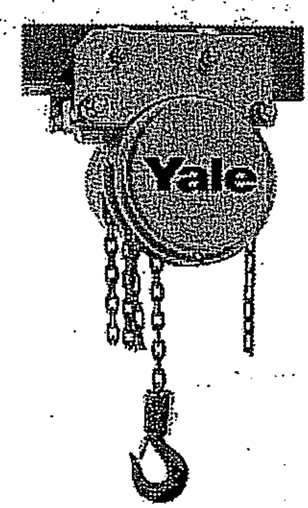
All Yale Hand Hoists and Army Type Trolley Hoists are thoroughly inspected and performance tested prior to shipment. If any properly maintained Trolley Hoist develops a performance problem due to a material or workmanship defect, as verified by Yale or an authorized service station, repair or replacement of the unit will be made to the original purchaser without charge. This repair/replacement policy applies only to Trolley Hoist installed, maintained and operated as outlined in this manual, and specifically excludes parts subject to normal wear, abuse, improper installation, improper or inadequate maintenance, hostile environmental effects, and unauthorized repairs/modifications.

We reserve the right to change materials or design if in our opinion, such changes will improve our product. Abuse, repair by an unauthorized person, or use of non-Yale replacement parts voids the guarantee and could lead to dangerous operation. For full Terms of Sale, see Sales Order Acknowledgment. Also, refer to the back cover of Manual No. Y646 for Limitations of Warranties, Remedies and Damages and, Indemnification and Safe Operation.

Yale®

Army Type Trolley Hoists

This compact trolley hoist features reduced headroom, side clearances and end approach which make it ideal for operation in tight spaces. Integral trolley has hardened universal tread flanged trackwheels which minimize rolling friction. Yale's Internal Load Limiter™ automatically guards against damaging overloads without increasing overall dimension. Capacities range from 1/4 thru 12 ton - plain or geared trolley. Adapts to a wide range of beam adjustments.



SPECIFICATIONS

Capacity		Ton	1/4	1/2	1	1-1/2	2	3	4	5	6	8	10	12
Code	Plain Trolley		925-02400	925-03400	925-05400	925-06400	925-07400	925-09400	925-11400	925-13400	925-14400	925-16400	925-17400	925-18400
	Geared Trolley		925-02500	925-03500	925-05500	925-06500	925-07500	925-09500	925-11500	925-13500	925-14500	925-16500	925-17500	925-18500
Standard Lift		Ft.	8	8	8	8	8	8	8	8	8	8	8	8
Strands of Chain			1	1	1	1	1	2	2	3	3	4	5	5
American Standard Shape Adjustment Ranges †	Depth	In.	6-12*	6-12*	6-12*	6-15	6-15	7-15	7-15	8-18	8-18	12-24	12-24	15-24
	Flange Width	In.	3 3/8-5 1/2	3 3/8-5 1/2	3 3/8-5 1/2	3 3/8-5 5/8	3 3/8-5 5/8	3 3/8-5 5/8	3 3/8-5 5/8	4-6 1/4	4-6 1/4	5-8	5/8	5 1/2-8
Chain Pull To Lift Full Capacity Load		Lbs.	23	46	69	80	83	85	87	74	89	91	93	95
Chain Overhauled to Lift Load One Foot		Ft.	22 1/2	22 1/2	30	40 1/2	52	81	104	156	156	208	260	312
Minimum Headroom		In.	11 7/16	11 7/16	11 3/4	15 5/16	15 5/16	19	19	22 9/16	23 1/16	29 5/16	29 5/16	31 13/16
Minimum Radius Curve		In.	30	30	30	30	30	48	48	60	60	72	72	96

*1/4 thru 1 ton plain Trolley Hoist can be adapted to 4" & 5" depth - American Standard Shapes (2 5/8"-3" flange widths) - at no extra charge.
† Specify exact beam size when ordering.

Warranty

HUBER Technology, Inc. a member of the HUBER Group warrants all screens, conveyance equipment, and parts manufactured by it to be free from defects in workmanship or materials for a period of one (1) year from the date of start-up, provided that in no event shall this warranty extend more than eighteen (18) months from date of shipment from the Hans Huber GmbH, Germany. If, during said warranty period, any screens, conveyance equipment or parts manufactured by said companies prove to be defective in workmanship or material under normal use and service, and if such equipment or parts are found to be defective by an authorized representative or a factory member of the Huber Group, they will be replaced or repaired free of charge.

The Huber Group or its affiliates assumes no liability for the consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of the Huber Group products by the purchaser, his employees or others. The Huber Group or affiliates will not be held responsible for travel expenses, rented equipment, outside contractor's fees, or unauthorized repair service or parts.

The warranty shall not apply to any product or part of product which has been subjected to misuse, accident, negligence or used in a manner contrary to The Huber Group or affiliates printed instructions or damage due to a defective power supply, improper electrical protection or faulty installation or repair. Wear caused due to corrosive fluids is not covered in this warranty.

Equipment and accessories purchased by The Huber Group or its affiliates from outside sources which are incorporated into any equipment by the Huber Group or any equipment parts are warranted only to the extent of the original manufactures warranty or guarantee, if any.

The HUBER Technology sole warranty and in lieu of all other warranties, expressed or implied, which are hear by excluded including in particular all warranties of merchantability or fitness for a particular purpose.

HUBER Technology neither assumes, nor authorizes any person or company to assume for it, any other obligation in connection with the sale of its equipment with the exception of a valid Huber Group guarantee or extended warranty, if applicable. Any other enlargement or modification of this warranty by a representative or other selling agent shall be his exclusive responsibility.

HUBER Technology, Inc.

TROUBLE SHOOTING

⚠ WARNING
Hazardous voltage

FAILURE TO DISCONNECT ELECTRICAL POWER BEFORE ATTEMPTING MAINTENANCE CAN CAUSE SHOCK, BURNS OR DEATH.

SYMPTOM

- MOTOR NOT RUNNING
  See Probable Causes 1,2,3,4,6,9
- LITTLE OR NO LIQUID DELIVERED BY PUMP
  See Probable Causes 5,6,7,8,10,14
- EXCESSIVE NOISE & VIBRATION
  See Probable Causes 3,4,7,14,15,16
- PUMP WILL NOT TURN OFF
  See Probable Causes 7,8,9,10,12,13
- PUMP CYCLES CONSTANTLY
  See Probable Causes 9,11,12,13

PROBABLE CAUSES

1. Motor thermal protector tripped
2. Open circuit breaker or blown fuse
3. Impeller, pump shaft binding
4. Defective motor
5. Pump is air locked
6. Low voltage
7. System head too high
8. Discharge, suction plugged
9. Level control defective or switch not properly positioned
10. Improper check valve direction
11. Check valve leaking
12. Incorrect size basin or wet-well
13. Inflow excessive for size of pump
14. Worn or plugged impeller
15. Worn motor bearing
16. Pump, motor or piping loose

LIMITED WARRANTY

GOULDS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;

(b) Reinstallation costs of repaired equipment;

(c) Reinstallation costs of replacement equipment;

(d) Consequential damages of any kind; and,

(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds and the dealer in purchases, consignments or contracts for sale of the subject pumps.

(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.

(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

GOULDS PUMPS
ITT Industries
SENECA FALLS, NEW YORK 13148

ARNING LABELS

The following warning labels and tags have been attached to the equipment:

L2430: TO AVOID POSSIBLE PERSONAL INJURY, DO NOT REMOVE SHIELDS WHILE METER IS IN USE. DO NOT EXCEED TEMP. AND PRESS. LIMITS: 200°F AND 200 PSI MAX.

L2431: TO AVOID POSSIBLE PERSONAL INJURY, DO NOT REMOVE SHIELDS WHILE METER IS IN USE. DO NOT EXCEED TEMP. AND PRESS. LIMITS 200°F AND 150 PSI MAX.

L2432: TO AVOID POSSIBLE PERSONAL INJURY, DO NOT REMOVE SHIELDS WHILE METER IS IN USE. DO NOT EXCEED TEMP. AND PRESS. LIMITS 200°F AND 90 PSI MAX.

L2433: TO AVOID POSSIBLE PERSONAL INJURY, DO NOT REMOVE SHIELDS WHILE METER IS IN USE FOR LIQUID SERVICE ONLY. DO NOT EXCEED TEMP. AND PRESS. LIMITS 140°F AND 200 PSI MAX.

L2434: TO AVOID POSSIBLE PERSONAL INJURY, DO NOT REMOVE SHIELDS WHILE METER IS IN USE FOR LIQUID SERVICE ONLY. DO NOT EXCEED TEMP. AND PRESS. LIMITS 140°F AND 150 PSI MAX.

L2435: TO AVOID POSSIBLE PERSONAL INJURY, DO NOT REMOVE SHIELDS WHILE METER IS IN USE FOR LIQUID SERVICE ONLY. DO NOT EXCEED TEMP. AND PRESS. LIMITS 140°F AND 90 PSI MAX.

L2436: TO AVOID POSSIBLE PERSONAL INJURY, DO NOT REMOVE SHIELDS WHILE METER IS IN USE. FOR LIQUID SERVICE ONLY. DO NOT EXCEED TEMP. AND PRESS. LIMITS 140°F AND 90 PSI MAX.

L2497: TO AVOID INJURY DO NOT OPERATE WITHOUT SHIELDS.

L2498: TO AVOID POSSIBLE PERSONAL INJURY DO NOT USE THIS METER FOR TOXIC OR HAZARDOUS FLUIDS OR FLUIDS THAT ATTACK GLASS. SEE INSTRUCTION BOOK FOR FURTHER PRECAUTIONS AND IMPORTANT INSTALLATION AND OPERATING DETAILS.

GUARANTEE AND WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder, except this exclusion shall not apply to chlorination equipment. Seller does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, (c) products subject to any abuse, misuse, negligence or accident, (d) products where parts not made, supplied, or approved by Seller are used and in the sole judgement of the Seller such use affects the products' performance, stability or reliability, and (e) products that have been altered or repaired in a manner in which, in the sole judgement of Seller, affects the products' performance, stability or reliability. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER.** If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing; Seller reserves the right to require the return of such defective parts to Seller, transportation charges prepaid, to verify such defect before this warranty is applicable. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 15 months after the date of shipment of the equipment or material.

LIMITATION OF BUYER'S REMEDIES. The **EXCLUSIVE REMEDY** for any breach of warranty is the replacement f.o.b. shipping point of the defective part or parts of the material or equipment. Any equipment or material repaired or replaced under warranty shall carry the balance of the original warranty period, or a minimum of three months. Seller shall not be liable for any liquidated, special, incidental or consequential damages, including without limitation, loss of profits, loss of savings or revenue, loss of use of the material or equipment or any associated material or equipment, the cost of substitute material or equipment, claims of third parties, damage to property, or goodwill, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory; provided, however, that such limitation shall not apply to claims for personal injury.

Statements and instructions set forth herein are based upon the best information and practices known to U.S. Filter/Wallace & Tiernan, Inc., but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

"ATTN. INSTALLER: After installation, please leave this instruction sheet for occupant's information."

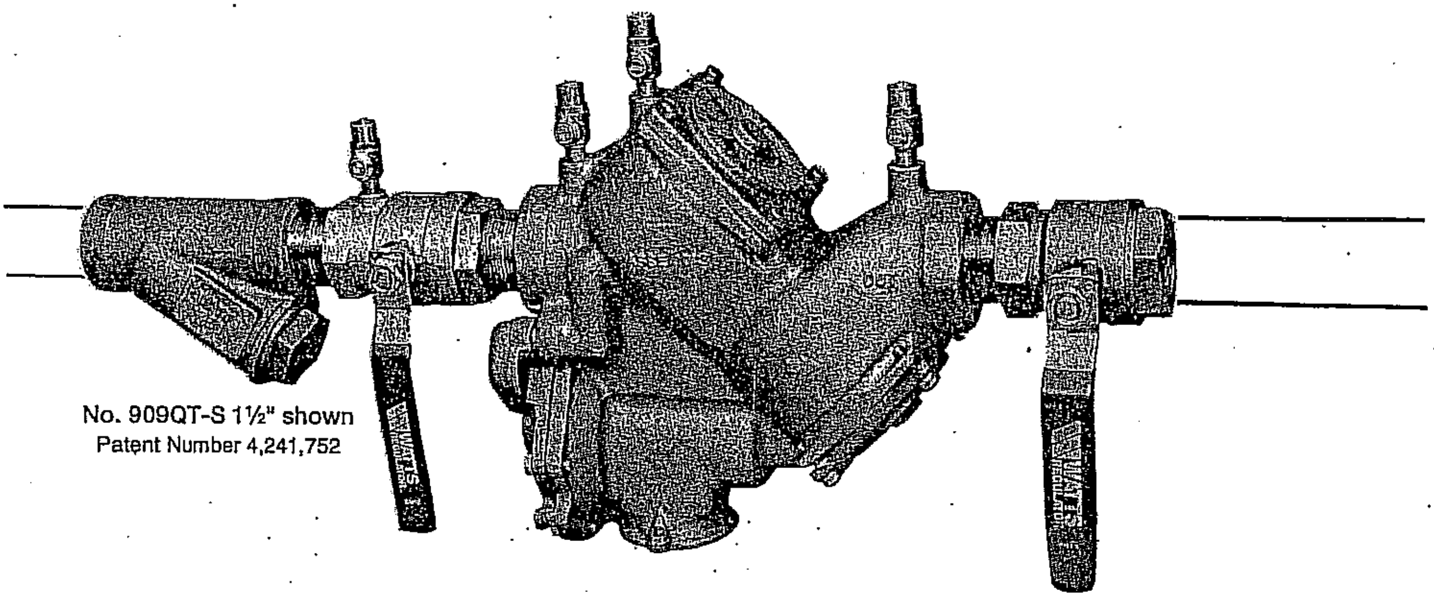
IMPORTANT: Inquire with governing authorities for local installation requirements.

NOTE: For *Australia* and *New Zealand*, line strainers should be installed between the upstream shutoff valve and the inlet of the backflow preventer.

Series 909

Reduced Pressure Zone Backflow Preventers

Sizes: 3/4" thru 2"



No. 909QT-S 1½" shown
Patent Number 4,241,752

- Installation
- Service
- Repair Kits
- Maintenance

LIMITED WARRANTY: Watts Regulator Company warrants each product against defects in material and workmanship for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge. This shall constitute the exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental or consequential damages, including without limitation, damages or other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemicals, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the product. THE COMPANY MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED EXCEPT AS PROVIDED IN THIS LIMITED WARRANTY.

For field testing procedure, send for IS-TK-DP/DL, IS-TK-9A, IS-TK-99E and IS-TK-99D.

For troubleshooting guide, send for S-TSG.

For other repair kits and service parts, send for PL-RP-BPD.

For technical assistance, contact your local Watts representative on back page.

CALIFORNIA PROPOSITION 65 WARNING

This product contains lead, a chemical known to the State of California to cause birth defects or other reproductive harm.

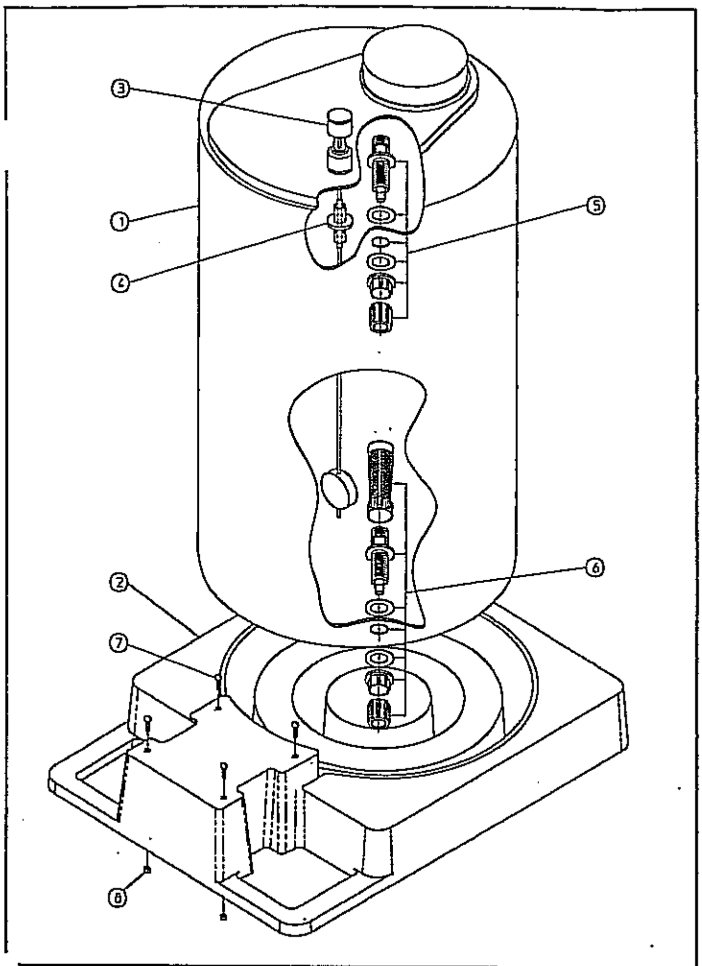
(Plumber: California law requires that this warning be given to the consumer.)

CONSUMER INFORMATION ABOUT CALIFORNIA PROPOSITION 65 WARNING

All faucets and products made of leaded brass alloys, even those that comply with U.S. Environmental Protection Agency regulations, contribute small amounts of lead to water that is allowed to stand in contact with the brass. This product complies with all E.P.A. regulations regarding the amount of lead used in plumbing brass and solder. The amount of lead contributed by any faucet/product is highest when the faucet/product is new.

The following steps will reduce potential exposure to lead from faucets and other parts of the plumbing system:

- Always run the water for a few seconds prior to use for drinking or cooking.
- Use only cold water for drinking or cooking.
- If you wish to flush the entire plumbing system of water that has been standing in the pipes or other fittings, run the cold water until the temperature of the water drops, indicating water coming from the outside main.
- If you are concerned about lead in your water, have your water tested by an EPA-certified laboratory in your area.



FILLING YOUR CHEMICAL TANK:

DANGER: DO NOT ATTEMPT TO FEED CHEMICALS WITHOUT CONSULTING YOUR CHEMICAL FEEDER DEALER OR CHEMICAL SUPPLIER. REFER TO PUMP MANUAL FOR ADDITIONAL CHEMICAL HANDLING PRECAUTIONS.

Check the chemical level in the reservoir frequently and refill as necessary.

When the red low level indicator appears, the chemical tank is ready to be refilled. Approximately 10 gallons of chemical solution may be added.

Remove tank cap by pressing dot on cap and rotating counter-clockwise.

DO NOT allow the level to drop too low before refilling. At least 4" of chemical should always remain in the tank.

IMPORTANT:

Be sure the tank lid is on tight after filling tank. Turn cap clockwise until detent locks into position and cap is tight.

MAINTENANCE:

Check tank and fittings frequently for deterioration and/or leakage.

ASS'Y	J40442	J40443	J40444	J40445	
ITEM	ASS'Y S100 .50"	ASS'Y S100 .38"	ASS'Y PULSA #1 .50"	ASS'Y PULSA #1 .38"	DESCRIPTION
1	40375	40375	40375	40375	15-GAL. TANK W/ COVER
2	J39372	J39372	J39370	J39370	TANK & MOTOR BASE
3	U0818399	U0818399	U0818399	U0818399	LOW LEVEL INDICATOR
4	U0818405	U0818405	U0818405	U0818405	FLOAT ASSEMBLY
5	J26879	J26885	J26879	J26885	BULKHEAD FITTING
6	J26859	J26860	J26859	J26860	BULKHEAD FITTING W/ STRAINER
7	U0811703	U0811703	U0811703	U0811703	NYLON SCREW
8	U0811704	U0811704	U0811704	U0811704	NYLON NUT

MANUFACTURER'S PRODUCT WARRANTY

The manufacturer warrants its equipment of its manufacture to be free of defects in material or workmanship. Liability under this policy extends for eighteen (18) months from the date of purchase or one (1) year from date of installation or whichever comes first. The manufacturer's liability is limited to repair or replacement of any device or part which is returned, prepaid, to the factory and which is proven defective upon examination. This warranty does not include installation or repair cost and in no event shall the manufacturer's liability exceed its selling price of such part.

The manufacturer disclaims all liability for damage to its products through improper installation, maintenance, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise, or any unauthorized repair. Replaceable elastomeric parts are expendable and are not covered by any warranty either expressed or implied. The manufacturer is not responsible for consequential or other damages, injuries or expense incurred through use of its products.

The above warranty is in lieu of any other warranty, either expressed or implied. The manufacturer makes no warranty of fitness or merchantability. No agent of ours is authorized to make any warranty other than the above.

SPECIFICATIONS

Model	Rated Watts	Btu/Hr	Amperes	Tip-Over Switch	Live Power Signal Light	Overload Switch with Caution Light
MH-114	1250	4270	10.4		•	
MH-621*	1000 1500	3412 5118	8.4 12.5		•	•
MH-761	1300	4436	10.8	•	•	
MH-771	AND	AND	AND	•	•	•
MH-800	1500	5118	12.5	•	•	

*Includes "Fan"- only setting for personal cooling.

- **Tip-Over Switch** shuts off heater automatically if unit tips over. When unit is "righted", heater will come back on.
- **Live Power Signal Light** glows amber when unit is plugged in.
- **Safety Overload Switch** automatically turns off heater if overheating occurs. Red caution light comes on. Determine and correct the cause of overheating. Heater will come back on when it cools.

Listed BTU is for one hour of uninterrupted use at rated watts and volts (120V, 60 HZ.)

This symbol on the product's nameplate (UL) means it is listed by UNDERWRITERS LABORATORIES, INC.

FULL ONE YEAR WARRANTY

This product is warranted against defects in materials or workmanship for one (1) year from date of original purchase. If your defective product is delivered prepaid during that period to an authorized service station, it will be repaired at no charge. Or you may write to **Rival's Service Division, 217 East 16th St., Sedalia Mo. 65301.** Your product will be repaired or replace (at our option) at no charge.

This warranty does not apply to commercial use, unreadable use, or to damage to the product (not resulting from defect or malfunction) while in the possession of the consumer.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

PATTON ELECTRIC/ A RIVAL COMPANY
Printed in U.S.A

Kansas City, MO 64131
R4-96 428-243

MATERIALS OF CONSTRUCTION

The wetted materials (those parts that contact the solution being pumped) available for construction are glass filled polypropylene, PVC, SAN, Hypalon, Viton, Teflon, 316 Stainless Steel, PVDF, Ceramic and Alloy C. These materials are very resistant to most chemicals. However, there are some chemicals, such as strong acids or organic solvents, which cause deterioration of some elastomer and plastic parts, such as the diaphragm, valve seats, or head. Consult Chemical Resistance Guide or Supplier for information on chemical compatibility.

Various manufacturers of plastics, elastomers and pumping equipment publish guidelines that aid in the selection of wetted materials for pumping commercially available chemicals and chemical compounds. Two factors must always be considered when using an elastomer or plastic part to pump chemicals. They are:

1. The temperature of service: Higher temperatures increase the effect of chemicals on wetted materials. The increase varies with the material and the chemical being used. A material quite stable at room temperature might be affected at higher temperatures.

2. Material choice: Materials with similar properties may differ greatly from one another in performance when exposed to certain chemicals.

MANUFACTURER'S PRODUCT WARRANTY

The manufacturer warrants its equipment of its manufacture to be free of defects in material or workmanship. Liability under this policy extends for eighteen (18) months from the date of purchase or one (1) year from date of installation or whichever comes first. The manufacturer's liability is limited to repair or replacement of any device or part which is returned, prepaid, to the factory and which is proven defective upon examination. This warranty does not include installation or repair cost and in no event shall the manufacturer's liability exceed its selling price of such part.

The manufacturer disclaims all liability for damage to its products through improper installation, maintenance, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise, or any unauthorized repair. Replaceable elastomeric parts are expendable and are not covered by any warranty either expressed or implied. The manufacturer is not responsible for consequential or other damages, injuries or expense incurred through use of its products.

The above warranty is in lieu of any other warranty, either expressed or implied. The manufacturer makes no warranty of fitness or merchantability. No agent of ours is authorized to make any warranty other than the above.

CHAPTER 17

WATER, SEWERS AND SEWAGE.[1]

Sec. 17-1. Rules and regulations governing town water and sewer systems.

All ordinances and resolutions of the town council establishing regulations for the laying of water or sewer pipes or mains or for the maintenance thereof or fixtures thereto, or for the tapping thereof or making connections thereto, including charges and fees and the issuance of permits therefore and the supervision of work with respect thereto, or which in any other manner relate to the town water supply or sewer systems, including but not limited to rates and charges to and against persons and properties served thereby and the manner of determining such rates and charges, whether by meter or otherwise, and the equitable classification of persons and properties served thereby (resident or nonresident,[2] commercial or industrial, residential, organizational, etc.), and the billing of persons served thereby and the due dates for the payment of such bills and the penalties for late payment or nonpayment thereof, shall be maintained by the town clerk, in current status, in his office at all times and shall there be available to the public for inspection and use during all regular business hours; and it shall be unlawful for any person to violate or fail to comply with any provision of any such ordinance or resolution.

Sec. 17-2. Landlord to pay for water and sewer.

All landlords, who have tenant houses and apartments for rent, are held responsible for the payment of all customary water and sewer rents for such tenant houses and apartments to the Town of Amherst. The superintendent of public utilities is hereby directed that water not be furnished to any rented premises without the express direction of the owner of such property. (Code 1965, Sec. 3-6.)

Sec. 17-3. Buildings within two hundred feet of public sanitary sewer must be connected thereto.[3]

Every building which abuts a street or right of way in which there is a public sanitary sewer, or within two hundred feet of a public sanitary sewer, shall be connected to the sewer by the owner of the premises, or

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[1]For charter provisions as to authority of town to acquire water and water rights, see Char., art. V., Sec. 1, subsec. (2). As to authority of town to construct, maintain and operate public improvements of all kinds, including sewage disposal works, see Char., art. V, Sec. 1, subsec. (6). As to authority of town to own, operate and maintain waterworks, etc., for the purpose of providing an adequate water supply to the town and piping and conducting water; and to lay and maintain mains for water and sewer lines in and beyond the town; to collect water rents, etc., see Char., art. VI, S. 1, subsec. (2). As to authority of town to establish and maintain sanitary sewers, sewer lines and systems and to charge reasonable fees for the use thereof, etc., see Char., art. VI, Sec. 1, subsec. (3). As to authority of town to impose and enforce the collection of water and sewer rates, etc., see Char., art. VI, Sec. 1, subsec. (6).

For state law as to town sewage disposal systems, see Code of Virginia, Sec. 15.2-2122 et seq.

[2]For charter provisions as to authority of town to charge different rates for public facilities provided beyond town limits than for those within the town, see Char., art. VI, Sec. 1, subsec. (4).

[3]For charter provisions as to authority of town to require property owners to connect their properties to public sewers, when available, see Char., art. VI, Sec. 1, subsec. (3).

his agent, in the most direct manner possible. (Code 1965, Sec. 3-5.)

Sec. 17-4. Sewage disposal requirements for buildings not connected to public sewers.

Every house used as a human habitation, every warehouse, every public building, every recreation or tourist camp, transient lodging house, or other place where human beings congregate, or are employed in the town and which is not required by section 17-3 to be connected to a public sanitary sewer, shall be provided (by owner or owners thereof) with a sanitary septic tank or other sanitary device for the catchment or receiving of human discharges and other sewage originating in such places. If an outside privy is to be used, it must be built and maintained in accordance with specifications of the state health department. If a septic tank is used, it must be built and maintained in accordance with specifications of the state health department.

All homes or other places having flush toilets, discharging on the ground or into small streams or ditches, shall be provided by the owner with a septic tank or other approved sewage disposal. (Code 1965, Sec. 3-5.)

Sec. 17-5. General sanitary provisions as to sewage disposal.

No person shall maintain on any premises owned or occupied by him or under his control any arrangements for sewage disposal which is unsanitary, or in violation of any law or ordinance or any rule or regulation promulgated pursuant to authority of law or ordinance, or which in any way constitutes a hazard to the health or safety of persons or is otherwise a nuisance, or which is accessible to insects, rodents or animals. No person shall deposit any human excrement upon the surface of the ground or in any place where it may endanger a source of drinking water or food supply or be accessible to flies or animals. (Code 1965, Sec. 3-5.)

Sec. 17-6 Permit required to install, maintain or repair sanitary privy or septic tank.

It shall be unlawful for any person to install, or have installed, or repair or maintain a sanitary privy or a septic tank in the town without first obtaining a permit from the county health officer, or his representative. (Code 1965, Sec. 3-5.)

Sec. 17-7. Septic tank requirements and regulations.

All septic tanks within the town shall conform in all respects to the standards, specifications, location and other requirements of the state health department. (Code 1965, Sec. 3-5.)

Sec. 17-8. Water to be shut off to properties for which adequate sewage disposal facilities are not provided.

If the owner of property which is in the town fails to properly and adequately dispose of the sewage from such property in order that it may not become obnoxious or offensive or a menace to public health, his water supply shall be cut off and stay so until such time as an approved method of the proper disposal of the sewage be made. (Code 1965, Sec. 3-4.)

Sec. 17-9. Sewage pre-treatment (Repealed on August 5, 2000)

Sec. 17-10. Disconnection of gutters in Town of Amherst sewer system.

No person, corporation, business or entity shall construct or maintain any gutter or stormwater system which discharges into the Town of Amherst Sewer System. Any person, corporation, business, or entity that discharges into the Town of Amherst Sewer System shall immediately disconnect from the Town of Amherst Sewer System. Further, any person, business, corporation, or other entity which discharges into the Town of Amherst Sewer System shall immediately disconnect such discharge from the Town of Amherst sewer system immediately upon notification by the Town Manager, the Superintendent of Utilities, or the Chief of Police or his duly designated deputies. (Enacted June 8, 1988)

Sec. 17-11. Changes and extensions of systems.

The Town Council has the authority to promulgate such orders, rules, resolutions or regulations as it deems necessary for the protection, repair, extension or improvement of waterworks or sewerage facilities of the Town.

The Town Council shall make or authorize such changes and extensions of the water and sewerage facilities as it may find to be necessary and proper. As such, the Town Council reserves the right to review each request for service and evaluate both requested service requirements and available system capacities. Should an application be made for a water or sewer connection where there is no water or sewer line in an adjoining street or right of way, such application shall be referred to the Town Council for consideration and such action as it deems appropriate.

Generally, the person or organization requesting the extension shall be required to bear all costs of the extension in addition to the connection and availability charges provided for herein so that such will not be a financial drain on the Town in terms of bad investment, liability, or any other aspect. Such costs shall include engineering and permit acquisition costs, rights-of-way, and machinery, equipment, labor and material incident to such extension. Within the boundaries of the property requesting the extension, the cost of facilities shall be borne by the developer, except in such cases where the Town Council determines the line must be oversized to accommodate future development in nearby service areas. Where oversized on-site facilities are required, the developer shall be compensated only for the added cost of oversizing. Water and sewer facilities may be extended to the property requesting the extension by the Town of Amherst, provided the property requesting the extension is inside the corporate limits and the Town Council finds that it is financially feasible and prudent to extend the facilities.

All extensions and changes to the Town of Amherst water and sewer systems shall be designed according to good engineering practice and Virginia Department of Health and Town of Amherst standards, approved by the Town Council, and constructed by the Town or under the inspection of the Town Manager. Upon completion of construction and acceptance by the Town Council, the new facilities shall become property of the Town of Amherst as part of its water and sewer system. The Town of Amherst shall own and maintain all water lines and facilities up to and including the customer's water meter. Unless otherwise agreed upon in writing, the The Town of Amherst shall own and maintain Town sewer mains where two or more users are connected to the same line or up to and including a cleanout installed at or near the property owner's property line.

Except for the purposes of preliminary discussion, no request or proposal to extend or change the Town of Amherst water and sewer systems shall be considered until such is submitted in writing and accompanied by drawings clearly explaining the request or proposal. Decisions of Council concerning the extension or change to the system shall be made within a reasonable period.

The provisions of this section shall not limit the authority of the Town Council to finance reasonable utility extensions, whether inside or outside the Town of Amherst corporate limits, to support new business or industry. (Enacted February 11, 1998)

Sec. 17-12. Water and sewer connections.

New connections to the Town of Amherst water and sewer system will be made under the following procedures:

(a) **Adequacy of system.** The portions of the Town of Amherst water and sewer system serving the vicinity of the proposed connection must be large enough to retain adequate levels service, in the sole determination of the Town Council, for existing users as well as the new users.

(b) Availability fees. Availability fees for residential water and sewer users are based on (a) the number of residences to be attached to the Town system and (b) the location of the new user. Nonresidential users are assessed based on the equivalent residential capacity of the water meter serving the user's new facility. Except for special assessment areas established by the Town Council, each new user of the Town of Amherst's water and sewer system shall be assessed an availability fee according to the following chart:

			In Town		Out of Town		
Meter Size	80% Capacity, gpm	Factor	Water	Sewer	Water	Sewer	
5/8"	16	1	$1,700	$2,500	$4,000	$5,000	Single Family Residential Service
3/4"	24	1.5	$2,550	$3,750	$6,000	$7,500	
1"	40	2.5	$4,250	$6,250	$10,000	$12,500	
1 1/2"	80	5	$8,500	$12,500	$25,000	$25,000	
2"	128	8	$13,600	$20,000	$40,000	$40,000	
3"	280	17.5	$29,750	$43,750	$87,500	$87,500	
4"	480	30	$51,000	$75,000	$150,000	$150,000	
6"	1000	62.5	$106,250	$156,250	$312,500	$312,500	

All availability fees and surcharges shall be paid in advance of zoning permit issuance or physical connection. Both water and sewer availability fees will be assessed in the event the size of a user's meter is increased. Existing users shall pay the difference between the larger meter fee and the fee that would be charged for the existing meter when larger meters are installed. No refund will be made for the removal or downsizing of meters.

In order to encourage economic development or employment for the Town, the Town Council may, in its sole discretion and by resolution, authorize the availability fee to be paid from the general fund for those commercial or industrial owners (applicants) which the Town Council in its sole discretion determines would provide economic development or significant employment opportunities.

(c) **Connection fees.** For both water and sewer connections, the cost of construction to the Town in making the connection will be assessed to the owner of the property requesting the connection in the form of a connection fee. The estimated connection fee shall be paid in advance to the Town if the projected cost of installing new facilities is in excess of $1,000.00. Actual connection to Town lines shall be done by the Town or by contractor following written approval for same and inspection by the Town Manager.

The Town Council may, in its sole discretion waive a portion of the availability or connection fees for facilities installed under federal or state funded projects. At the Town's request, the portion waived shall be indicated as Town financial participation in the project.

(Enacted February 11, 1998; amended December 14, 2005.)

Sec. 17-13. New water and sewer users located outside the corporate limits.

Connections to the Town of Amherst water and sewer system by users located outside the corporate limits may be authorized by the Town Council under the following circumstances.

(a) The applicant shall be a property owner who makes a written application to the Town Manager for Town water or sewer service after voluntarily petitioning for his property to be included within the Town of Amherst corporate limits. The petitions shall be in a form acceptable to the Town Attorney for filing in the Amherst County Clerk of the Circuit Court's office with the land records to run with the property and be binding on future owners for a period not to exceed 20 years. (Amended July 15, 1998)

(b) The applicant shall agree in writing to the following conditions regarding water and sewer use:

(1) That his successors and assigns in title to the property will pay Town all water and sewer bills against such property.

(2) That the user fees for water and sewer used outside the Town's corporate limits shall be established by the Town Council and may be amended at any time at the sole discretion of the Town Council.

(3) That the petitioner will observe and perform all the rules, regulations and ordinances now in force or that may be hereafter passed or enacted by the Town Council in reference to the use of Town water and sewer.

(4) That the Town reserves the right to temporarily interrupt the water and sewer service at any time from any and all persons using same for maintenance, nonpayment of bills, or any other reasonable purpose.

(5) That upon approval of the application by the Town Council the procedure for the introduction of water and sewer shall be the same as provided for inside the Town of Amherst corporate limits.

The provisions of this section shall not limit the authority of the Town Council to support economic development outside the Town of Amherst corporate limits by providing water and sewer service on negotiated terms to new or existing institutions, business or industry if inclusion of such new business or industry within the corporate limits is not a practical requirement. (Enacted February 11, 1998)

Sec. 17-14. Title

This ordinance shall be referred to as the **Cross Connection Control Ordinance**. (Adopted October 13, 1999)

Sec. 17-14.1. Intent

This ordinance provides for the establishment and enforcement of a program of cross connection control and backflow prevention in accordance with the Commonwealth of Virginia, Virginia Department of Health, Waterworks Regulations. The purpose of this section is to abate or control actual or potential cross connections and protect the public health in a manner consistent with state and federal law.

Sec. 17-14.2. Definitions

The following words, terms and phrases, when used in this section, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

Air gap separation means the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying pure water to a tank, plumbing fixture, or other device and the rim of the receptacle.

Auxiliary Water System means any water system on or available to the premises other than the waterworks. These auxiliary waters may include water from another purveyor's waterworks; or water from a source such as wells, lakes, or streams; or process fluids; or used water. They may be polluted or contaminated or objectionable, or constitute an unapproved water source or system over which the water purveyor does not have control.

Backflow means the flow of contaminants, pollutants, process fluids, used water, untreated waters, undesirable chemicals or gases, or nonpotable waters into any part of a waterworks.

Backflow Prevention Device means any approved device, method, or type of construction intended to prevent backflow into a waterworks.

Consumer means the owner or person in control of any premises supplied by or connected in any manner to a waterworks.

Consumer's water system means any water system located on the consumer's premises, supplied by or in any manner connected to a waterworks.

Contamination means any introduction into pure water of micro-organisms, wastes, wastewater, undesirable chemicals or gases.

Cross-connection means any connection or structural arrangement, direct or indirect, to the waterworks whereby backflow can occur.

Degree of hazard is derived from an evaluation of the potential risk to health and the adverse effect upon the waterworks.

Double gate-double check valve assembly means an approved assembly composed of two (2) single, independently acting check valves including tightly closing shutoff valves located at each end of the assembly and petcocks and test gauges for testing the watertightness of each check valve.

Health hazard means any condition, device, or practice in a waterworks or its operation that creates, or may create, a danger to the health and well-being of the water consumer.

Interchangeable connection means an arrangement or device that will allow alternate but not simultaneous use of two (2) sources of water.

Pollution means the presence of any foreign substance (chemical, physical, radiological, or biological) in water that tends to degrade its quality so as to constitute an unnecessary risk or impair the usefulness of the water.

Pollution hazard means a condition through which an aesthetically objectionable or degrading material may enter the waterworks or a consumer's water system.

Process Fluids means any kind of fluid or solution which may be chemically, biologically, or otherwise contaminated or polluted which would constitute a health, pollutional, or system hazard if introduced into the waterworks. This includes, but is not limited to:

1. Polluted or contaminated water,
2. Process waters,
3. Used water, originating from the waterworks which may have deteriorated in sanitary quality.
4. Cooling waters,
5. Contaminated natural waters taken from wells, lakes, streams, or irrigation systems,
6. Chemicals in solution or suspension, and
7. Oils, gases, acids, alkalis, and other liquid and gaseous fluid used in industrial or other processes, or for fire fighting purposes.

Pure Water or Potable Water means water fit for human consumption and domestic use which is sanitary and normally free of minerals, organic substances, and toxic agents in excess of reasonable amounts for domestic usage in the area served and normally adequate in quantity and quality for the minimum health requirements of the persons served.

Reduced Pressure Principle Backflow Prevention Device (RPZ device) means a device containing a minimum of two independently acting check valves together with an automatically operated pressure differential relief valve located between the two (2) check valves. During normal flow and at the cessation of normal flow, the pressure between these two (2) checks shall be less than the supply pressure. In case of leakage of either check valve, the differential relief valve, by discharging to the atmosphere, shall operate to maintain the pressure between the check valves at less than the supply pressure. The unit must include tightly closing shutoff valves located at each end of the device, and each device shall be fitted with properly located test cocks. These devices must be of the approved type.

Service Connection means the terminal end of a service line from the waterworks. If a meter is installed at the end of the service, then the service connection means the downstream end of the meter.

System Hazard means a condition posing a threat of or actually causing damage to the physical properties of the waterworks or a consumer's water system.

Used Water means water supplied by a waterworks to a consumer's water supply system after it has passed through the service connection.

Water purveyor means an individual, group of individuals, partnership, firm, association, institution, corporation, municipal corporation, county, or authority which supplies water to any person within this state from or by any means of any waterworks.

Waterworks means all structures and appliances used in connection with the collection, storage, purification and treatment of water for drinking or domestic use and the distribution thereof to the public or residential consumers as set forth in Title 32.1, Chapter 6, Article 2, Section 32.1-167, Code of Virginia.

Sec. 17-14.3. Status of section

This section is a supplement to the applicable plumbing codes.

Sec. 17-14.4. Adoption of regulation

12 VAC 5-590-580 et seq., *Cross-Connection Control and Backflow Prevention in Waterworks*, Virginia Department of Health Waterworks Regulations, is hereby adopted by reference.

Sec. 17-14.5. Inspection for cross-connections

It shall be the duty of the Town Manager, or his duly authorized representative, to cause inspection to be made of properties served by the waterworks where cross-connection with the waterworks is deemed possible. The frequency of inspections, and reinspections, based on potential health hazards involved, shall be established by the Town Manager in a cross connection control and backflow prevention program consistent with Virginia Department of Health guidelines.

Sec. 17-14.6. Right for entry for inspection

The Town Manager, or his duly authorized representative, bearing proper credentials and identification, shall be permitted to enter at any reasonable time properties served by a connection to the waterworks of the Town for the purpose of inspecting the piping system or systems for cross-connections. Upon request, the owner or occupants of property served shall furnish to the inspection agent pertinent information regarding the piping system or systems on such property. The refusal of such information or refusal of access, when requested, shall be deemed evidence of the presence of cross-connections.

Sec. 17-14.7. Denial or discontinuance of water service

The water purveyor may deny or discontinue the water service to a consumer if the required backflow prevention device is not installed. If it is found that the device has been removed or bypassed or if a cross-connection exists on the premises, or if the pressure in the waterworks is lowered below 10 psi gauge, the purveyor shall take positive action to insure that the waterworks is adequately protected at all times. Water service to such premises shall not be restored until the deficiencies have been corrected or eliminated in accordance with Commonwealth of Virginia, Virginia Department of Health, Waterworks Regulations and to the satisfaction of the purveyor.

Sec. 17-14.8. Labeling unsafe outlets

The potable water made available on the properties served by the waterworks shall be protected from possible contamination or pollution by enforcement of this chapter and the Uniform Statewide Building Code. Any water outlet which could be used for potable or domestic purposes and is not supplied by the potable system must be labeled as "Water Unsafe for Drinking" in a conspicuous manner.

Sec. 17-15. Title

This section of the Town Code of the Town of Amherst shall be referred to as the **Wastewater Pretreatment Ordinance**. (Adopted April 5, 2000)

Sec. 17-15.1 General provisions.

Sec. 17-15.1.1 Purpose and policy

This ordinance sets forth uniform requirements for users of the Publicly Owned Treatment Works (POTW) for the Town of Amherst and enables the Town to comply with all applicable State and Federal laws, including the VPDES Permit Regulation (9VAC 25-321-10 et seq., Part VII), Clean Water Act (33 United States Code Section 1251 *et seq.)* and the General Pretreatment Regulations (40 Code of Federal Regulations Part 403). The objectives of this ordinance are:

A. To prevent the introduction of pollutants into the Publicly Owned Treatment Works that will interfere with its operation;

B. To prevent the introduction of pollutants into the Publicly Owned Treatment Works that will pass through the Publicly Owned Treatment Works, inadequately treated, into receiving waters, or otherwise be incompatible with the Publicly Owned Treatment Works;

C. To protect both Publicly Owned Treatment Works personnel who may be affected by wastewater and sludge in the course of their employment and the general public;

D. To promote reuse and recycling of industrial wastewater and sludge from the Publicly Owned Treatment Works;

E. To provide for fees for the equitable distribution of the cost of operation, maintenance, and improvement of the Publicly Owned Treatment Works; and

F. To enable the Town to comply with its Virginia Pollutant Discharge Elimination System permit conditions, sludge use and disposal requirements, and any other Federal or State laws to which the Publicly Owned Treatment Works is subject.

This ordinance shall apply to all users of the Publicly Owned Treatment Works. The ordinance authorizes the issuance of wastewater discharge permits; provides for monitoring, compliance, and enforcement activities; establishes administrative review procedures; requires user reporting; and provides for the setting of fees for the equitable distribution of costs resulting from the program established herein.

Sec. 17-15.1.2 Administration

Except as otherwise provided herein, the Town Manager shall administer, implement and enforce the provisions of this ordinance. Any authority granted to or duties imposed upon the Town Manager may be delegated by the Town Manager to a Pretreatment Coordinator or other Town personnel.

Sec. 17-15.1.3 Abbreviations

The following abbreviations, when used in this ordinance, shall have the designated meanings:

- BOD - Biochemical Oxygen Demand
- CFR - Code of Federal Regulations
- COD - Chemical Oxygen Demand
- EPA - U.S. Environmental Protection Agency
- gpd - gallons per day
- mg/l - milligrams per liter
- NPDES/VPDES - National Pollutant Discharge Elimination System/Virginia Pollution Discharge Elimination System
- POTW - Publicly Owned Treatment Works
- RCRA - Resource Conservation and Recovery Act
- SIC - Standard Industrial Classification
- TSS - Total Suspended Solids
- U.S.C. - United States Code

Sec. 17-15.1.4 Definitions

Unless a provision explicitly states otherwise, the following terms and phrases, as used in this ordinance, shall have the meanings hereinafter designated.

A. *Act or The "Act."* The Federal Water Pollution Control Act, also known as the Clean Water Act, as amended, 33 U.S.C. § 1251 *et seq.*

B. *Approval Authority.* Department of Environmental Quality, Commonwealth of Virginia, Richmond, Virginia.

C. *Authorized Representative of the User*

(1) If the user is a corporation:

(a) The president, secretary, treasurer, or a vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or

(b) The manager of one or more manufacturing, production, or operation facilities employing more than two hundred fifty (250) persons or having gross annual sales or expenditures exceeding twenty-five (25) million dollars (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) If the user is a partnership or sole proprietorship: a general partner or proprietor, respectively.

(3) If the user is a Federal, State or local governmental facility: a director or highest official appointed or designated to oversee the operation and performance of the activities of the government facility, or their designee.

(4) The individuals described in paragraphs 1 through 3, above, may designate another authorized representative if the authorization is in writing, the authorization specifies the individual or position responsible for the overall operation of the facility from which the discharge originates or having overall responsibility for environmental matters for the company, and the written authorization is submitted to the Town.

D. *Biochemical Oxygen Demand or BOD.* The quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedures for five (5) days at 20° centigrade, usually expressed as a concentration (e.g., mg/l).

E. *Categorical Pretreatment Standard or Categorical Standard.* Any regulation containing pollutant discharge limits promulgated by EPA in accordance with Sections 307(b) and (c) of the Act (33 U.S.C. § 1317) which apply to a specific category of users and which appear in 40 CFR Chapter I, Subchapter N, Parts 405-471.

F. *Environmental Protection Agency or EPA.* The U.S. Environmental Protection Agency or, where appropriate, the Regional Water Management Division Director, or other duly authorized official of said agency.

G. *Existing Source.* Any source of discharge, the construction or operation of which commenced prior to the publication by EPA of proposed categorical pretreatment standards, which will be applicable to such source if the standard is thereafter promulgated in accordance with Section 307 of the Act.

H. *Grab Sample.* A sample, which is taken from a wastestream without regard to the flow in the wastestream and over a period of time not to exceed fifteen (15) minutes.

I. *Indirect Discharge or Discharge.* The introduction of pollutants into the POTW from any nondomestic source regulated under Section 307 (b), (c), or (d) of the Act.

J. *Instantaneous Maximum Allowable Discharge Limit.* The maximum concentration of a pollutant allowed to be discharged at any time, determined from the analysis of any discrete or composited sample collected, independent of the industrial flow rate and the duration of the sampling event.

K. *Interference.* A discharge, which alone or in conjunction with a discharge or discharges from other sources, inhibits or disrupts the POTW, its treatment processes or operations or its sludge processes, use or disposal; and therefore, is a cause of a violation of the Town 's VPDES permit or of the prevention of sewage sludge use or disposal in compliance with any of the following statutory/regulatory provisions or permits issued thereunder, or any more stringent State or local regulations: Section 405 of the Act; the Solid Waste Disposal Act, including Title II commonly refereed to as. the Resource Conservation and Recovery Act (RCRA); any State regulations contained in any State sludge management plan prepared pursuant to Subtitle D of the Solid Waste Disposal Act; the Clean Air Act; the Toxic Substances Control Act; and the Marine Protection, Research, and Sanctuaries Act.

L. *Medical Waste.* Isolation wastes, infectious agents, human blood and blood products, pathological wastes, sharps, body parts, contaminated bedding; surgical wastes, potentially contaminated laboratory wastes, and dialysis wastes.

M. *New Source.*

(1) Any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced after the publication of proposed pretreatment standards under Section 307(c) of the Act which will be applicable to such source if such standards are thereafter promulgated in accordance with that section, provided that:

(a) The building, structure, facility, or installation is constructed at a site at which no other source is located; or

(b) The building, structure, facility, or installation totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or

(c) The production or wastewater generating process of the building, structure, facility, or installation is substantially independent of an existing source at the same site. In determining whether these are substantially independent, factors such as the extent to which the new facility is integrated with the existing plant, and the extent to which the new facility is engaged in the same general type of activity as the existing source, should be considered.

(2) Construction on a site at which an existing source is located results in a modification rather than a new source if the construction does not create a new building, structure, facility, or installation meeting the criteria of Sec. 17-15.(1)(b) or (c) above but otherwise alters, replaces, or adds to existing process or production equipment.

(3) Construction of a new source as defined under this paragraph has commenced if the owner or operator has:

(a) Begun, or caused to begin, as part of a continuous onsite construction program

(i) any placement, assembly, or installation of facilities or equipment; or

(ii) significant site preparation work including clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment; or

(b) Entered into a binding contractual obligation for the purchase of facilities or equipment that are intended to be used in its operation within a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contacts for feasibility, engineering, and design studies do not constitute a contractual obligation under this paragraph.

N. *Noncontact Cooling Water.* Water used for cooling which does not come into direct contact with any raw material, intermediate product, waste product, or finished product.

O. *Pass Through.* A discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the Town's VPDES permit, including an increase in the magnitude or duration of a violation.

P. *Person.* Any individual, partnership, copartnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity, or any other legal entity; or their legal representatives, agents, or assigns. This definition includes all Federal, State, and local governmental entities.

Q. *PH.* A measure of the acidity or alkalinity of a solution, expressed in standard units.

R. *Pollutant.* Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, medical wastes, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, municipal, agricultural and industrial wastes, and certain characteristics of wastewater (e.g., pH, temperature, TSS, turbidity, color, BOD, COD, toxicity, or odor).

S. *Pretreatment* The reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, introducing such pollutants into the POTW. This reduction or alteration can be obtained by physical, chemical, or biological processes; by process changes; or by other means, except by diluting the concentration of the pollutants unless allowed by an applicable pretreatment standard.

T. *Pretreatment Coordinator.* The person designated by the Town of Amherst who is charged with certain duties and responsibilities by this policy, including the operation of the POTW, or a duly authorized representative of that person.

U. *Pretreatment Requirements.* Any substantive or procedural requirement related to pretreatment imposed on a user, other than a pretreatment standard.

V. *Pretreatment Standards or Standards.* Pretreatment standards shall mean prohibited discharge standards, categorical pretreatment standards, and local limits.

W. *Prohibited Discharge Standards or Prohibited Discharges.* Absolute prohibitions against the discharge of certain substances; these prohibitions appear in Sec. 17-15.2.1 of this ordinance.

X. *Publicly Owned Treatment Works or POTW.* A "treatment works," as defined by Section 212 of the Act (33 U.S.C. §1292), which is owned by the Town . This definition includes any devices or systems used in the collection, storage, treatment, recycling and reclamation of sewage or industrial wastes of a liquid nature and any conveyances which convey wastewater to a treatment plant.

Y. *Septic Tank Waste.* Any sewage from holding tanks such as vessels, chemical toilets, campers, trailers, and septic tanks.

Z. *Sewage.* Human excrement and gray water (household showers, dishwashing operations, etc.).

AA. *Significant Industrial User.*

(1) A user subject to categorical pretreatment standards; or

(2) A user that:

(a) Discharges an average of twenty five thousand (25,000) gpd or more of process wastewater to the POTW (excluding sanitary, non-contact cooling, and boiler blow down wastewater);

(b) Contributes a process waste stream which makes up five (5) percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or

(c) Is designated as such by the Town on the basis that it has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement.

(3) Upon a finding that a user meeting the criteria in Subsection (2) has no reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement, the Town may at any time, on its own initiative or in response to a petition received from a user, and in accordance with procedures in 40 CFR 403.8(f)(6), determine that such user should not be considered a significant industrial user.

BB. *Slug Load or Slug.* Any discharge at a flow rate or concentration that could cause a violation of the prohibited discharge standards in Sec. 17-15.2.1 of this ordinance.

CC. *Standard Industrial Classification (SIC) Code.* A classification pursuant to the *Standard Industrial Classification Manual* issued by the United States Office of Management and Budget.

DD. *Storm Water.* Any flow occurring during or following any form of natural precipitation, and resulting from such precipitation, including snowmelt.

EE. *Suspended Solids.* The total suspended matter that floats on the surface of, or is suspended in, water, wastewater, or other liquid; and which is removable by laboratory filtering.

FF. *Town.* Refers to the Town of Amherst, Virginia and its acting personnel.

GG. *Town Manager.* The person designated by the Town of Amherst who is charged with certain duties and responsibilities by this policy, or a duly authorized representative of that person.

HH. *User or Industrial User.* A source of indirect discharge.

II. *Wastewater*. Liquid and water-carried industrial wastes and sewage from residential dwellings, commercial buildings, industrial and manufacturing facilities; and institutions, whether treated or untreated, which are contributed to the POTW.

JJ. *Wastewater Treatment Plant or Treatment Plant.* That portion of the POTW that is designed to provide treatment of municipal sewage and industrial waste.

Sec. 17-15.1.5 Town's authority to amend ordinance

Pursuant to the Code of Virginia, the Town Council of the Town of Amherst, having the responsibilty to take all necessary measures to ensure the integrity of the Town's wastewater collection and treatment operation and the authority to create and adopt this ordinance, shall have the authority to amend or repeal this ordinance or any section thereof.

Sec. 17-15.2 General sewer use requirements.

Sec. 17-15.2.1 Prohibited discharge standards

A. <u>General Prohibitions</u>. No user shall introduce or cause to be introduced into the POTW any pollutant or wastewater that causes pass through or interference. These general prohibitions apply to all users of the POTW whether or not they are subject to categorical pretreatment standards or any other National, State, or local pretreatment standards or requirements.

B. Specific Prohibitions. No user shall introduce or cause to be introduced into the POTW the following pollutants, substances, or wastewater:

(1) Pollutants which create a fire or explosive hazard in the POTW, including, but not limited to, waste streams with a closed-up flashpoint of less than 140°F (60°C) using the test methods specified in 40 CFR 261.21;

(2) Wastewater having a pH less than 5.0 or more than 10, or otherwise may cause corrosive structural damage to the POTW or equipment;

(3) Solid or viscous substances in amounts that will cause obstruction of the flow in the POTW resulting in interference but in no case solids greater than 2 inches in any dimension;

(4) Pollutants, including oxygen-demanding pollutants (BOD, etc.), released in a discharge at a flow rate and/or pollutant concentration which, either singly or by interaction with other pollutants, will cause interference with the POTW;

(5) Wastewater which will inhibit biological activity in the treatment plant resulting in interference, specifically including wastewater which causes the temperature at the introduction into the treatment plant to exceed 104°F (40°C);

(6) Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin, in amounts that will cause interference or pass through;

(7) Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems;

(8) Trucked or hauled pollutants, except at times and discharge points designated by the Pretreatment Coordinator in accordance with Sec. 17-15.3.4 of this ordinance;

(9) Noxious or malodorous liquids, gases, solids, or other wastewater which, either singly or by interaction with other wastes, are sufficient to create a public nuisance or a hazard to life, or to prevent entry into the sewers for maintenance or repair;

(10) Wastewater which imparts color which cannot be removed by the treatment process, such as, but not limited to, dye wastes and vegetable tanning solutions which consequently imparts color to the treatment plant's effluent, thereby violating the Town 's VPDES permit;

(11) Wastewater containing any radioactive wastes or isotopes except in compliance with applicable State or Federal regulations;

(12) Storm water, surface water, ground water, artesian well water, roof runoff, subsurface drainage, swimming pool drainage, condensate, de-ionized water, unconcentrated non-contact cooling water, and unpolluted wastewater, unless specifically authorized by the Town Council of the Town of Amherst;

(13) Sludges, screenings, or other residues from the pretreatment of industrial wastes;

(14) Medical wastes, except as specifically authorized by the Pretreatment Coordinator in a wastewater discharge permit;

(15) Wastewater causing, alone or in conjunction with other sources, the treatment plant's effluent to fail a toxicity test;

(16) Detergents, surface-active agents, or other substances which may cause excessive foaming in the POTW;

(17) Fats, oils, or greases of animal or vegetable origin in concentrations greater than 100 mg/l; or

(18) Wastewater causing two readings on an explosion hazard meter at the point of discharge into the POTW, or at any point in the POTW, of more than five percent (5%) or any single reading over ten percent (10%) of the Lower Explosive Limit of the meter.

Pollutants, substances, or wastewater prohibited by this section shall not be processed or stored in such a manner that they could be discharged to the POTW.

Sec. 17-15.2.2 National categorical pretreatment standards

The categorical pretreatment standards found at 40 CFR Chapter I, Subchapter N, Parts 405-471 are hereby incorporated.

A. Where a categorical pretreatment standard is expressed only in terms of either the mass or the concentration of a pollutant in wastewater, the Pretreatment Coordinator may impose equivalent concentration or mass limits in accordance with 40 CFR 403.6(c).

B. When wastewater subject to a categorical pretreatment standard is mixed with wastewater not regulated by the same standard, the Pretreatment Coordinator shall impose an alternate limit using the combined waste stream formula in 40 CFR 403.6(e).

C. A user may obtain a variance from a categorical pretreatment standard if the user can prove, pursuant to the procedural and substantive provisions in 40 CFR 403.13, that factors relating to its discharge are fundamentally different from the factors considered by EPA when developing the categorical pretreatment standard.

D. A user may obtain a net gross adjustment to a categorical standard in accordance with 40 CFR 403.15.

Sec. 17-15.2.3 State pretreatment standards

State Pretreatment Standards are located at 9VAC25-31-10 et. seq., specifically Part VII.

Sec. 17-15.2.4 Local limits

Local pollutant limits have been established to protect against pass through and interference. No person shall discharge wastewater containing in excess of the instantaneous maximum allowable discharge limits outlined below:

Parameter	Daily Maximum Concentration
Total Toxic Organics (TTO)	2.13 mg/1
Cadmium	0.014 mg/1
Chromium (+6)	0.14 mg/1
Chromium (+3)	1.0 mg/1
Copper	0.10 mg/1
Cyanide	0.06 mg/1
Lead	0.18 mg/1
Mercury	0.0002 mg/1
Nickel	0.25 mg/1
Oil and Grease	100 mg/1
Silver	0.05 mg/1
Zinc	0.72 mg/1
PH	Range (6-9)

The above limits for cadmium, chromium, copper, cyanide, lead, mercury, nickel, selenium, silver and zinc are based on present water quality standards and an allotment of 10 percent of total POTW flow for industrial dischargers. All other limits have been established based on the POTW design criteria.

The above limits apply at the point where the wastewater is discharged to the POTW. All concentrations for metallic substances are for "total" metal unless indicated otherwise. The Town Manager may impose mass limitations in addition to, or in place of, the concentration-based limitations above.

Sec. 17-15.2.5 Town 's right of revision

The Town reserves the right to establish, by ordinance or in wastewater discharge permits, more stringent standards or requirements on discharges to the POTW.

Sec. 17-15.2.6 Dilution

No user shall increase the use of process water, or in any way attempt to dilute a discharge, as a partial or complete substitute for adequate treatment to achieve compliance with a discharge limitation unless expressly authorized by an applicable pretreatment standard or requirement. The Pretreatment Coordinator may impose mass limitations on users who are using dilution to meet applicable pretreatment standards or requirements, or in other cases when the imposition of mass limitations is appropriate.

Sec. 17-15.3 Pretreatment of wastewater.

Sec. 17-15.3.1 Pretreatment facilities

Users shall provide wastewater treatment as necessary to comply with this ordinance and shall achieve compliance with all categorical pretreatment standards, local limits, and the prohibitions set out in Sec. 17-15.2.1 of this ordinance within the time limitations specified by EPA, the State, or the Pretreatment Coordinator, whichever is more stringent. Any facilities necessary for compliance shall be provided, operated, and maintained at the user's expense. Detailed plans describing such facilities and operating procedures shall be submitted to the Pretreatment Coordinator for review, and shall be acceptable to the Pretreatment Coordinator before such facilities are constructed. The review of such plans and operating procedures shall in no way relieve the user from the responsibility of modifying such facilities as necessary to produce a discharge acceptable to the Town under the provisions of this ordinance.

Sec. 17-15.3.2 Additional pretreatment measures

A. Whenever deemed necessary, the Pretreatment Coordinator may require users to restrict their discharge during peak flow periods, designate that certain wastewater be discharged only into specific sewers, relocate and/or consolidate points of discharge, separate sewage wastestreams from industrial wastestreams, and may impose such other conditions as may be necessary to protect the POTW and determine the user's compliance with the requirements of this ordinance.

B. The Pretreatment Coordinator may require any person discharging into the POTW to install and maintain, on the owner's property and at its expense, a suitable storage and flow-control facility to ensure equalization of flow. A wastewater discharge permit may be issued solely for flow equalization.

C. Users with the potential to discharge flammable substances may be required to install and maintain an approved combustible gas detection meter at a location designated by the Pretreatment Coordinator.

Sec. 17-15.3.3 Accidental discharge/slug control plans

At least once every two (2) years, the Pretreatment Coordinator shall evaluate whether each significant industrial user needs an accidental discharge/slug control plan. The Pretreatment Coordinator may require any user to develop, submit for approval, and implement such a plan. Alternatively, the Pretreatment Coordinator may develop such a plan for any user. An accidental discharge/slug control plan shall address, at a minimum, the following:

A. Description of discharge practices, including non-routine batch discharges;

B. Description of stored chemicals;

C. Procedures for immediately notifying the Pretreatment Coordinator of any accidental or slug discharge, as required by Sec. 17-15.6.6 of this ordinance; and

Procedures to prevent adverse impact from any accidental or slug discharge. Such procedures include, but are not limited to, inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site runoff, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants, including solvents, and/or measures and equipment for emergency response.

Sec. 17-15.3.4. Hauled wastewater.

A. Policy.

Persons desiring to routinely discharge used or untreated untreated liquid wastes, hereinafter referred to as septage, taken from septic tanks, cesspools or other sewage containers into the sewage system of the Town shall possess a valid septage hauler discharge permit. Permits will be issued by the Town Manager or his designee for a term not to exceed one (1) year and will specifically identify the types of septage which can be discharged. For purposes of classification, there are two (2) types of septage:

(1) Septage collected from establishments where only household type activities have occurred and delivered to the sewage system by a Sewerage Handler licensed by the Commonwealth of Virginia.
(2) All other types of hauled septage. Such other types of septage will be subject to the conditions of contractual agreements between the Town of Amherst and the septage generator. All requests for such other types of hauled septage shall be accompanied by an appropriate laboratory analysis showing the concentration of pollutants to be discharged.

B. Conditions.

All persons discharging a hauled septage to the sewage system of the Town will adhere to the following conditions:

(1) Each vehicle transporting septage must have a copy of the current discharge permit identifying the full tank capacity and the Virginia Department of Health Sewerage Handling Permit in the vehicle at all times and provide same to the pretreatment coordinator or other Town official upon demand.
(2) All septage will be brought to the designated discharge location at the wastewater treatment plant.
(3) A completed manifest form, containing the appropriate signatures and identifying the source of the septage, shall be presented to the wastewater treatment plant operator prior to discharge.
(4) No truckload will exceed twenty-five hundred (2,500) gallons unless prior permission has been granted by the Town Manager or his designee.
(5) Any truckload which contains any amount of restaurant-generated septage or grease will be rejected and not allowed to unload.

(6) Contractual loads cannot be mixed with any other type of waste.
(7) Changes to information supplied with a permit application or in an approved permit shall be grounds for suspension of a permit and so must be reported immediately to the pretreatment coordinator.

C. Administration.

The Pretreatment Coordinator shall establish reasonable rules and procedures to facilitate the implementation of this Section 17-15.3.4, including the development of informational documents, application forms, permit forms, and manifest forms.

D. Fees and charges.

To cover the administrative cost of the septic hauler discharge permit, fifty dollars ($50.00) per year of permit term will be charged.

All fees and charges will be accumulated over each calendar month and be billed on a monthly basis. In the case of contractual agreements payment will be subject to the conditions of the contract.

Disposal services will be suspended for customers with an outstanding bill not paid by due date.

Disposal costs for residential septage will be assessed at the rates established by the Town Council along with other rates during the budgetary process.

Whenever the Town utilizes the services of an attorney or a collection agency to collect any delinquent fees, rents or charges for the use and services of the Town's sewage disposal system, reasonable attorney's fees or collection agency's fees shall be added to the delinquent bill. The attorney's fees or collection agency's fees shall not exceed twenty (20) per cent of the delinquent bill and may be recovered by the Town by action at law or suit in equity. Attorney's fees shall be added only if such delinquency is collected by action at law or suit in equity.

Sec. 17-15.3.5 Grease and sand traps

Background and Policy

Fats, oils, and greases, hereinafter collectively referred to as grease, are problem substances in wastewater that can be effectively controlled by properly maintained interceptors (traps). Adequate grease interceptor installation and maintenance will lower the number of grease stoppages in the Town of Amherst sewage collection system. Preventing grease from entering the sewerage system also benefits the Wastewater Treatment Plant since the Plant's biological treatment processes more effectively remove pollutants when not inhibited by high grease concentrations. Grease itself is difficult for Plant microorganisms to digest and, therefore, is only partially removed during the wastewater treatment process, and grease can contribute to foaming problems experienced at the Plant. Grease buildups also cause sewage pump station maintenance problems. Grease interceptors shall be provided by users at their expense when, in the opinion of the Pretreatment Coordinator, they are necessary for the proper handling of wastewater containing excessive amounts of grease. All restaurants, cafeterias, and similar uses shall have a grease interceptor and associated maintenance plan approved by Pretreatment Coordinator.

Similarly, excessive amounts of sand can build up and cause line stoppages in the sewage collection system. Sand interceptors shall be provided by users at their expense when, in the opinion of the Pretreatment Coordinator, they are necessary for the proper handling of wastewater containing excessive amounts of sand or grit. All car washes shall have a sand trap and associated maintenance plan approved by Pretreatment Coordinator. Grease and sand interceptors shall not be required for residential users.

A. *Design and Installation*

All interceptor units shall be of a type and size approved by the Pretreatment Coordinator and shall be so located to be easily accessible for cleaning and inspection. Such interceptors shall be inspected, cleaned, and repaired regularly, as needed, by the user at its expense.

A grease or sand interceptor already in place must be properly sized or be replaced or improved to meet the Town's requirements. The Town of Amherst Pretreatment Program Coordinator shall determine by inspection and through information provided by the user whether the existing interceptor is properly sized. A change in the nature or scale of the user's operation may require a reinspection of the interceptor and a redetermination of whether the interceptor and associated maintenance plan is adequate.

Grease inteceptors shall be located on plumbing lines downstream from wash sinks and other primary sources of grease and shall be isolated from blackwater. Retrofit installations shall have interceptors with a minimum of 100 pounds grease capacity. New installations shall have outdoor grease interceptors with a minimum capacity of 1,000 gallons. However, in lieu of these minimum requirements, a sewer user may elect to provide an alternate design along with a maintenance plan as prepared by professional engineer licensed to practice in the Commonwealth of Virginia. The Pretreatment Coordinator may approve such alternate proposal if the intent of this Section 17-15.3.5 is met. All applicable local plumbing and construction codes shall be followed during interceptor installation.

B. *Operation, Maintenance and Inspection*

A user must adequately clean the interceptor as needed but at least once every thirty (30) days. The Pretreatment Coordinator may require more frequent cleaning if conditions warrant.

A facility must keep written interceptor cleaning records on file for a minimum of one year. These records must be on the premises and readily available and subject to inspection by the Pretreatment Coordinator. Information documenting the location of the interceptor, responsible parties, and actual maintenance performed shall be submitted to the Pretreatment Coordinator on a quarterly basis on a form provided by him.

Emulsifier, de-greaser, and enzyme use in grease interceptors is prohibited. Hot water flushing to clear the interceptor is prohibited.

C. *Exemptions*

Any contributor covered by this Section 17-15.3.5 who is able to prove that compliance would be economically or physically infeasible on the particular facts and circumstances of his case, may apply on that ground to the Town Council for an exemption from any portion of this Ordinance.

D. *Compliance*

Upon a finding by the Pretreatment Coordinator that a user has failed to comply with the provisions of this Section 17-15.3.5 the user shall be subject to the permit provisions of this Section 17-15, including ongoing laboratory sampling of his effluent, and reimbursement of the Town for pretreatment program expenses.

(Amended December10, 2003 and September 8, 2004)

Sec. 17-15.4 Wastewater discharge permit application

Sec. 17-15.4.1 Wastewater analysis

When requested by the Pretreatment Coordinator, a user must submit information on the nature and characteristics of its wastewater within sixty (60) days of the request. The Pretreatment Coordinator is authorized to prepare a form for this purpose and may periodically require users to update this information.

Sec. 17-15.4.2 Wastewater discharge permit requirement

A. No significant industrial user shall discharge wastewater into the POTW without first obtaining a wastewater discharge permit from the Pretreatment Coordinator, except that a significant industrial user that has filed a timely application pursuant to Sec. 17-15.4.3 of this ordinance may continue to discharge for the time period specified therein.

B. The Pretreatment Coordinator may require other users to obtain wastewater discharge permits as necessary to carry out the purposes of this ordinance.

C. Any violation of the terms and conditions of a wastewater discharge permit shall be deemed a violation of this ordinance and subjects the wastewater discharge permitted to the sanctions set out in Sections 17-15.10 through 17-15.12 of this ordinance. Obtaining a wastewater discharge permit does not relieve a permittee of its obligation to comply with all Federal and State pretreatment standards or requirements or with any other requirements of Federal, State, and local law.

Sec. 17-15.4.3 Wastewater discharge permitting: existing connections

Any user required to obtain a wastewater discharge permit who was discharging wastewater into the POTW prior to the effective date of this ordinance and who wishes to continue such discharges in the future, shall, within thirty (30) days after said date, apply to the Pretreatment Coordinator for a wastewater discharge permit in accordance with Sec. 17-15.4.5 of this ordinance, and shall not cause or allow discharges to the POTW to continue after one hundred twenty (120) days of the effective date of this ordinance except in accordance with a wastewater discharge permit issued by the Pretreatment Coordinator.

Sec. 17-15.4.4 Wastewater discharge permitting: new connections

Any user required to obtain a wastewater discharge permit who proposes to begin or recommence discharging into the POTW must obtain such permit prior to the beginning or recommencing of such discharge. An application for this wastewater discharge permit, in accordance with Sec. 17-15.4.5 of this ordinance, must be filed at least ninety (90) days prior to the date upon which any discharge will begin or recommence.

Sec. 17-15.4.5 Wastewater discharge permit application contents

All users required to obtain a wastewater discharge permit must submit a permit application. The Pretreatment Coordinator may require all users to submit as part of an application the following information:

A. All information required by Sec. 17-15.6.1(B) of this ordinance;

B. Description of activities, facilities, and plant processes on the premises, including a list of all raw materials and chemicals used or stored at the facility which are, or could accidentally or intentionally be, discharged to the POTW;

C. Number and type of employees, hours of operation, and proposed or actual hours of operation;

D. Each product produced by type, amount, process or processes, and rate of production;

E. Type and amount of raw materials processed (average and maximum per day);

F. Site plans, floor plans, mechanical and plumbing plans, and details to show all sewers, floor drains, and appurtenances by size, location, and elevation, and all points of discharge;

G. Time and duration of discharges; and

H. Any other information as may be deemed necessary by the Pretreatment Coordinator to evaluate the wastewater discharge permit application.

Incomplete or inaccurate applications will not be processed and will be returned to the user for revision.

Sec. 17-15.4.6 Application signatories and certification

All wastewater discharge permit applications and user reports must be signed by an authorized representative of the user and contain the following certification statement:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Sec. 17-15.4.7 Wastewater discharge permit decisions

The Pretreatment Coordinator will evaluate the data furnished by the user and may require additional information. Within sixty (60) days of receipt of a complete wastewater discharge permit application, the Pretreatment Coordinator will determine whether or not to issue a wastewater discharge permit. The Pretreatment Coordinator may deny any application for a wastewater discharge permit.

Sec. 17-15.5 Wastewater discharge permit issuance process.

Sec. 17-15.5.1 Wastewater discharge permit duration

A wastewater discharge permit shall be issued for a specified time period, not to exceed five (5) years from the effective date of the permit. A wastewater discharge permit may be issued for a period less than five (5) years, at the discretion of the Pretreatment Coordinator. Each wastewater discharge permit will indicate a specific date upon which it will expire.

A wastewater discharge permit may be administratively extended by the Town past its expiration date in the event that through no fault of the industrial user, in submitting a complete and timely application the permit is not reissued prior to the expiration date.

Sec. 17-15.5.2 Wastewater discharge permit contents

A wastewater discharge permit shall include such conditions as are deemed reasonably necessary by the Pretreatment Coordinator to prevent pass through or interference, protect the quality of the water body receiving the treatment plant's effluent, protect worker health and safety, facilitate sludge management and disposal, and protect against damage to the POTW.

A. Wastewater discharge permits must contain:

(1) A statement that indicates wastewater discharge permit duration, which in no event shall exceed five (5) years

(2) A statement that the wastewater discharge permit is nontransferable without prior notification to the Town in accordance with Sec. 17-15.5.5 of this ordinance, and provisions for furnishing the new owner or operator with a copy of the existing wastewater discharge permit;

(3) Effluent limits based on applicable pretreatment standards;

(4) Self-monitoring, sampling, reporting, notification, and record-keeping requirements. These requirements shall include an identification of pollutants to be monitored, sampling location, sampling frequency, and sample type based on Federal, State, and local law; and

(5) A statement of applicable civil and criminal penalties for violation of pretreatment standards and requirements and any applicable compliance schedule. Such schedule may not extend the time for compliance beyond that required by applicable Federal, State, or local law.

B. Wastewater discharge permits may contain, but need not be limited to, the following conditions:

(1) Limits on the average and/or maximum rate of discharge, time of discharge,

and/or requirements for flow regulation and equalization;

(2) Requirements for the installation of pretreatment technology, pollution control, or construction of appropriate containment devices, designed to reduce, eliminate, or prevent the introduction of pollutants into the treatment works;

(3) Requirements for the development and implementation of spill control plans or other special conditions including management practices necessary to adequately prevent accidental, unanticipated, or non-routine discharges;

(4) Development and implementation of waste minimization plans to reduce the amount of pollutants discharged to the POTW;

(5) The unit charge or schedule of user charges and fees for the management of the wastewater discharged to the POTW;

(6) Requirements for installation and maintenance of inspection and sampling facilities and equipment;

(7) A statement that compliance with the wastewater discharge permit does not relieve the permittee of responsibility for compliance with all applicable Federal and State pretreatment standards including those which become effective during the term of the wastewater discharge permit; and

(8) Other conditions as deemed appropriate by the Pretreatment Coordinator to ensure compliance with this ordinance, and State and Federal laws, rules, and regulations.

Sec. 17-15.5.3 Wastewater discharge permit appeals

The Pretreatment Coordinator shall provide public notice of the issuance of a wastewater discharge permit. Any person, including the user, may petition the Pretreatment Coordinator to reconsider the terms of a wastewater discharge permit within 30 days of notice of its issuance.

A. Failure to submit a timely petition for review shall be deemed to be a waiver of the administrative appeal.

B. In its petition, the appealing party must indicate the wastewater discharge permit provisions objected to, the reasons for the objection, and the alternative condition, if any, it seeks to place in the wastewater discharge permit.

C. The effectiveness of the wastewater discharge permit shall not be stayed pending the appeal.

D. If the Pretreatment Coordinator fails to act within 60 days, a request for reconsideration shall be deemed to be denied. Decisions not to reconsider a wastewater discharge permit, not to issue a wastewater discharge permit, or not to modify a wastewater discharge permit shall be considered final administrative actions for purposes of review.

E. Aggrieved parties seeking review of the final administrative wastewater discharge permit decision must do so by filing a complaint with the Town Council of the Town of Amherst.

F. Aggrieved parties seeking judicial review of the Town Council's wastewater discharge permit decision must do so by filing a complaint with the Circuit Court for the County of Amherst.

Sec. 17-15.5.4 Wastewater discharge permit modification

The Pretreatment Coordinator may modify a wastewater discharge permit for good cause, including, but not limited to, the following reasons:

A. To incorporate any new or revised Federal, State, or local pretreatment standards or requirements;

B. To address significant alterations or additions to the user's operation, process, or wastewater volume or character since the time of wastewater discharge permit issuance;

C. A change in the POTW that requires either a temporary or permanent reduction or elimination of the authorized discharge;

D. Information indicating that the permitted discharge poses a threat to the Town 's POTW, Town personnel, or the receiving waters;

E. Violation of any terms or conditions of the wastewater discharge permit;

F. Misrepresentations or failure to fully disclose all relevant facts in the wastewater discharge permit application or in any required reporting;

G. Revision of or a grant of variance from categorical pretreatment standards pursuant to 40 CFR 403.13;

H. To correct typographical or other errors in the wastewater discharge permit; or

I. To reflect a transfer of the facility ownership or operation to a new owner or operator.

Sec. 17-15.5.5 Wastewater discharge permit transfer

Wastewater discharge permits may be transferred to a new owner or operator only if the permittee gives at least ninety (90) days advance notice to the Pretreatment Coordinator and the Pretreatment Coordinator approves the wastewater discharge permit transfer. The notice to the Pretreatment Coordinator must include a written certification by the new owner or operator which:

A. States that the new owner and/or operator has no immediate intent to change the facility's operations and processes;

B. Identifies the specific date on which the transfer is to occur; and

C. Acknowledges full responsibility for complying with the existing wastewater discharge permit

Failures to provide advance notice of a transfer renders the wastewater discharge permit void as of the date of facility transfer.

Sec. 17-15.5.6 Wastewater discharge permit revocation

The Pretreatment Coordinator may revoke a wastewater discharge permit for good cause, including, but not limited to, the following reasons:

A. Failure to notify the Pretreatment Coordinator of significant changes to the wastewater prior to the changed discharge;

B. Failure to provide prior notification to the Pretreatment Coordinator of changed conditions pursuant to Sec. 17-15.6.5 of this ordinance;

C. Misrepresentation or failures to fully disclose all relevant facts in the wastewater discharge permit application;

D. Falsifying self-monitoring reports;

E. Tampering with monitoring equipment;

F. Refusing to allow the Pretreatment Coordinator timely access to the facility premises and records;

G. Failure to meet effluent limitations;

H. Failure to pay fines;

I. Failure to pay sewer charges;

J. Failure to meet compliance schedules;

K. Failure to complete a wastewater survey or the wastewater discharge permit application;

L. Failure to provide advance notice of the transfer of business ownership of a permitted facility; or

M. Violation of any pretreatment standard or requirement, or any terms of the wastewater discharge permit or this ordinance.

Wastewater discharge permits shall be voidable upon cessation of operations or transfer of business ownership. All wastewater discharge permits issued to a particular user are void upon the issuance of a new wastewater discharge permit to that user.

Sec. 17-15.5.7 Wastewater discharge permit reissuance

A user with an expiring wastewater discharge permit shall apply for wastewater discharge permit reissuance by submitting a complete permit application, in accordance with Sec. 17-15.4.5 of this ordinance, a minimum of one hundred twenty (120) days prior to the expiration of the user's existing wastewater discharge permit.

Sec. 17-15.6 Reporting requirements.

Sec. 17-15.6.1 Baseline monitoring reports

A. Within either one hundred eighty (180) days after the effective date of a categorical pretreatment standard, or the final administrative decision on a category determination under 40 CFR 403.6(a)(4), whichever is later, existing categorical users currently discharging to or scheduled to discharge to the POTW shall submit to the Pretreatment Coordinator a report which contains the information listed in paragraph B, below. At least ninety (90) days prior to commencement of their discharge, new sources, and sources that become categorical users subsequent to the promulgation of an applicable categorical standard, shall submit to the Pretreatment Coordinator a report which contains the information listed in paragraph B, below. A new source shall report the method of pretreatment it intends to use to meet applicable categorical standards. A new source also shall give estimates of its anticipated flow and quantity of pollutants to be discharged.

B. Users described above shall submit the information set forth below.

(1) Identifying Information. The name and address of the facility, including the name of the operator and owner.

(2) Environmental Permits. A list of any environmental control permits held by or for the facility.

(3) Description of Operations. A brief description of the nature, average rate of production, and standard industrial classifications of the operation(s) carried out by such user. This description should include a schematic process diagram that indicates points of discharge to the POTW from the regulated process.

(4) Flow Measurement. The information showing the measured average daily and maximum daily flow, in gallons per day, to the POTW from regulated process streams and other streams, as necessary, to allow use of the combined wastestream formula set out in 40 CFR 403.6(e).

(5) Measurement of Pollutants.

(a) The categorical pretreatment standards applicable to each regulated process.

(b) The results of sampling and analysis identifying the nature and concentration, and/or mass, where required by the standard or by the Pretreatment Coordinator, of regulated pollutants in the discharge from each regulated process. Instantaneous, daily maximum, and long-term average concentrations, or mass, where required, shall be reported. The sample shall be representative of daily operations and shall be analyzed in accordance with procedures set out in Sec. 17-15.6.10 of this ordinance.

(c) Sampling must be performed in accordance with procedures set out in Sec. 17-15.6.11 of this ordinance.

(6) Certification. A statement, reviewed by the user's authorized representative and certified by a qualified professional, indicating whether pretreatment standards are being met on a consistent basis, and, if not, whether additional operation and maintenance (O&M) and/or additional pretreatment is

required to meet the pretreatment standards and requirements.

(7) Compliance Schedule. If additional pretreatment and/or O&M will be required to meet the pretreatment standards, the shortest schedule by which the user will provide such additional pretreatment and/or O&M. The completion date in this schedule shall not be later than the compliance date established for the applicable pretreatment standard. A compliance schedule pursuant to this section must meet the requirements set out in Sec. 17-15.6.2 of this ordinance.

(8) Signature and Certification. All baseline-monitoring reports must be signed and certified in accordance with Sec. 17-15.4.6 of this ordinance.

Sec. 17-15.6.2 Compliance Schedule progress reports

The following conditions shall apply to the compliance schedule required by Sec. 17-15.6.1(B)(7) of this ordinance:

A. The schedule shall contain progress increments in the form of dates for the commencement and completion of major events leading to the construction and operation of additional pretreatment required for the user to meet the applicable pretreatment standards (such events include, but are not limited to, hiring an engineer, completing preliminary and final plans, executing contracts for major components, commencing and completing construction, and beginning and conducting routine operation);

B. No increment referred to above shall exceed nine (9) months;

C. The user shall submit a progress report to the Pretreatment Coordinator no later than fourteen (14) days following each date in the schedule and the final date of compliance including, as a minimum, whether. or not it complied with the increment of progress, the reason for any delay, and, if appropriate, the steps being taken by the user to return to the established schedule; and

D. In no event shall more than nine (9) months elapse between such progress reports to the Pretreatment Coordinator.

Sec. 17-15.6.3 Reports on compliance with categorical pretreatment standard deadline

Within ninety (90) days following the date for final compliance with applicable categorical pretreatment standards, or in the case of a new source following commencement of the introduction of wastewater into the POTW, any user subject to such pretreatment standards and requirements shall submit to the Pretreatment Coordinator a report containing the information described in Sec. 17-15.6.1 (B) (4-6) of this ordinance. For users subject to equivalent mass or concentration limits established in accordance with the procedures in 40 CFR 403.6(c), this report shall contain a reasonable measure of the user's long-term production rate. For all other users subject to categorical pretreatment standards expressed in terms of allowable pollutant discharge per unit of production (or other measure of operation), this report shall include the user's actual production during the appropriate sampling period. All compliance reports must be signed and certified in accordance with Sec. 17-15.4.6 of this ordinance.

Sec. 17-15.6.4 Periodic compliance reports

A. All significant industrial users shall, at a frequency determined by the Pretreatment Coordinator but in no case less than twice per year (in June and December), submit a report indicating the nature and concentration of pollutants in the discharge which are limited by pretreatment standards and the measured or estimated average and maximum daily flows for the reporting period. All periodic compliance reports must be signed and certified in accordance with Sec. 17-15.4.6 of this ordinance.

B. All wastewater samples must be representative of the user's discharge. Wastewater monitoring and flow measurement facilities shall be properly operated, kept clean, and maintained in good working order at all times. The failure of a user to its monitoring facility in good working order shall not be grounds for the user to claim that sample results are unrepresentative of its discharge.

C. If a user subject to the reporting requirement in this section monitors any pollutant more frequently than required by the Pretreatment Coordinator, using the procedures prescribed in Sec. 17-15.6.11 of this ordinance, the results of this monitoring shall be included in the report.

Sec. 17-15.6.5 Reports of changed conditions

Each user must notify the Pretreatment Coordinator of any planned significant changes to the user's operations or system which might alter the nature, quality, or volume of its wastewater at least sixty (60) days before the change.

A. The Pretreatment Coordinator may require the user to submit such information as may be deemed necessary to evaluate the changed condition, including the submission of a wastewater discharge permit application under Sec. 17-15.4.5 of this ordinance.

B. The Pretreatment Coordinator may issue a wastewater discharge permit under Sec. 17-15.4.7 of this ordinance or modify an existing wastewater discharge permit under Sec. 17-15.5.4 of this ordinance in response to changed conditions or anticipated changed conditions.

C. For purposes of this requirement, significant changes include, but are not limited to, flow increases of twenty percent (20%) or greater, and the discharge of any previously unreported pollutants.

Sec. 17-15.6.6 Reports of potential problems

A. In the case of any discharge, including, but not limited to, accidental discharges, discharges of a non-routine, episodic nature, a non-customary batch discharge, or a slug load, that may cause potential problems for the POTW, the user shall immediately telephone and notify the Pretreatment Coordinator of the incident. This notification shall include the location of the discharge, type of waste, concentration and volume, if known, and corrective actions taken by the user.

B. Within five (5) days following such discharge, the user shall, unless waived by the Pretreatment Coordinator, submit a detailed written report describing the cause(s) of the discharge and the measures to be taken by the user to prevent similar future occurrences. Such notification shall not relieve the user of any expense, loss, damage, or other liability which may be incurred as a result of damage to the POTW, natural resources, or any other damage to person or property; nor shall such notification relieve the user of any fines, penalties, or other liability which may be imposed pursuant to this ordinance.

C. A notice shall be permanently posted on the user's bulletin board or other prominent place advising employees whom to call in the event of a discharge described in paragraph A, above. Employers shall ensure that all employees, who may cause such a discharge to occur, are advised of the emergency notification procedure.

Sec. 17-15.6.7 Reports from unpermitted users

All users not required to obtain a wastewater discharge permit shall provide appropriate reports to the Pretreatment Coordinator as the Pretreatment Coordinator may require.

Sec. 17-15.6.8 Notice of violation/repeat sampling and reporting

If sampling performed by a user indicates a violation, the user must notify the Pretreatment Coordinator within twenty-four (24) hours of becoming aware of the violation. The user shall also repeat the sampling and analysis and submit the results of the repeat analysis to the Pretreatment Coordinator within thirty (30) days after becoming aware of the violation. The user is not required to re-sample if the Pretreatment Coordinator monitors at the user's facility at least once a month, or if the Pretreatment Coordinator samples between the user's initial sampling and when the user receives the results of this sampling.

Sec. 17-15.6.9 Notification of the discharge of hazardous waste

A. Any user who commences the discharge of hazardous waste shall notify the POTW, the EPA Regional Waste Management Division Director, and State hazardous waste authorities, in writing, of any discharge into the POTW of a substance which, if otherwise disposed of, would be a hazardous waste under 40 CFR Part 261. Such notification must include the name of the hazardous waste as set forth in 40 CFR Part 261, the EPA hazardous waste number, and the type of discharge (continuous, batch, or other). If the user discharges more than one hundred (100) kilograms of such waste per calendar month to the POTW, the notification also shall contain the following information to the extent such information is known and readily available to the user: an identification of the hazardous constituents contained in the wastes, an estimation of the mass and concentration of such constituents in the wastestream discharged during that calendar month, and an estimation of the mass of constituents in the wastestream expected to be discharged during the following twelve (12) months. All notifications must take place no later than one hundred and eighty (180) days after the discharge commences. Any notification under this paragraph need be submitted only once for each hazardous waste discharged. However, notifications of changed conditions must be submitted under Sec. 17-15.6.5 of this ordinance. The notification requirement in this section does not apply to pollutants already reported by users subject to categorical pretreatment standards under the self-monitoring requirements of Sections Sec. 17-15.6.1, Sec. 17-15.6.3, and Sec. 17-15.6.4 of this ordinance.

B. Discharges are exempt from the requirements of paragraph A, above, during a calendar month in which they discharge no more than fifteen (15) kilograms of hazardous wastes, unless the wastes are acute hazardous wastes as specified in 40 CFR 261.30(d) and 261.33(e). Discharge of more than fifteen (15) kilograms of nonacute hazardous wastes in a calendar month, or of any quantity of acute hazardous wastes as specified in 40 CFR 261.30(d) and 261.33(e), requires a one-time notification. Subsequent months during which the user discharges more than such quantities of any hazardous waste do not require additional notification.

C. In the case of any new regulations under Section 3001 of RCRA identify additional characteristics of hazardous waste or listing any additional substance as a hazardous waste, the user must notify the Pretreatment Coordinator, the EPA Regional waste Management Waste Division Director, and State hazardous waste authorities of the discharge of such substance within ninety (90) days of the effective date of such regulations.

D. In the case of any notification made under this section, the user shall certify that it has a program in place to reduce the volume and toxicity of hazardous wastes generated to the degree it has determined to be economically practical.

E. This provision does not create a right to discharge any substance not otherwise permitted to be discharged by this ordinance, a permit issued thereunder, or any applicable Federal or State law.

Sec. 17-15.6.10 Analytical requirements

All pollutant analyses, including sampling techniques, to be submitted as part of a wastewater discharge permit application or report shall be performed in accordance with the techniques prescribed in 40 CFR Part 136, unless otherwise specified in an applicable categorical pretreatment standard. If 40 CFR Part 136 does not contain sampling or analytical techniques for the pollutant in question, sampling and analyses must be performed in accordance with procedures approved by EPA and the Virginia Department of Environmental Quality.

Sec. 17-15.6.11 Sample collection

A. Except as indicated in Section B, below, the user must collect wastewater samples using flow proportional composite collection techniques. In the event flow proportional sampling is infeasible, the Pretreatment Coordinator may authorize the use time proportional sampling or a minimum of four (4) grab samples where the user demonstrates that this will provide a representative sample of the effluent being discharged. In addition, grab samples may be required to show compliance with instantaneous discharge limits.

B. Samples for oil and grease, temperature, pH, cyanide, phenols, sulfides, and volatile organic compounds must be obtained using grab collection techniques.

Sec. 17-15.6.12 Timing

Written reports will be deemed to have been submitted on the date postmarked. For reports that are not mailed, postage prepaid, into a mail facility serviced by the United States Postal Service, the date of receipt of the report shall govern.

Sec. 17-15.6.13 Record keeping

Users subject to the reporting requirements of this ordinance shall retain, and make available for inspection and copying, all records of information obtained pursuant to any monitoring activities required by this ordinance and any additional records of information obtained pursuant to monitoring activities undertaken by the user independent of such requirements. Records shall include the date, exact place, method, and time of sampling, and the name of the person(s) taking the samples; the dates analyses were performed; who performed the analyses; the analytical techniques or methods used; and the results of such analyses. These records shall remain available for a period of at least three (3) years. This period shall be automatically extended for the duration of any litigation concerning the user or the Town, or where the user has been specifically notified of a longer retention period by the Pretreatment Coordinator.

Sec. 17-15.7 Compliance monitoring.

Sec. 17-15.7.1 Right of entry: inspection and sampling

The Pretreatment Coordinator shall have the right to enter the premises of any user to determine whether the user is complying with all requirements of this ordinance and any wastewater discharge permit or order issued hereunder. Users shall allow the Pretreatment Coordinator ready access to all parts of the premises for the purposes of inspection, sampling, records examination and copying, and the performance of any additional duties.

A. Where a user has security measures in force which require proper identification and clearance before entry into its premises, the user shall make necessary arrangements with its security guards so that, upon presentation of suitable identification, the Pretreatment Coordinator will be permitted to enter without delay for the purposes of performing specific responsibilities.

B. The Pretreatment Coordinator shall have the right to set up on the user's property, or require installation of, such devices as are necessary to conduct sampling and/or metering of the user's operation

C. The Pretreatment Coordinator may require the user to install monitoring equipment as necessary. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the user at its own expense. All devices used to measure wastewater flow and quality shall be calibrated at least once per year to ensure their accuracy.

D. Any temporary or permanent obstruction to safe and easy access to the facility to be inspected and/or sampled shall be promptly removed by the user at the written or verbal request of the Pretreatment Coordinator and shall not be replaced. The costs of clearing such access shall be born by the user.

E. Unreasonable delays in allowing the Pretreatment Coordinator access to the user's premises shall be a violation of this ordinance.

Sec. 17-15.7.2 Search warrants

If the Pretreatment Coordinator has been refused access to a building, structure, or property, or any part thereof, and is able to demonstrate probable cause to believe that there may be a violation of this ordinance, or that there is a need to inspect and/or sample as part of a routine inspection and sampling program of the Town designed to verify compliance with this ordinance or any permit or order issued hereunder, or to protect the overall public health, safety and welfare of the community, then the Pretreatment Coordinator may seek issuance of a search warrant from the Circuit Court of the County of Amherst, Virginia or from such other court which has jurisdiction over the matter.

Sec. 17-15.8 Confidential information.

Information and data on a user obtained from reports, surveys, wastewater discharge permit applications, wastewater discharge permits, and monitoring programs, and from the Pretreatment Coordinator' inspection and sampling activities, shall be available to the public without restriction, unless the user specifically requests, and is able to demonstrate to the satisfaction of the Pretreatment Coordinator, that the release of such information would divulge information, processes, or methods of production entitled to protection as trade secrets under applicable State law. Any such request must be asserted at the submission of the information or data. When requested and demonstrated by the user furnishing a report that such information should be held confidential, the portions of a report which might disclose trade secrets or secret processes shall not be made available for inspection by the public, but shall be made available immediately upon request to governmental agencies for uses related to the NPDES/VPDES program or pretreatment program, and in enforcement proceedings involving the person furnishing the report. Wastewater constituents and characteristics and other "effluent data" as defined by 40 CFR 2.302 will not be reorganized as confidential information and will be available to the public without restriction.

Sec. 17-15.9 Publication of users in significant noncompliance.

The Pretreatment Coordinator shall publish annually, in the largest daily newspaper published in the municipality where the POTW is located, a list of the users which, during the previous twelve (12) months, were in significant noncompliance with applicable pretreatment standards and requirements. The term significant noncompliance shall mean:

A. Chronic violations of wastewater discharge limits, defined here as those in which sixty-six percent (66%) or more of wastewater measurements taken during a six (6) month period exceed the daily maximum limit or average limit for the same pollutant parameter by any amount;

B. Technical Review Criteria (TRC) violations, defined here as those in which thirty-three percent (33%) or more of wastewater measurements taken for each pollutant parameter during a six (6) month period equals or exceeds the product of the daily maximum limit or the average limit multiplied by the applicable criteria (1.4 for BOD, TSS, fats, oils and grease, and 1.2 for all other pollutants except pH);

C. Any other discharge violation that the Pretreatment Coordinator finds has caused, alone or in combination with other discharges, interference or pass through, including any discharge endangering the health of POTW personnel or the general public;

D. Any discharge of pollutants that has caused imminent endangerment to the public or to the environment, or has resulted in the Pretreatment Coordinator's exercise of its emergency authority to halt or prevent such a discharge;

E. Failure to meet, within ninety (90) days of the scheduled date, a compliance schedule milestone contained in a wastewater discharge permit or enforcement order for starting construction, completing construction, or attaining final compliance;

F. Failure to provide within thirty (30) days after the due date, any required reports, including baseline monitoring reports, reports on compliance with categorical pretreatment standard deadlines, periodic self-monitoring reports, and reports on compliance with compliance schedules;

G. Failure to accurately report noncompliance; or

H. Any other violation(s) that the Pretreatment Coordinator determines will adversely affect the operation or implementation of the local pretreatment program.

Sec. 17-15.10 Administrative enforcement remedies.

Sec. 17-15.10.1 Notification of violation

When the Pretreatment Coordinator finds that a user has violated, or continues to violate, any provision of this ordinance, a wastewater discharge permit or order issued hereunder, or any other pretreatment standard or requirement, the Pretreatment Coordinator may serve upon that user a written Notice of Violation. Within fourteen (14) days of the receipt of this notice, an explanation of the violation and a plan for the satisfactory correction and prevention thereof, to include specific required actions, shall be submitted by the user to the Pretreatment Coordinator. Submission of this plan in no way relieves the user of liability for any violations occurring before or after receipt of the Notice of Violation. Nothing in this section shall limit the authority of the Pretreatment Coordinator to take any action, including emergency actions or any other enforcement action, without first issuing a Notice of Violation.

Sec. 17-15.10.2 Consent orders

The Pretreatment Coordinator may enter into Consent Orders, assurances of voluntary compliance, or other similar documents establishing an agreement with any user responsible for noncompliance. Such documents will include specific action to be taken by the user to correct the noncompliance within a time period specified by the document. Such documents shall have the same force and effect as the administrative orders issued pursuant to Sections Sec. 17-15.10.4 and Sec. 17-15.10.5 of this ordinance and shall be judicially enforceable.

Sec. 17-15.10.3 Show cause hearing

The Pretreatment Coordinator may order a user which has violated, or continues to violate, any provision of this ordinance, a wastewater discharge permit or order issued hereunder, or any other pretreatment standard or requirement, to appear before the Pretreatment Coordinator and show cause why the proposed enforcement action should not be taken. Notice shall be served on the user specifying the time and place for the meeting, the proposed enforcement action, the reasons for such action, and a request that the user show cause why the proposed enforcement action should not be taken. The notice of the meeting shall be served personally or by registered or certified mail (return receipt requested) at least fourteen (14) days prior to the hearing. Such notice may be served on any authorized representative of the user. A show cause hearing shall not be a bar against, or prerequisite for, taking any other action against the user.

Sec. 17-15.10.4 Compliance orders

When the Pretreatment Coordinator finds that a user has violated, or continues to violate, any provision of this ordinance, a wastewater discharge permit or order issued hereunder, or any other pretreatment standard or requirement, the Pretreatment Coordinator may issue an order to the user responsible for the discharge directing that the user come into compliance within a specified time. If the user does not come into compliance within the time provided, sewer service may be discontinued unless adequate treatment facilities, devices, or other related appurtenances are installed and properly operated. Compliance orders also may contain other requirements to address the noncompliance, including additional self-monitoring and management practices designed to minimize the amount of pollutants discharged to the sewer. A compliance order may not extend the deadline for compliance established for a pretreatment standard or requirement, nor does a compliance order relieve the user of liability for any violation, including any continuing violation. Issuance of a compliance order shall not be a bar against, or a prerequisite for taking any other action against the user.

Sec. 17-15.10.5 Cease and desist orders

When the Pretreatment Coordinator finds that a user has violated, or continues to violate, any provision of this ordinance, a wastewater discharge permit or order issued hereunder, or any other pretreatment standard or requirement, or that the user's past violations are likely to recur, the Pretreatment Coordinator may issue an order to the user directing it to cease and desist all such violations and directing the user to:

A. Immediately comply with all requirements; and

B. Take such appropriate remedial or preventive action as may be needed to properly address a continuing or threatened violation, including halting operations and/or terminating the discharge.

Issuance of a cease and desist order shall not be a bar against, or a prerequisite for, taking any other action against the user.

Sec. 17-15.10.6 Emergency suspensions

The Pretreatment Coordinator may immediately suspend a user's discharge permit, after informal notice to the user, whenever such suspension is necessary to stop an actual or threatened discharge which reasonably appears to present or cause an imminent or substantial endangerment to the health or welfare of persons. The Pretreatment Coordinator may also immediately suspend a user's discharge, after notice and opportunity to respond, that threatens to interfere with the operation of the POTW, or which presents, or may present, an endangerment to the environment.

A. Any user notified of a suspension of its discharge shall immediately stop or eliminate its contribution. In the event of a user's failure to immediately comply voluntarily with the suspension order, the Pretreatment Coordinator may take such steps as deemed necessary, including immediate severance of the sewer connection, to prevent or minimize damage to the POTW, its receiving stream, or endangerment to any individuals. The Pretreatment Coordinator may allow the user to recommence its discharge when the user has demonstrated to the satisfaction of the Pretreatment Coordinator that the period of endangerment has passed, unless the termination proceedings in Sec. 17-15.10.7 of this ordinance are initiated against the user.

B. A user that is responsible, in whole or in part, for any discharge presenting imminent endangerment shall submit a detailed written statement, describing the causes of the harmful contribution and the measures taken to prevent any future occurrence, to the Pretreatment Coordinator prior to the date of any show cause or termination hearing under Sec. 17-15.10.3 and Sec. 17-15.10.7 of this ordinance. Nothing in this section shall be interpreted as requiring a hearing prior to any emergency suspension under this section. The Pretreatment Coordinator shall provide the user an opportunity to be heard on any proposed emergency suspension, if practicable under the circumstances.

Sec. 17-15.10.7 Termination of discharge

In addition to the provisions in Sec. 17-15.5.6 of this ordinance, any user who violates the following conditions is subject to discharge termination:

A. Violation of wastewater discharge permit conditions;

B. Failure to accurately report the wastewater constituents and characteristics of its discharge;

C. Failure to report significant changes in operations or wastewater volume, constituents, and characteristics prior to discharge;

D. Refusal of reasonable access to the user's premises for the purpose of inspection, monitoring, or sampling; or

E. Violation of the pretreatment standards in Sec. 17-15.2 of this ordinance.

Such user will be notified of the proposed termination of its discharge and be offered an opportunity to show cause under Sec. 17-15.10.3 of this ordinance why the proposed action should not be taken. Exercise of this option by the Pretreatment Coordinator shall not be a bar to, or a prerequisite for, taking any other action against the user.

Sec. 17-15.11 Judicial enforcement remedies.

Sec. 17-15.11.1 Injunctive relief

When the Pretreatment Coordinator finds that a user has violated, or continues to violate, any provision of this ordinance, a wastewater discharge permit, or order issued hereunder, or any other pretreatment standard or requirement, the Pretreatment Coordinator may petition the Circuit Court of the County of Amherst, Virginia or other court of competent jurisdiction through the Town Attorney for the issuance of a temporary or permanent injunction, as appropriate, which restrains or compels the specific performance of the wastewater discharge permit, order, or other requirement imposed by this ordinance on activities of the user. The Pretreatment Coordinator may also seek such other action as is appropriate for legal and/or equitable relief, including a requirement for the user to conduct environmental remediation. A petition for injunctive relief shall not be a bar against, or a prerequisite for, taking any other action against a user.

Sec. 17-15.11.2 Civil penalties

A. A user who has violated, or continues to violate, any provision of this ordinance, a wastewater discharge permit, or order issued hereunder, or any other pretreatment standard or requirement shall be liable to the Town for civil and criminal penalty in the amount of at least $1,000 per violation per day. In the case of a monthly or other long-term average discharge limit, penalties shall accrue for each day during the period of the violation.

B. The Pretreatment Coordinator may recover reasonable attorneys' fees, court costs, and other expenses associated with enforcement activities, including sampling and monitoring expenses, and the cost of any actual damages incurred by the Town .

C. In determining the amount of civil liability, the Court shall take into account all relevant circumstances, including, but not limited to, the extent of harm caused by the violation, the magnitude and duration of the violation, any economic benefit gained through the user's violation, corrective actions by the user, the compliance history of the user, and any other factor as justice requires.

D. Filing a suit for civil penalties shall not be a bar against, or a prerequisite for, taking any other action against a user.

Sec. 17-15.11.3 Criminal prosecution

A. A user who willfully or negligently violates any provision of this ordinance, a wastewater discharge permit, or order issued hereunder, or any other pretreatment standard or requirement shall, upon conviction, be guilty of a misdemeanor, punishable by a fine of not more than two thousand five hundred dollars ($2,500.00) per violation, per day, or imprisonment for not more than twelve (12) months, or both.

B. A user who willfully or negligently introduces any substance into the POTW which causes personal injury or property damage shall, upon conviction, be guilty of a misdemeanor punishable by a fine of not more than two thousand five hundred dollars ($2,500.00) per violation, per day, or imprisonment for not more than twelve (12) months, or both. This penalty shall be in addition to any other cause of action for personal injury or property damage available under State law.

C. A user who knowingly makes any false statements, representations, or certifications in any application, record, report, plan, or other documentation filed, or required to be maintained, pursuant to this ordinance, wastewater discharge permit, or order issued hereunder, or who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required under this ordinance shall, upon conviction, be punished by a fine of not more than two thousand five hundred dollars ($2,500.00) per violation, per day, or imprisonment for not more than twelve (12) months, or both.

Sec. 17-15.11.4 Remedies nonexclusive

The remedies provided for in this ordinance are not exclusive. The Pretreatment Coordinator may take any, all, or any combination of these actions against any user that is not in compliance. Enforcement of pretreatment violations will generally be in accordance with the Town's enforcement response plan, where such a plan has been approved. However, the Pretreatment Coordinator may take other action against any user when the circumstances warrant. Further, the Pretreatment Coordinator is empowered to take more than one enforcement action against any user not in compliance with this ordinance.

Sec. 17-15.12 Supplemental enforcement action.

Sec. 17-15.12.1 Performance bonds

If any user has failed to comply with any provision of this ordinance, a previous wastewater discharge permit, or order issued hereunder, or any other pretreatment standard or requirement, the Pretreatment Coordinator may require such user to file a satisfactory secured bond, payable to Town, in a sum not to exceed a value determined by the Pretreatment Coordinator to be necessary to achieve consistent compliance.

Sec. 17-15.12.2 Liability insurance

If any user has failed to comply with any provision of this ordinance, a previous wastewater discharge permit, or order issued here under or any other pretreatment standard or requirement, the Pretreatment Coordinator may require that the user, prior to issuing or reissuing a discharge permit, first submit proof that it has obtained financial assurances sufficient to restore or repair damage to the POTW caused by its discharge.

Sec. 17-15.12.3 Water supply severance

Whenever a user has violated or continues to violate any provision of this ordinance, a wastewater discharge permit, or order issued hereunder, or any other pretreatment standard or requirement, water service to the user may be severed. Service will only recommence, at the user's expense, after it has satisfactorily demonstrated its ability to comply.

Sec. 17-15.13 Affirmative defenses to discharge violations.

Sec. 17-15.13.1 Upset

A. For the purposes of this section, "upset" means an exceptional incident in which there is unintentional and temporary noncompliance with categorical pretreatment standards because of factors beyond the reasonable control of the user. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

B. An upset shall constitute an affirmative defense to an action brought for noncompliance with categorical pretreatment standards if the requirements of paragraph (C), below, are met.

C. A user who wishes to establish the affirmative defense of upset shall demonstrate through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and the user can identify the cause(s) of the upset;

(2) The facility was at the time being operated in a prudent and workman-like manner and in compliance with applicable operation and maintenance procedures; and

(3) The user has submitted the following information to the Pretreatment Coordinator within twenty-four (24) hours of becoming aware of the upset. If this information is provided orally, a written submission must be provided

within five (5) days**:**

(a) A description of the indirect discharge and cause of noncompliance;

(b) The period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and

(c) Steps being taken and/or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

D. In any enforcement proceeding, the user seeking to establish the occurrence of an upset shall have the burden of proof.

E. Users will have the opportunity for a judicial determination on any claim of upset only in an enforcement action brought for noncompliance with categorical pretreatment standards.

F. Users shall control production of all discharges to the extent necessary to maintain compliance with categorical pretreatment standards upon reduction, loss, or failure of its treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

Sec. 17-15.13.2 Prohibited discharge standards

A user shall have an affirmative defense to an enforcement action brought against it for noncompliance with the general prohibitions in Sec. 17-15.2.1(A) of this ordinance or the specific prohibitions in Sec. 17-15.2.1 (B)(3) through (7) of this ordinance if it can prove that it did not know, or have reason to know, that its discharge, alone or in conjunction with discharges from other sources, would cause pass through or interference and that either:

A. A local limit exists for each pollutant discharged and the user was in compliance with each limit directly prior to, and during, the pass through or interference; or

B. No local limit exists, but the discharge did not change substantially in nature or constituents from the user's prior discharge when the Town was regularly in compliance with its VPDES permit, and in the case of interference, was in compliance with applicable sludge use or disposal requirements.

Sec. 17-15.13.3 Bypass

A. For the purposes of this section,

(1) "Bypass" means the intentional diversion of wastestreams from any portion of a user's treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

B. A user may allow any bypass to occur which does not cause pretreatment standards or requirements to be violated, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject. to the provision of paragraphs (C) and (D)of this section.

C.

(1) If a user knows in advance of the need for a bypass, it shall submit prior notice to the Pretreatment Coordinator, at least ten (10) days before the date of the bypass, if possible.

(2) A user shall submit oral notice to the Pretreatment Coordinator of an unanticipated bypass that exceeds applicable pretreatment standards within twenty four (24) hours from the time it becomes aware of the bypass. A written submission shall also provided within five (5) days of the time the user becomes aware of the bypass. The written submission shall contain a description of the bypass and its cause; the duration of the bypass, including exact dates and times, and, if the bypass has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass. The Pretreatment Coordinator may waive the written report on a case-by-case basis if the oral report has been received within twenty-four (24) hours.

D.

(1) Bypass is prohibited, and the Pretreatment Coordinator may take an enforcement action against a user for a bypass, unless

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(c) The user submitted notices as required under paragraph (C) of this section.

(2) The Pretreatment Coordinator may approve an anticipated bypass, after considering its adverse effects, if the Pretreatment Coordinator determines that it will meet the three conditions listed in paragraph (D)(1) of this section.

Sec. 17-15.14 Wastewater treatment rates

Users of the Town of Amherst wastewater collection and treatment utility service are subject to rates which may be changed from time to time. In addition to the usual facility charges, debt service charges, monthly “base” charges, and volume charges, users contributing wastewaters characterized by unusual quantity, quality, content or flow pattern are subject to special assessments which may be established or changed at the sole discretion of the Town Council of the Town of Amherst.

Sec. 17-15.15 Miscellaneous provisions.

Sec. 17-15.15.1 Pretreatment charges and fees

The Town Council of the Town of Amherst may assess reasonable fees for reimbursement of the out-of-pocket costs of operating the Town 's Pretreatment Program that may include:

A. Fees for wastewater discharge permit applications including the cost of processing such applications;

B. Fees for monitoring, inspection, and surveillance procedures including the cost of collection and analyzing a user's discharge, and reviewing monitoring reports submitted by users;

C. Fees for reviewing and responding to accidental discharge procedures and construction;

D. Fees for filing appeals and defending filed appeals; and

E. Other fees as the Town Council of the Town of Amherst may deem necessary to carry out the requirements contained herein. These fees relate solely to the matters covered by this ordinance and are separate from all other fees, fines, and penalties charged by the Town.

Sec. 17-15.15.2 Severability

If any court of competent jurisdiction invalidates any provision of this ordinance, the remaining provisions shall not be effected and shall continue in full force and effect.

Sec. 17-16. Emergency powers of the Mayor in the event of a drought.

1. *Policy*: It is the policy of the Town of Amherst to require that all retail water users connected to its municipal water distribution system to conserve water to the extent possible during periods when the normal flow of water in Buffalo River falls to a very low level. To the extent practical, it is the intent of the Town of Amherst to limit the use of water produced and distributed by the Town to human ingestion and bona fide health and sanitary purposes during these restriction periods.

2. *Authority*: The Mayor is authorized to declare restriction periods, declare that any restriction period is ended, and take such further action as may be deemed necessary and to provide for such rules and regulations as may be necessary to implement and/or administer appropriate water conservation measures in furtherance of the intent of this ordinance. The Mayor is also authorized to request release of water from county-operated reservoirs if the need for such release arises.

3. *Notice*: In the event a restriction period is declared, the Town Clerk is authorized and directed to promulgate the declaration of the restriction period, this ordinance, and a list of possible conservation measures to the local press, large water users, the Amherst County Board of Supervisors, the Town Council and Town

employees, and all other interested individuals.

4. *Standards*: Water conservation measures to employed by water users connected to the Town of Amherst water distribution system during restriction periods shall include, but need not be limited to, the following regarding potable water supplied by the Town of Amherst water distribution system:

A. Washing cars and trucks, other than at commercial car washes, shall be prohibited.

B. Irrigation of lawn grass, gardens and plantings outside of a building shall be prohibited.

C. Recreational use, including the refilling of all swimming pools, shall be prohibited.

D. Washing of decks, sidewalks and driveways shall be prohibited.

Town of Amherst water customers shall be encouraged to conserve water to the extent possible during restriction periods. A listing of water conservation techniques shall be promulgated by the Town Clerk.

5. *Enforcement*: This policy and ordinance shall be enforced during restriction periods as follows:

A. Town employees will be authorized and directed to patrol the Town and out-of-town water service areas regularly to ensure that the intent of this ordinance is being met. If any Town employee finds that water conservation methods are not being employed, then he or she shall advise the user of the impact of the lack of water conservation on the Town's water system and fellow users.

B. If appropriate water conservation measures are not employed by a user immediately after written notice by a Town employee, the Town Manager or his designee may suspend water service to that user for up to 24 hours.

C. Willful violations of this ordinance shall be punishable as a Class 4 misdemeanor that carries a fine of up to $250.00 per offense. A willful violation shall be determined to exist upon discovery of a violation after the restoration of a suspended water service. Each day of a violation shall constitute a separate offense. (Adopted January 8, 2003)

Truck Hauled Waste Policy
Town of Amherst
Effective July 1, 2005

A. Terms Defined

The following terms, when used in this policy, shall have the meanings specified below unless the context indicates otherwise.

a. "*Discharge Permit*" means a written permit issued by the Town of Amherst for the disposal of truck hauled waste at a designated location in the Town pursuant to Sec.17-15.3.4 of the Town Code.
b. "*Permittee*" means a person issued a Discharge Permit (Waste Hauler).
c. "*Commercial and industrial wastewater*" means non- domestic waste.
d. "*Waste*" means used or untreated liquid septage.
e. "*Superintendent*" means the Town of Amherst Superintendent of Water and Wastewater Plant Operations.

B. Application and Issuance of Discharge Permit Application

a. A person desiring a discharge permit shall submit a Town application for Discharge Permit and comply with the Towns Truck Hauled Wastewater Policy and submit them to the Town with a copy of his current Virginia Department of Health operation (Sewerage Handling) Permit.
b. The Town will issue all Discharge Permits.
c. Each vehicle transporting waste must have a copy of the current Discharge Permit identifying full tank capacity at each sight gauge and the Department of Health Sewerage Handling Permit in the vehicles at all times.
d. Any change to the information supplied on the permit application **MUST** be reported in writing to the Superintendent at the address below **AS SOON AS POSSIBLE,** but in no event later than thirty days after such change or when the change would effect charges (e.g., a tank capacity change), prior to any discharge affected by the change.

Superintendent of Water and Wastewater Plant Operations
Town of Amherst
186 South Main Street
P.O. Box 280
Amherst, VA. 24521

C. Terms and Conditions for Discharge

a. Permitted substances
   I. Only domestic septage, portable toilet waste or other similar wastewaters generated from **RESIDENCES, BUSINESSES,** and **PROPERTIES** will be accepted for discharge.
   II. Notwithstanding the issuance of a discharge permit, **NO COMMERCIAL OR INDUSTRIAL WASTEWATER SHALL BE DISCHARGED** without the prior express written approval of the Superintendent. All request for commercial or industrial discharges must be accompanied by a laboratory analysis showing the concentration of pollutants to be discharged and all parameters in Section 17-15.2.4 of the Town Code.

b. Prohibited Substances

I. There shall be **NO** hazardous or toxic wastes discharged into the Town of Amherst Sewerage System.

II. There shall be **NO** oil/grease trap waste, leachate, or similar wastewaters discharged into the sewerage system.

c. Locations, Procedures, and Times for Discharge

I. All wastewater discharged by permittees shall be at the Town of Amherst Rutledge Creek WWTP, located at the end of Industrial Drive in the Town of Amherst. The discharge of wastewater at any other location is prohibited. Any permittee discharging into a manhole or any other location other than the Town of Amherst Rutledge Creek WWTP will be charged with Sec. 17-15.11.3 of the Town Code.

II. Town of Amherst Rutledge Creek WWTP Facility:

i. This facility may be closed to truck hauled waste at anytime by the Superintendent for good cause.

ii. Any vehicle that is not identified on the permit will be denied access to the facility.

iii. All loads brought to this facility shall be accompanied by a properly completed and legible "Truck Hauled Waste Manifest" (copy attached) at the time the truck arrives. Loads brought to this facility that are not accompanied by a properly completed and legible "Truck Hauled Waste Manifest" at the time the tank truck arrives will be denied access to the facility.

iv. This facility will accept truck hauled waste on a limited basis which is subject to change. Haulers may call the Town of Amherst Rutledge Creek WWTP Facility at (434)946-5769 prior to driving to the facility to determine whether or not the waste will be accepted and/or to make a reservation for dumping. Reservations may only be made up to 24 hours in advance. If, in the opinion of the Town of Amherst, conditions at the plant are such that truck hauled waste dumping should not occur, haulers with or without reservations for dumping will not be allowed to dump. Haulers abusing the reservation system will not be allowed to utilize the facility.

III. Samples of waste being discharged at the discharge site will be required of the hauler, collected in the presence of the Town of Amherst personnel and analyzed by or for the Town of Amherst and the origin of waste may be traced. Any resulting violations of policies will result in immediate revocation of the Discharge Permit, in accordance with paragraph E, and any additional penalties provided by law. If waste is inadvertently spilled at the discharge site, it is the permittee's responsibility to notify the Plant personnel and to clean the affected area immediately. Violations of this policy will result in revocation of the permit in accordance with paragraph E.

IV. The hours of operation shall be Monday through Saturday from 10:00 a.m. until 2:30 p.m., except that the Town will not accept truck hauled waste on holidays and other days that the Town Hall is closed. Emergency service at other times may be provided by the Town as practical, as determined by the Superintendent.

V. Waste haulers shall be responsible for maintaining the receiving facility in a neat and well kept manner. All refuse shall be placed in appropriate containers.

D. Charges, Billing and Payment

a. An invoice will be sent by the Town of Amherst to all permittees. THE INVOICE SHALL BE PAID IN FULL BY ITS DUE DATE.
b. The current rate for discharging domestic septage and portable toilet waste is fifty-five dollars per one thousand gallons ($55.00/1000 gal) with a $55.00 per load minimum.
c. Any person who is delinquent in payments will forfeit his/her permit and will not be allowed to discharge until the bill is paid in full and permission has been granted by the Town of Amherst.

E. Revocation of Permit

Persons found to be discharging who are not in conformance with the Truck Hauled Waste Policy will be issued a Notice of Violation and will have their permit revoked. Any permittee whose permit has been revoked shall not be eligible for a new permit for ninety (90) days. Revocations of Permits shall be determined by the Superintendent.

F. Appeals

Appeals of decisions by the Superintendent may be made in writing to the Town Manager. Appeals of decisions by the Town manager may be made in writing to the Town Council of the Town of Amherst.

APPROVED__________________________

DATE________________________________

Town of Amherst
186 South Main Street
P.O. Box 280
Amherst Virginia 24521
(434)946-7885 Fax (434)946-2087

TOWN OF AMHERST RUTLEDGE CREEK WWTP
TRUCK HAULED WASTE MANIFEST

Manifest Number _________ *(Obtain from the Town Hall)*

This Section to be completed by the Waste Hauler (Permittee)

Customer Information

Date:_____________	Date:_____________
Name:_________________________	Name:______________________
Address:_______________________	Address:______________________
______________________________	______________________________
______________________________	______________________________
Phone #:_______________________	Phone #:______________________
County of Origin________________	County of Origin_______________

Hauler Information:
Name of Company____
Discharge Permit Number_____________________
Truck License Number______________________
Name of Truck Driver (*Print*)_______________________________________

Truck Waste Information *(Check all that apply)*

___ Domestic Septage from Residential Source/ pH_____
___ Domestic Septage from Commercial Source/ pH_____
___ Other Waste with Prior approval pH_____
Gallons Discharged ______________

Certification:
I hereby certify to the best of my knowledge that the contents of this truck contain no hazardous waste and was obtained from the source specified above. I am aware that submitting false information may result in termination of the privilege to dispose of trucked waste at the Town of Amherst facility.

____
Signature of Hauler Date

This section to be filled out by Town personnel
Received by:______________________ Date:_________________ Time:______________
Signature
Visual Inspection/Comments:____
Sample collected YES NO Sample I.D. Number__________________________________
Lab sent to:______________________ Date: _________________ Time: ______________
Verified Origin of disposed waste with generator: YES NO

OPERATING HOURS M-SAT 10 a.m. to 2:30 p.m. Closed Holidays!

Town of Amherst
186 South Main Street
P.O. Box 280
Amherst Virginia 24521
(434)946-7885 Fax (434)946-2087

APPLICATION FOR TRUCK HAULED WASTE DISCHARGE PERMIT

Permission is hereby requested for the following vehicles to discharge truck hauled wastewater into the Town of Amherst Rutledge Creek WWTP Facility.

DMV License #	Vehicle Type	Color	Total Capacity

Company Name:____________________________________
Mailing Address:____________________________________
____
____

Authorizing Representative:___________________________ (PRINT)
Title:____

I certify that NO commercial generated grease, oil, industrial or hazardous wastes will be discharged into the Town of Amherst Rutledge Creek WWTP Facility. I further certify that I shall comply with the terms and conditions of the attached Truck Hauled Waste Policy.

Signed: ______________________________________ Date:___________________________

Permit fee: $50.00/yr

Town of Amherst
186 South Main Street
P.O. Box 280
Amherst Virginia 24521
(434)946-7885 Fax (434)946-2087

TRUCK HAULED WASTE DISCHARGE PERMIT

PERMIT #________________

____

Is hereby permitted to discharge into the Town of Amherst Rutledge Creek WWTP under the Terms and conditions in the Truck Hauled Waste Policy of the Town of Amherst.

Signed: ________________________________
Superintendent of Water and Wastewater Plants

Effective Date:_________________________

Expiration Date: _______________________

PRETREATMENT PROGRAM

PROCEDURES MANUAL

Prepared For:

Town of Amherst, Virginia

Town Manager

Jack Hobbs

March 8, 2001

Prepared By:

Draper Aden Associates

Blacksburg ◆ Richmond, Virginia

Engineering ◆ Surveying ◆ Environmental Services

TABLE OF CONTENTS

I. INTRODUCTION

A. Definitions

1. *Compliance Order or CO*: An official enforcement document which directs an Industrial User to undertake or to cease specific activities and which carries specific legal actions for repeated noncompliance.
2. *Compliance Schedule*: A schedule of required activities (or milestones) necessary for an Industrial User to achieve compliance with all pretreatment program requirements.
3. *Consent Order*: An agreement between the Town and the Industrial User which specifies the specific activities and completion date which will be taken to correct noncompliance.
4. *Industrial Users, IU, or User*: A source of indirect discharge.
5. *Incident*: Any pollutant released in a discharge, spill, or changed discharge that causes an upset, pass through, or interference at the Town's POTW.
6. *Interference*: A discharge, which alone or in conjunction with a discharge or discharges from other sources, inhibits or disrupts the POTW, its treatment processes or operations or its sludge processes, use of disposal; and therefore, is a cause of a violation of the Town's VPDES permit or of the prevention of sewage sludge use or disposal in compliance with any of the following statutory/regulatory provisions or permits issued thereunder, or any more stringent State or local regulations: Section 405 of the Act; the Solid Waste Disposal Act, including Title II commonly referred to as the Resource Conservation and Recovery Act (RCRA); any State regulations contained in any State sludge management plan prepared pursuant to Subtitle D of the Solid Waste Disposal Act; the Clean Air Act; the Toxic Substances Control Act; and the Marine Protection, Research, and Sanctuaries Act.
7. *Isolated Violation*: Any violation which occurs 2 times or less during any 6 month period or as determined by the Pretreatment Coordinator.
8. *Late Report*: Any report, communication or response that is received by the Town after the specified due date.
9. *Milestone Date*: Any date included in a Compliance Schedule which defines when a certain requirement must be met as, but not limited to, engineering, ordering and installation of pretreatment equipment, and compliance with a pretreatment standard.
10. *Notice of Violation or NOV*: An official communication from the Town to an Industrial User which informs the Industrial User that a pretreatment violation has occurred.

11. *Pass Through*: A discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the Town's VPDES permit, including an increase in the magnitude or duration of a violation.

12. *Penalties*: Depending on the circumstances of the violation(s), the term "legal action" refers to either civil or criminal penalties as described below:

    a. *Civil Penalties*: Where warranted, the Town may impose civil penalties on Industrial Users who fail to comply with the Town's Pretreatment Policy or a federal, state, or local pretreatment regulation. These fines will be up to a maximum of $2,500 per day per violation for repeated or severe violations.

    b. *Criminal Penalties*: Any Industrial User who willfully or negligently violates any provisions of the Town's Pretreatment Policy or a federal, state, or local pretreatment regulation may be subject to criminal prosecution. Criminal prosecution may also be commenced where it is determined that an Industrial User has falsified information in connection with the pretreatment requirements. Violations may result in criminal penalties of up to $2,500 per day per violation and/or 12 months in jail for each violation.

13. *Pretreatment Coordinator*: The person designated by the Town of Amherst who is charged with certain duties and responsibilities by this policy, including the operation of the POTW, or a duly authorized representative of that person.

14. *Publicly Owned Treatment Works or POTW*: A "treatment works," as defined by Section 212 of the Act (33 U.S.C. §1292), which is owned by the Town . This definition includes any devices or systems used in the collection, storage, treatment, recycling and reclamation of sewage or industrial wastes of a liquid nature and any conveyances which convey wastewater to a treatment plant.

15. *Repeated Violation*: Any violation which occurs more than 2 times during any 6 month period or as determined by the Pretreatment Coordinator.

16. *Severe Violation*: Any discharge whether isolated or continual that would cause an upset or pass through at the Town's treatment plant in the wastewater treatment process or sludge treatment processes, use, or disposal.

17. *Show Cause Hearing*: An official meeting between the Town and an Industrial User to resolve violations. As a result, the Town will decide whether to grant a Compliance Schedule or issue a Consent Order to the noncompliant User, or take any other action that might be necessary.

18. *Significant Noncompliance*: The term significant noncompliance shall mean:

a. Chronic violations of wastewater discharge limits, defined here as those in which sixty-six percent (66%) or more of wastewater measurements taken during a six (6) month period exceed the daily maximum limit or average limit for the same pollutant parameter by any amount;

b. Technical Review Criteria (TRC) violations, defined here as those in which thirty-three percent (33%) or more of wastewater measurements taken for each pollutant parameter during a six (6) month period equals or exceeds the product of the daily maximum limit or the average limit multiplied by the applicable criteria (1.4 for BOD, TSS, fats, oils and grease, and 1.2 for all other pollutants except pH);

c. Any other discharge violation that the Pretreatment Coordinator finds has caused, alone or in combination with other discharges, interference or pass through, including any discharge endangering the health of POTW personnel or the general public;

d. Any discharge of pollutants that has caused imminent endangerment to the public or to the environment, or has resulted in the Pretreatment Coordinator's exercise of its emergency authority to halt or prevent such a discharge;

e. Failure to meet, within ninety (90) days of the scheduled date, a compliance schedule milestone contained in a wastewater discharge permit or enforcement order for starting construction, completing construction, or attaining final compliance;

f. Failure to provide within thirty (30) days after the due date, any required reports, including baseline monitoring reports, reports on compliance with categorical pretreatment standard deadlines, periodic self-monitoring reports, and reports on compliance with compliance schedules;

g. Failure to accurately report noncompliance; or

h. Any other violation(s) that the Pretreatment Coordinator determines will adversely affect the operation or implementation of the local pretreatment program.

19. *Termination of Service*: The issuance of a formal notice of termination by the Town to an Industrial User for repeated or severe violations, or for Significant Noncompliance.

20. *Town*: Refers to the Town of Amherst, Virginia and its acting personnel.

B. Industrial User Identification

The following methods will be used to identify and locate Industrial Users subject to control under Section 17-15 of the Pretreatment Ordinance. A standard survey form will be used to identify the character and volume of discharge.

1. Site Plan Approvals - As part of the site plan approval process, the Town will require that a Significant Discharger Survey Form be submitted to the Pretreatment Coordinator. These forms will be required as part of each site plan application. Completed forms will be provided to the Pretreatment Coordinator to determine if proposed discharge characteristics need to be further investigated and regulated. Further investigation will be deemed appropriate if the proposed discharge would cause the establishment to be determined to be a significant industrial user (SIU) pursuant to Chapter 17-15 of the Town Code. Site plan approval will not be granted until the Pretreatment Coordinator is assured that the project proposed by the site plan will comply with Chapter 17-15 of the Town Code.

2. Plumbing Permits - All Town plumbing permits are issued through the Department of Building Inspection. The Department of Inspection will require each nonresidential plumbing and building permit applicants to complete a Significant Discharger Survey Form. Completed forms will be provided to the Pretreatment Coordinator to determine if discharge characteristics need to be further investigated and regulated. Further investigation will be deemed appropriate if the estimated discharge would cause the establishment to be determined to be a significant industrial user pursuant to Chapter 17-15 of the Town Code. In accordance with §108 of the Virginia Uniform Statewide Building Code, the Department of Code Compliance will not issue any plumbing or building permit that the Pretreatment Coordinator has determined may result in the permitee not complying with the Town's Sewer Use and Pretreatment Ordinance (Ordinance). In addition, the Office of Inspection inspects all new or replaced water/sewer services after installation.

3. Review of other Information - If requested by the Pretreatment Coordinator, the Town's Utility Billing Department can supply reports on water consumption patterns. If requested by the Pretreatment Coordinator, the Town's Fire Department will provide a list of current hazardous use permits.

4. Industrial User Surveys - Industrial user survey forms will be mailed every 5 years beginning in l998. A list of all industrial and commercial water and sewer customers will be generated by the Town's Department of Public Works. Customers that are determined to have discharges which could contain priority pollutants or discharges which could affect the operation of the publicly owned treatment works (POTW) will be sent a survey to complete. The response to the survey will be required within 30

days of mailing. The enterprises to be surveyed will include but not be limited to:

a. All industrial customers
b. Automotive and boat repair shops
c. Machine shops
d. Dentist offices
e. Medical/Optical offices or clinics
f. Dry cleaners
g. Photo developing services
h. Laboratories (commercial and educational)
i. Commercial laundries
j. Retail petroleum sales
k. Furniture refinishers
l. Printing shops
m. Radiator repair shops
n. Funeral homes
o. Animal clinics
p. Restaurants
q. Motels
r. Car/truck washes

C. Issuance and Reissuance of Industrial User Permits

1. Survey Review - The Town's Pretreatment Coordinator will review the completed wastewater surveys and the Significant Discharger Survey Form to determine discharges of concern. Dischargers contributing flows which may effect the POTW will be inspected. If, in the judgement of the Pretreatment Coordinator, a nonpermitted discharger requires regulating, the facility will be requested to complete an industrial wastewater discharge permit/waiver application.

2. The need to conduct sewer main surveillance sampling or self-monitoring to collect baseline data will be determined by the Pretreatment Coordinator. The decision will be based on an interview with the discharger on the content of the survey, or any other information that the Pretreatment Coordinator feels is relevant.

3. Discharge Permit Renewals - All significant industrial users will be issued discharge permits which are effective for not longer than five years. Permit language requires the filling of a new permit application 90 days prior to permit expiration.

4. Notification of Pretreatment Standards - If the conditions warrant, a Permit will be issued by the Pretreatment Coordinator within 30 days of receiving the completed permit application. Monitoring and reporting requirements, concentration limitations, and the need for slug control plans will be identified.

II. COMPLIANCE MONITORING

A. Self Monitoring

Unless otherwise required in the Industrial User Permit, self monitoring will be conducted quarterly for Significant Industrial Users. The installation of self-monitoring sampling equipment will be subject to the approval of the Town. Flow proportional sampling devices may be required by the Town if dictated by Federal or State law or if appropriate to protect the POTW. Compliance with sampling protocol will be verified during annual on-site inspections. All required sampling and monitoring procedures are to be performed in accordance to EPA requirements (40 CFR Part 136).

B. Unscheduled Monitoring

The Town will perform compliance monitoring to verify the accuracy of data by splitting samples or by conducting random unscheduled independent sampling events once per year. Compliance monitoring events conducted by the Town will be in accordance with 40 CFR Part 136. A portable composite sampling device will be used to allow insertion into a manhole. The discharger will be responsible for providing an approved sampling manhole for the collection of such samples. All sampling events will be documented by a sampling log filled out by the person conducting the sampling. All required sampling and monitoring procedures are to be performed in accordance to EPA requirements (40 CFR Part 136).

C. Demand Monitoring

Emergency, demand or investigative monitoring shall be conducted by the Town in response to known or suspected violations of a discharger's permit or of the Town's pretreatment ordinance. Instances of pass through, interference sludge contamination or POTW workers experiencing injuries or illness related to industrial discharges to the POTW may also initiate emergency, demand or investigative monitoring. Such monitoring shall be structured to address the conditions giving rise to the monitoring. All sampling events will be documented by a sampling log filled out by the person conducting the sampling. All sampling and monitoring procedures are to be performed in accordance to EPA requirements (40 CFR Part 13')

D. Receiving and Analyzing Reports from Industrial Users

All self monitoring, compliance monitoring, reports, compliance schedules, compliance status and enforcement actions will be recorded in a computerized record keeping program. Any document received by the Town of Amherst will be rubber stamped with date it was received. Data entry will be made under the direction of the Pretreatment Coordinator. The Pretreatment Coordinator will perform review and tracking of these reports in accordance with the procedures described in the Enforcement Response Plan. A hard copy of the data will be generated semi-annually. A separate filing system will be used to track individual industrial user industrial pretreatment program documents and correspondence. A separate file drawer will be reserved to contain these files. As a minimum, the files will contain the following:

1. Permit/Waiver and completed Permit/Waiver applications
2. Correspondence
3. Completed on site inspection forms
4. Compliance monitoring sample results
5. Enforcement
6. Reports

E. Violation Response

Should the Pretreatment Coordinator determine that a violation of the Ordinance or the Industrial User Permit has occurred, the Pretreatment Coordinator shall proceed with the violation response procedures given in Section III of this manual. In cases where Notices of Violations (NOVs) or other written enforcement documents are issued, the Pretreatment Coordinator may require inspections. NOVs and other enforcement documents may contain corrective and reporting requirements which would initiate reinspections and additional monitoring to verify that corrective actions have been taken. NOVs will provide opportunities and requirements for responses by the permittees. Abatement and control of problem discharges may be addressed by the enforcement procedures given in the Section III of this manual, the slug control plan and by permit revisions.

F. Sampling

1. General Sampling Protocol

   Sample collection for self-monitoring, compliance monitoring and emergency, demand or investigative monitoring shall consist of grab samples, grab composite samples, and flow proportional composite samples.

a. Samples will be collected at an easily accessible location that provides a well-mixed waste stream. The sampling point will be located at the end of the process and/or the convergence where the discharger discharges into the POTW.

b. Grab and composite sampling will be conducted primarily during working hours and will be flow proportioned if possible.

c. All sampling shall be performed in accordance with 40 CFR 136. All samples shall be appropriately preserved. Only EPA recommended sampling containers will be used to collect and store the samples.

d. An accurate sampling and chain-of-custody log shall be maintained for all samples. The log shall contain as a minimum, date and time of sampling, exact location of sampling, type of sample collected (i.e. grab, composite), method of sampling, method of preservation, name(s) and signature(s) of person(s) handling the samples in the field, during transportation, and in the laboratory, date and time samples were received at the laboratory for analysis, date analysis was performed, name(s), analytical techniques or method used, and the results of the analysis.

2. Reporting

All significant industrial users must report at least quarterly during the months of January, April, July and October. Noncompliance, pretreatment system bypass, and slug load events must be reported immediately to the Town of Amherst. These requirements for reporting will appear in the standard permit language. All other reporting requirements such as 90-day compliance reports, baseline monitoring reports, etc. will appear in the individual permits or in enforcement orders.

3. On-Site Inspections

a. Inspections - On-site inspections of all significant industrial users will be conducted by Town staff annually. More frequent site inspections can be made at the discretion of the Pretreatment Coordinator. Additional inspections could be made if an SIU has repeated slug discharges, repeated violations of permit limits, has an increased water consumption, has undergone an expansion, or if monitoring of any kind suggests that an inspection may be warranted. Also changes in the POTW's influent or effluent characteristics or residuals characteristics, or the occurrences of pass through, interference or any instances of injury or illness to POTW workers related to industrial discharges may result in more frequent on-site inspections. All inspection activities will be documented on the inspection form. The form must be signed by the person conducting the inspection.

b. Violation Response - Should, during the inspection, the Pretreatment Coordinator or the inspector determine that a violation of the Pretreatment Ordinance or of the discharge permit has occurred, the Pretreatment Coordinator or inspector shall proceed with the violation response procedures given in Section III. of this plan. In cases where NOVs or other written enforcement documents are issued, reinspections may be required by the Pretreatment Coordinator. NOVs and other enforcement documents may contain correction and reporting requirements which would initiate reinspections and additional monitoring to verify that corrective actions have been taken. The NOVs will provide opportunities and requirements for responses by the permittees or dischargers. Abatement and control of problem discharges may be addressed by the enforcement procedures given in the Enforcement Response Plan, and by permit revisions.

G. Emergency Situations

Regardless of the method of discovery, an emergency situation can be deemed to exist by the Pretreatment Coordinator if as a result of an ongoing or potential discharge, an imminent or substantial endangerment to the health or welfare of persons, or the environment or an imminent or potential interference or pass through is discovered or detected.

1. Immediate Notification

Upon discovery of an emergency situation, the Pretreatment Coordinator shall notify

a. The discharger of the situation and shall require that the conditions giving rise to the emergency situation be abated or controlled as soon as possible;

b. The Town of Amherst

c. The Town of Amherst Department of Emergency Services and if required, the Virginia Department of Emergency Services and the HAZMAT unit if hazardous materials are involved; and

d. The Virginia Department of Environmental Quality (DEQ).

2. Suspension of Sewer Service

If in accordance with Section III of this manual and Sec. 17-15.10.6 of the Pretreatment Ordinance, the Pretreatment Coordinator determines that the situation endangers public safety or may result in disruption or damage to the POTW, or harm to the environment, the sewer service to the discharging facility may be terminated pending delivery of the written order to cease and desist such violations giving rise to the emergency situation. The written order to cease and desist will be issued by the Town of Amherst in accordance with Sec. 17-15.10.5 of the Pretreatment Ordinance. In the event that the discharger fails to comply with such a suspension order, the Town of Amherst may take other actions as may be appropriate to prevent damage to the POTW or the endangerment to any individual.

H. Review of Local Limits

Local limits development is not a one-time event for POTWs. Local limits should be reviewed annually and revised as necessary to respond to changes in Federal or State regulations, environmental protection criteria, plant design and operational criteria, and the nature of industrial contributions to POTW influent. To the extent that a POTW can anticipate changes and develop appropriately protective local limits, the need to revise a particular local limit in the future may be reduced. Factors that may influence the need for reevaluation of local limits include:

- Changes in VPDES permit limits to include additional or more restrictive toxic pollutant limits, including organic pollutants
- Changes in water quality limits including toxicity requirements
- Changes in sludge disposal standards or POTW disposal methods
- Modifications to the treatment plant, causing changes in the process removal efficiencies and tolerance to inhibition from pollutant removal efficiencies and/or process inhibition.
- Connection to the POTW of new industrial users
- Addition of new processes at existing industrial users
- Shutdown of industrial users or discontinuation of process discharges
- Changes to existing industrial user processes, including chemical substitutions, expected to alter pollutant characteristics and loadings to the POTW
- Alteration of pretreatment operations.

By use of foresight, POTWs can extend the validity of local limits to the projected term of an IU permit (five years). Effective planning will eliminate frequent local limits modifications which may tax POTW resources and weaken IU compliance efforts.

I. Public Participation Requirements

Public participation requirements are based upon the requirements imposed by EPA, DEQ, and for rate wetting purposes, the code of Virginia.

1. New or Modified Program Approval Public Notice - The POTW shall comply with VR680-14-01 §7.8.B as it relates to funding the DEQ issued public notice for approval of the Town's pretreatment program.

2. Significant Noncompliance Public Notice - In January of each year, any users in significant noncompliance during the preceding year shall have their names and addresses published in the local newspaper, as required under 40 CFR 403.8 (f) (2) (vii) and Section 17-15.9 of the Pretreatment Ordinance.

3. Rate Setting Public Notice - At such times that discharge permit fees are set or revised, a public notice on the establishment or revision of rates would be published in the a local newspaper.

4. Revisions to the Pretreatment Ordinance and to Local Limits Establishment or Revisions - In accordance with 40 CFR §403.5 (c) (3), the Town will provide individual notice and an opportunity to respond to affected persons and groups before promulgation of new or revised local limits. These notices will be mailed to each known discharger subject to categorical pretreatment standards, each known significant discharger, and to the Town of Amherst DPW. In addition, a public notice on the establishment or revision to local limits shall be published in the a local newspaper.

5. Public Access to Records - In accordance with Section 17-15.8 of the Pretreatment Ordinance, information and data on any industrial user obtained from reports, questionnaires, permit applications, permits, monitoring programs, and from governmental inspections shall be available to the public without restriction unless the industrial user specifically requests and is able to demonstrate to the satisfaction of the Town that the release of such information would divulge information, processes, or methods of production entitled to protection under the Virginia Freedom of Information Act or other applicable law. Such confidential information shall be made available upon written request to governmental agencies for uses related to the Town's Sewer Use and Pretreatment Ordinance in accordance with Section 17-15.8 of the Pretreatment Ordinance. All other information relating to development, implantation, execution, or modification of the industrial pretreatment program shall be available to the public as provided by the Virginia Freedom of Information Act. All requests for information relating to these matters can be requested from the Town of Amherst.

III. ENFORCEMENT RESPONSE

A. Procedures

1. Pre-Enforcement Screening

The pre-enforcement screening is accomplished by reviewing information as soon as possible after it is received. The screening is designed to effectively separate non-complying dischargers from those meeting their wastewater permit conditions. Screening will be performed by the Pretreatment Coordinator or his/her designated representative. These procedures should also identify all reports expected in a specified time period (i.e. all reports due in the next 30 days), specify criteria for determining obvious compliance from non-compliance, and describe follow-up activities (i.e. action to take if non-compliance detected).

Along with procedures to identify non-compliance, Publicly Owned Treatment Works should also track previous non-compliance. A means for evaluating the severity of each instance of non-compliance should also be established including time frames for responses to detected violations. Additional procedures should indicate how the Publicly Owned Treatment Works intends to document the violation (i.e. technical evidence that the permit has been violated), identify individual/governmental entity responsible for evaluating the Significant Industrial User's compliance, and identify and track what action, if any, has been taken by the Publicly Owned Treatment Works. The Pretreatment Coordinator will develop and maintain a database for tracking non-compliance.

2. Formal Enforcement Evaluation

Once the need for an enforcement response has been determined by the pre-enforcement screening, the selection of an appropriate initial action must be made. Initial actions can range from informal responses, such as a telephone call, to civil penalties or termination of service. The Town's Enforcement Response Plan which outlines the appropriate range of enforcement responses is provided in Section III.D.

A sound enforcement program should establish a chain of concurrence. (i.e. the technical staff determines the type of violation, and the city attorney concurs that the evidence presented legally supports the enforcement response planned). This concurrence should be given or denied within a certain time period. Procedures and criteria for escalating the enforcement response in a timely manner are delineated in Section III.D.

3. Formal Enforcement Action

A formal enforcement action is defined as one that requires action to achieve compliance (including a timetable or compliance schedule to undertake that action), contains consequences for non-compliance that are independent of the original violation, and subjects the person to adverse legal consequences for non-compliance.

4. Demand Monitoring and Inspections

Field investigations are often the most critical factor in determining an appropriate enforcement response. Such investigations provide an independent basis to identify instances of non-compliance. The Town's Enforcement Response Plan in Section III.D. contains criteria and protocols for when to conduct "demand" sampling. Protocols for "demand" sampling are provided in Section II.F.3.b.

B. Enforcement Responses

1. Notice of Violations

A Notice of Violation (NOV) is an official communication from the Pretreatment Coordinator to the noncompliant Industrial User which informs the User that a pretreatment violation has occurred. The NOV is an appropriate initial response to nonsignificant violations. In case of significant noncompliance, a NOV may also be issued prior to issuing an administrative order or pursuing judicial remedies. The NOV's purpose is to notify the industrial User of the violation(s): it may be the only response necessary in cases of infrequent and generally minor violations. If the User does not return to compliance following receipt of the NOV, the Pretreatment Coordinator should proceed to more stringent enforcement measures.

The NOV is issued for relatively minor or infrequent violations of pretreatment standards and requirements. Although it may lack the deterrent effect of an administrative fine or criminal indictment, a NOV can nevertheless be an effective response for several reasons. First, the NOV provides the Industrial User with an opportunity to correct noncompliance on its own initiative rather than according to a schedule of actions determined by the Pretreatment Coordinator, and thus fosters a cooperative environment between the Industrial User and the Control Authority. Second, the NOV documents the initial attempts of the Control Authority to resolve the noncompliance. Should circumstances require the Control Authority to subsequently take a more stringent approach, the NOV establishes that the Control Authority escalated its response according to its enforcement response plan, rather than reacting to the noncompliance with arbitrary or unnecessarily harsh enforcement. Finally, by providing the Pretreatment Coordinator with an inexpensive and prompt response to violations, the NOV demonstrates to the regulated community the viability of the Town's pretreatment enforcement program.

For maximum effectiveness, the NOV should be written and delivered to the User immediately upon detection of the violation. The NOV should be received by the User no later than five (5) business days after discovery of the noncompliance. The NOV should either be hand-delivered to the Industrial User by Town personnel or be sent to the Industrial User via certified mail, return receipt requested.

A copy of each NOV, signed by the responsible Control Authority official, should be placed in the Industrial User's file, along with the certified mail receipt or similar statement by the person who delivered it.

The violating User must respond to the NOV within 10 days. The response must include written explanation for the violation, how is was corrected and what procedures will be initiated to prevent the reoccurrence or the violation in the future.

If the User fails to respond to the NOV within 10 days of receipt, the Pretreatment Coordinator will issue a second NOV, which may be accompanied by a Compliance Order.

All NOVs should be copied to the Town Attorney and the Virginia Department of Environmental Quality.

2. Consent Order

The consent order is an agreement between the Town and the industrial user normally containing three elements: (1) compliance schedules: (2) stipulated fines or remedial actions: and (3) signatures of Town and industry representatives.

A consent order is appropriate when the user assumes responsibility for its noncompliance and is willing (in good faith) to correct its cause(s). The user need not admit the noncompliance in the text of the order. Thus, signing the order is neither an admission of liability for purposes of civil litigation nor a plea of guilty for purposes of criminal prosecution. However, the Pretreatment Coordinator must make sure that the consent order prohibits future violations and provides for corrective action on the part of the industry. The consent order should address every identified (and potential) deficiency in the user's compliance status at the time of the order.

In determining the terms to include in the consent order, the Pretreatment Coordinator may take a user's extenuating circumstances (e.g.. financial difficulties, technical problems, and other impediments to necessary corrective action) into consideration.

3. Show Cause Hearing

An order to show cause directs the user to appear before the Pretreatment Coordinator, explain its noncompliance, and show cause why more severe enforcement actions against the user should not go forward. The order to show cause is typically issued after informal contacts or NOVs have failed to resolve the noncompliance. However, the show cause order/hearing can also be used to investigate violations of previous orders.

The hearing may be formal (i.e.. conducted according to the rules of evidence, with verbatim transcripts and cross-examination of witnesses) and open to the public. Alternatively, the Pretreatment Coordinator may choose to conduct an informal hearing or close it to the public. However, findings resulting from informal hearings should also be carefully documented. For example, the Pretreatment Coordinator could use an informal hearing to interview employees of the industrial user, examine discharge records, or negotiate the installation of a pretreatment system.

If a formal hearing is held, the Pretreatment Coordinator will typically put forth evidence of noncompliance. In response, the user may admit or deny the noncompliance, explain mitigating circumstances, demonstrate its eventual compliance and describe all other corrective measures. During the hearing, the Pretreatment Coordinator can explore the circumstances surrounding the noncompliance and evaluate the sufficiency of the evidence for subsequent civil or criminal actions. If the user does not understand the violation's nature (that is, what constitutes a violation under the ordinance). the hearing can serve to educate the user while saving the Town litigation expenses.

The Pretreatment Coordinator must then determine whether further action is warranted and, if so, its nature and extent. For example, if the problems causing the noncompliance appear to be resolved or nearly resolved at the hearing's conclusion, a consent decree may be drafted which incorporates the findings of the hearing. If the user must install pretreatment equipment to achieve compliance, the circumstances surrounding the noncompliance should be weighed and a reasonable schedule for installation and start-up developed. Completion of this schedule and any additional requirements will normally be administered through the consent order.

Should the hearing result in an impasse between the user and the Pretreatment Coordinator, the Pretreatment Coordinator may follow up the meeting by issuing a compliance order, including a schedule, impose a fine or refer the case to its attorney for civil litigation or criminal prosecution. The results of a formal show cause hearing, along with any data and testimony (recorded by tape machine or stenographer) submitted as evidence, are generally available to the public and may also serve as evidentiary support for future enforcement actions.

4. Compliance Order

A compliance order directs the user to achieve or restore compliance by a date specified in the order. It is issued unilaterally and its terms need not be discussed with the industry in advance. The compliance order is usually issued when noncompliance cannot be resolved without construction, repair, or process changes. Compliance orders are also frequently used to require industrial users to develop management practices, spill prevention programs and related pretreatment program requirements.

The compliance order should document the noncompliance and state required actions to be accomplished by specific dates, including interim and final reporting requirements. In drafting the compliance schedule, the Pretreatment Coordinator should be firm but reasonable, taking into consideration all factors relevant to an appropriate schedule duration. For example, if the user must install a complete pretreatment system, time should be allowed to obtain the necessary construction permits, and to design and construct the system. However, in such cases the Pretreatment Coordinator should require intermediate measures to ensure that the user is making acceptable progress.

Once these milestones are set, the Pretreatment Coordinator must track the user's performance against them and escalate its enforcement response as needed. For example, the Pretreatment Coordinator may order the user to show cause for failing to meet a major milestone, impose an additional fine or initiate judicial proceedings.

5. Cease and Desist Order

A cease and desist order directs a noncompliant user to cease illegal or authorized discharges immediately or to terminate its discharge altogether. A cease and desist order should be used in situations where the discharge could cause interference or pass through, or otherwise create an emergency situation. The order may be issued immediately upon discovery of the problem or following a hearing. In an emergency, the order to cease and desist may be given by telephone. However, a subsequent written order should be served on the industrial user, either in person or by registered mail. If necessary (and within the Town's legal authority), the Pretreatment Coordinator may order immediate cessation of any discharge to the Town's collection system, regardless of a user's compliance status. In nonemergency situations, the cease and desist order may be used to suspend or permanently revoke industrial wastewater discharge permits. If the user fails to comply with the order, the Town may take independent action to halt the discharge, such as terminating water service or blocking the user's connection point.

C. Considerations

The enforcement response selected must also be appropriate to the violation. This determination is often a matter of common sense. The Pretreatment Coordinator should consider the following criteria when determining a proper response:

1. Magnitude of the Violation

   Generally, an isolated instance of noncompliance can be met with an informal response or a NOV. Any "significant noncompliance" should be met with an enforceable Compliance Order that requires a return to compliance by a specific deadline.

2. Duration of the Violation

   Violations (regardless of severity) which continue over prolonged periods of time should subject the industrial user to escalated enforcement actions. For example, an effluent violation which occurs in two out of three samples over a six-month period or a report which is more than 30 days overdue is considered significant. while a report which is two days late should not be deemed significant.

   The Pretreatment Coordinator's response to these situations must prevent extended periods of noncompliance from recurring. A Compliance Order is recommended for chronic violations. If the Industrial User fails to comply with the Compliance Order, the Pretreatment Coordinator should initiate judicial action with civil penalties. If the prolonged violation results in serious harm to the POTW, the Pretreatment Coordinator should also consider terminating service or obtaining a court order to halt further violations as well as to recover the costs of repairing the damage.

3. Effect on the Receiving Water

   One of the primary objectives of the National Pretreatment Program is to prevent pollutants from "passing through" the POTW and entering the receiving stream. Consequently, any violation which results in environmental harm should be met with a severe response. Environmental harm should be presumed when an industry discharges a pollutant into the sanitary sewer system which:

   – Passes through the POTW

   – Causes a violation of the POTW's VPDES permit (including water quality standards)

   – Has a toxic effect on the receiving waters (i.e., fish kill).

   At a minimum, responses to these circumstances should include a Compliance Order. Where the Town incurs or is likely to incur VPDES fines and penalties, the response should initiate judicial action with civil penalties to ensure recovery from the noncompliant User. In severe instances, the Pretreatment Coordinator may also wish to pursue damages for the destruction or harm to local natural resources. If a User's discharge causes repeated harmful effects, the Control Authority should seriously consider terminating service to the User.

4. Effect on the POTW

Some violations may have negative impacts on the POTW itself. For example, they may result in significant increases in treatment costs, interfere or harm POTW personnel, equipment, processes, operations, or cause sludge contamination resulting in increased disposal costs. These violations should be met with a civil penalty and an order to correct the violation in addition to recovery of additional costs and expenses to repair the POTW. For example, when the Industrial User's discharge upsets the treatment plant, damages the collection system through pipe corrosion, causes an obstruction or explosion, or causes additional expenses (e.g., to trace a spill back to its source), the Pretreatment Coordinator's response should include cost recovery, civil penalties, and a requirement to correct the condition causing the violation.

5. Compliance History of the User

A pattern of recurring violations (even of different program requirements) may indicate either that the User's treatment system is inadequate or that the user has taken a casual approach to operating and maintaining its treatment system. These indications should alert the Pretreatment Coordinator to the likelihood of future significant violations. Accordingly, users exhibiting recurring compliance problems should be strongly dealt with to ensure that consistent compliance is achieved. Compliance history is an important factor for deciding which of the two or three designated appropriate remedies to apply to a particular violator. For example, if the violator has a good compliance history, the Pretreatment Coordinator may decide to use the less severe option.

6. Good Faith of the User

The User's "good faith" in correcting its noncompliance is a factor in determining which enforcement response to invoke. "Good faith" may be defined as the User's honest intention to remedy its noncompliance coupled with actions which give support to this intention. Generally, a User's demonstrated willingness to comply should predispose the Pretreatment Coordinator to select less stringent enforcement responses. However, good faith does not eliminate the necessity of an enforcement action. For example, if the POTW experiences a treatment upset, it should recover its costs regardless of prior good faith. Good faith is typically demonstrated by cooperation and completion of corrective measures in a timely manner (although compliance with previous enforcement orders is not necessarily good faith).

D. Enforcement Response Plan

SAMPLING, MONITORING AND REPORTING

Non-Compliance	Circumstances	Range of Response and Responsible Position
Failure to sample, monitor or report (routine reports, BMRs)	Isolated or infrequent More than 30 days overdue – Significant Noncompliance (SNC)	Phone call or written Notice of Violation (NOV) requiring a report within 10 days. If no response is received, issue an Compliance Order (CO) by the Pretreatment Coordinator.
Failure to sample, monitor report or notify	Industrial User (IU) does not respond to letters, does follow through on verbal or written agreement or frequent violation-Significant Noncompliance (SNC)	CO or judicial action including penalties if no response is received. Request criminal investigation. Within 10 days by the Pretreatment Coordinator.
Failure to notify of effluent limit violation or slug discharge	Isolated or infrequent. No known effect.	Phone call or NOV. If no response within 10 days, issue and CO by the Pretreatment Coordinator.
Failure to notify of effluent limit violations or slug discharge	Frequent or continued violation – SNC.	Show cause meeting, CO or judicial actions, including penalties. Within 10 days by the Pretreatment Coordinator.
Minor sampling, monitoring or reporting deficiencies (computational or typographical errors).	Isolated or infrequent	Phone call or NOV. Corrections to be made on next submittal. CO if continued. Within 10 days by the Pretreatment Coordinator.
Major or gross sampling, monitoring, or reporting deficiencies (missing information late reports).	Isolated or infrequent	NOV or CO. Corrections to be made on the next submittal. Within 10 days by the Pretreatment Coordinator.
Major or gross reporting deficiencies	Continued. Remains uncorrected 30 days or more –SNC.	CO or judicial action. Within 10 days by the Pretreatment Coordinator.
Reporting false information	Any instance –SNC.	Request for criminal investigation. Judicial action, penalties, sewer ban. Within 10 days by the Pretreatment Coordinator.

COMPLIANCE SCHEDULES (Construction Phases or Planning)

Non-Compliance	Circumstances	Range of Response and Responsible Position
Missed interim date.	Will not cause late final date or other interim dates.	NOV. Within 10 days by the Pretreatment Coordinator.
Missed interim date.	Will result in other missed interim dates. Violation for good or valid cause.	NOV or CO. Within 10 days by the Pretreatment Coordinator.
Missed interim date.	Will result in other missed interim dates. No good or valid cause – SNC.	NOV, CO, or judicial action including penalty. Within 10 days by the Pretreatment Coordinator.
Missed final date	Violation due to force major (strike, act or God, etc.).	Contact permittee and require documentation of good or valid cause; show cause. Within 10 days by the Pretreatment Coordinator.
Missed final date, initial or final construction date	90 days or more outstanding. Failure or refusal to comply without good or valid cause – SNC.	CO or judicial action including penalty. Within 10 days by the Pretreatment Coordinator.
Failure to install monitoring equipment	Continued –SNC.	CO to begin monitoring (using outside contracts, if necessary) and install equipment within 30 days by the Pretreatment Coordinator. Temporary sewer ban.

EFFLUENT LIMITS

Non-Compliance	Circumstances	Range of Response and Responsible Position
Exceeding final limits (categorical local or prohibited).	Infrequent or minor violations.	NOV. Within 10 days by the Pretreatment Coordinator.
Exceeding final limits.	Infrequent or isolated major violations exceed the limits by TRC of a single effluent limit.	NOV, CO (judicial if environmental harm resulted including penalty). Within 10 days by the Pretreatment Coordinator.
Exceeding final limits.	Violation(s) that are SNC.	CO or judicial action including penalty. Within 10 days by the Pretreatment Coordinator.
Exceeding interim (categorical or local)	Without known damages	NOV or CO. Within 10 days by the Pretreatment Coordinator.
Exceeding interim limits.	Results in known environmental or POTW damage –SNC.	CO or judicial action including penalty. Within 10 days by the Pretreatment Coordinator.
Reported slug load	Isolated without known damage.	Show cause or CO. Within 10 days by the Pretreatment Coordinator.
Reported slug load	Isolated with interference, pass-through or damage-SNC.	CO or judicial action including penalty. Within 10 days by the Pretreatment Coordinator.
Reported slug load	Recurring –SNC.	Judicial action, including penalty. Sewer Ban. Within 10 days by the Pretreatment Coordinator.
Discharge without a permit or approval	One time without known environmental or POTW damage.	CO. Within 10 days by the Pretreatment Coordinator.
Discharge without a permit or approval	One time that results in environmental damage or continuing violation – SNC.	CO or judicial action penalty. Request for criminal investigation. Within 10 days by the Pretreatment Coordinator.
Discharge without a permit or approval	Continuing violation with known environmental or POTW damage – SNC.	Judicial action and penalty. Request for criminal investigation. Disconnect from sewer. Within 10 days by the Pretreatment Coordinator.

NON-COMPLIANCE DETECTED THROUGH INSPECTIONS OR FIELD INVESTIGATIONS

Non-Compliance	Circumstances	Range of Response and Responsible Position
Minor violation of analytical procedures	Any instance.	NOV. Within 10 days by the Pretreatment Coordinator.
Major violation of analytical procedures	No evidence of intent	NOV or CO. Within 10 days by the Pretreatment Coordinator.
Major violation of analytical procedures	Evidence of negligence or intent – SNC.	CO or judicial action penalty (possible criminal action). Within 10 days by the Pretreatment Coordinator.
Minor violation of permit condition	No evidence of negligence or intent.	NOV. Immediate correction required. Within 10 days by the Pretreatment Coordinator.
Minor violation of permit condition	Evidence of negligence or intent – SNC.	CO or judicial action and penalty (possible criminal action). Within 10 days by the Pretreatment Coordinator.
Major violation of permit condition	Evidence of negligence or intent – SNC.	CO or judicial action and penalty (possible criminal action). Sewer ban. Within 10 days by the Pretreatment Coordinator.

E. ERP Evaluation

After the Enforcement Response Plan has been implemented, its effectiveness should be periodically assessed to identify progress and institute improvements. An Enforcement Response Plan should detect instances of non-compliance near their occurrence. Therefore, evaluation and modification of the Enforcement Response Plan should occur annually so that an ineffective system is not retained for a long period of time.

IV. REPORTING REQUIREMENTS

The Pretreatment Coordinator shall submit a report annually to the Virginia Department of Environmental Quality (DEQ) describing the Town's pretreatment activities over the past 12 months. In the event that the Town is not in compliance with any condition or requirement of the permit, the Pretreatment Coordinator shall also include the reasons for non-compliance and state how and when the Town shall comply with such conditions and requirements. This annual report is due on January 15 of each year and shall contain, but not be limited to, the following information:

1. A summary of the results of the Rutledge Creek WWTP influent, effluent, and sludge sampling for those pollutants for which the Town regulates discharges by Industrial Users, and for any non-priority pollutants which the Town believes may be causing or contributing to interference of pass though or adversely impacting sludge quality.

2. A discussion of upset, interference, or pass through incidents, if any, at the Rutledge Creek WWTP which the Town knows or suspects were caused by Industrial Users of the treatment works. The discussion shall include the reason why the incidents occurred, the corrective actions taken, and, if known, the name and address of the Industrial User(s) responsible.

3. The cumulative number of Industrial Users that the Pretreatment Coordinator has notified regarding Baseline Monitoring Reports, 90 Day Compliance Reports, and the cumulative number of Industrial Users response.

4. An updated list of the Town's Industrial Users including their name and address or a list of deletions and additions keyed to a previously submitted list. The Pretreatment Coordinator shall provide a brief explanation of each deletion. The list shall identify the Industrial Users subject to Federal Categorical Pretreatment Standards and which set(s) of standards are applicable; Industrial Users subject to local limits only; and Industrial Users subject to local limits that are more stringent than Federal Categorical Pretreatment Standards. The Pretreatment Coordinator shall also identify the users classified as Significant Industrial Users. The Pretreatment Coordinator shall characterize the compliance status of each Industrial user (and describe which standards or requirements are not being complied with) by employing the following descriptions:

a. In compliance with baseline monitoring report and 90 day compliance report requirements (where applicable);

b. Consistently achieving compliance;

c. Inconsistently achieving compliance;

d. Significantly violating applicable pretreatment requirements as defined in VR 680-14-01;

e. On a compliance schedule to achieve compliance (include the date final compliance (include the date final compliance is required);

f. Not achieving compliance and not on a compliance schedule;

g. Industrial Users compliance status unknown; and

h. Industrial Users without permits, including Industrial Users with expired permits.

A summary of the sampling and inspection activities conducted by the Town during the past year to gather information and data regarding Industrial Users. The summary shall include:

1. The names and addresses of the Industrial Users subject to surveillance by the Town and an indication of whether they were inspected, sampled or both, and the frequency of those activities at each Industrial User; and

2. The conclusions or results of the inspection or sampling of each Industrial User.

A summary of the compliance and enforcement activities during the past year. The summary shall include the names and addresses of the Industrial Users affected by the following actions:

1. Warning letter of notice of violation;

2. Administrative Order;

3. Civil actions;

4. Criminal actions;

5. Assessment of monetary penalties, identify the amount of the penalty assessed each industrial user;

6. Restriction of flow to the Publicly Owned Treatment Works; and

7. Disconnection from discharge to the Publicly Owned Treatment Works.

A description of any significant changes in operating the pretreatment program which differ from the information in the Town's approved Pretreatment Program including, but not limited to, changes concerning;

1. The program's administrative structure;

2. Local Industrial User limitations;

3. Monitoring program or monitoring frequencies;

4. Legal Authority or enforcement policy;

5. Funding mechanisms;

6. Resource requirements; and

7. Staffing levels.

A summary of the annual pretreatment budget, including the cost of pretreatment program administrative functions and equipment purchases.

A summary of the public participation activities to involve the public. This shall include a copy of the annual publication of significant violators, if such publication was needed to comply with VR 680-14-01:1.

Other requirements in accordance with VPDES special conditions and DEQ guidance.

The Pretreatment Coordinator shall submit to DEQ a statement of the basis for desired program modification and a modified program description for all substantial program modifications as defined in VR 680-14-01. The Town must await formal approval from DEQ before implementing substantial program modifications.

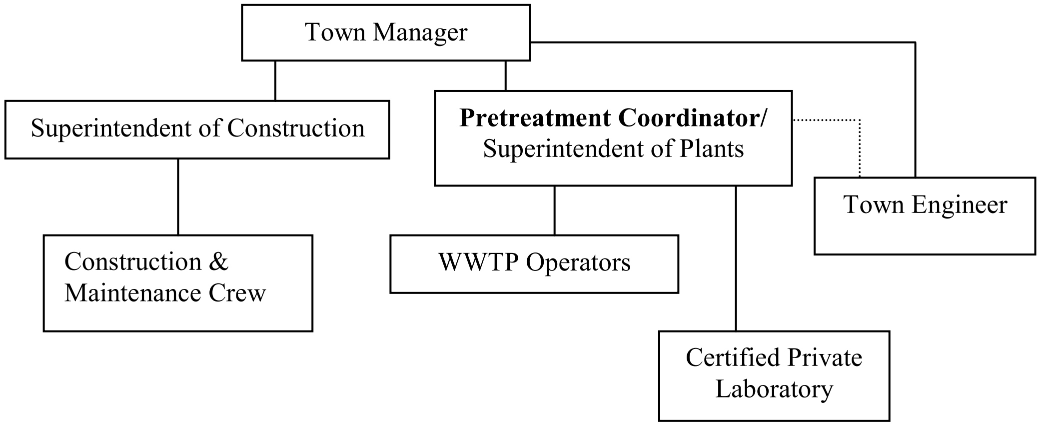
The Pretreatment Coordinator shall notify DEQ of any other modifications to its Pretreatment Program at least 30 days prior to implementation. Modifications that are not considered substantial are deemed approved unless DEQ notifies the Town within 90 days that the modification is not approved.

V. RESOURCES FOR DEVELOPMENT AND IMPLEMENTATION

A. Staffing

Day-to-day responsibility for the ongoing development and implementation of the Industrial Pretreatment Program will rest with the Town of Amherst staff unless and until the operation of the wastewater treatment plant is outsourced to a contract operator. The Superintendent of Plants has been designated the "Pretreatment Coordinator." Other Town of Amherst staff, however, will be utilized for a portion of the administrative duties. The following organizational chart depicts the Town's staffing structure:

Staffing for Industrial Pretreatment Program



Amherst has a Town Attorney who is retained by, and who answers directly to, the Town Council of the Town of Amherst. Although the attorney is the Council's attorney, he also serves as the Town Manager's legal counsel for most matters, including the enforcement of the Town's ordinances which includes the Industrial Pretreatment Ordinance.

In Amherst, the Town Manager is ultimately responsible for all staff activities and functions related to the wastewater treatment service. Development and implementation of Amherst's industrial pretreatment program has been delegated to the Superintendent of Plants. The Superintendent of Plants is responsible for the operation and maintenance of the Town's wastewater treatment plant, and the Town's Superintendent of Construction oversees the maintenance of the off-plant portions of the sanitary sewage collection system. Since overall administration of the industrial pretreatment program is the responsibility of the Superintendent of Plants, management of the program has been delegated to that official. Permit writing, technical review of submittals, etc. will be coordinated by the Superintendent of Plants and jointly handled by the Town Manager and the Town Engineer. Sampling and laboratory analysis will be performed by the WWTP operators under the direction of the Superintendent of Plants. A private certified laboratory will be used for the analysis of all flow parameters for which the WWTP laboratory is not certified to perform.

Zoning permits for significant new construction, building renovation, and building modification are issued by the Town Manager. Building code enforcement is handled by the Amherst County Building Official's office. The zoning permit process will allow the Town Manager to review which provisions of the Industrial Pretreatment Program apply to the applicant.

B. Equipment

The Town of Amherst has the vehicles, samplers, computers and laboratory equipment necessary to implement the industrial pretreatment program. Some analytical testing, such as metal analysis, will have to be performed by private laboratories.

C. Program Funding & Revenue Sources

The Town of Amherst's wastewater utility system is a self-supporting enterprise separate and apart from the Town's general fund and is supported by user fees. Direct costs and overhead for all administrative and staff support are charged to this Sewer Fund.

The Town's annual budget includes funding for public works personnel, private laboratory work, and consultants required to implement the industrial pretreatment program. The Town's Industrial Pretreatment Ordinance provides for the setting of reasonable fees to recover the costs of maintaining the industrial pretreatment program. As of this writing, the costs of implementing the program are being absorbed as a general operating cost.

APPENDIX A

SAMPLE ENFORCEMENT CONTROL DOCUMENTS

[Town of Amherst Letterhead]

DATE

Certified Mail
Return Receipt Requested

Name
Title
Company
Address

RE: Industrial User Permit No. __
Notice of Violation

Dear ______:

This notice is to inform you that your facility is in violation of your Industrial User Permit. The specific details of the violations are outlined below. Within ten (10) days of receipt of this notice, you must respond in writing with an explanation regarding how these violations occurred, and what actions will be taken to prevent the violation from reoccurring.

Standards/Requirements Violated:

1. ______________________
2. ______________________

All self-monitoring, sampling and reporting must be done in accordance with your permit requirements. Failure to meet the requirements of your permit may result in the imposition of penalties, and possible suspension or your wastewater service.

If you have any questions regarding this letter or your permit requirements, please call me at (___) ___-____.

Sincerely,

First Name Last Name
Pretreatment Coordinator

VML Insurance Programs
Confined Space Entry Program

Checklist to Complete a Confined Space Entry Program

Before you start:

- Read and understand the sample program.
- Complete the required information for the sample program. Your VML Insurance Programs' safety consultant will be able to assist with this process.
- Complete the management letter announcing the program and assigning responsibilities.
- Present the completed program to management for approval, management may have board/council pass a resolution adopting the program.
- Communicate the written Confined Space Entry Program to employees at all levels of the organization.
- Provide training for all personnel involved in the Confined Space Entry Program.
- Determine employee and supervisor responsibility.
- Develop sign-off sheets for employees to read, sign, and return stating that they have read, understood, and accepted the plan.

When writing the program:

❑ Determine which of the following elements to include in your program and training:

________ **Purpose**

________ **Confined Space Identification**

________ **Confined Space Classification (Permit-Required / Non-Permit Required)**

________ **Training for Entrants, Supervisors, Attendants, Rescue Personnel**

________ **Atmospheric Testing**

CONFINED SPACE LISTING

PAGE
1 OF

	VERBAL DESIGNATION	NUMERICAL	ASSESSED	PERMIT				DISK FILE #	LOCATION
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		
					Yes		No		

CONFINED SPACE ENTRY PROGRAM

	Permit Required		Non-Permit	CONFINED SPACE ASSESSMENT

SPACE INFORMATION

VERBAL SPACE DESIGNATION:

NUMERICAL SPACE DESIGNATION:

LOCATION:

SPACE MARKED: ❑ YES ❑ NO | ENTRY CONTROLLED: ❑ YES ❑ NO

SIGNAGE ❑ YES ❑ NO | BARRIERS ❑ YES ❑ NO | LOCKS ❑ YES ❑ NO | OTHER:

CURRENT USE OF SPACE:

PREVIOUS USE OF SPACE:

RELATED OPERATING PROCEDURES REVIEWED

HAZARD COMMUNICATION	❑	RESPIRATORY PROTECTION	❑	ELECTRICAL SAFETY	❑
LOCK OUT TAG OUT	❑	JOB HAZARD ANALYSIS	❑	PROCESS SAFETY	❑
WELDING SAFETY	❑	ACCIDENT INVESTIGATION	❑	FIRE PREVENTION	❑
	❑		❑		❑

CONFINED SPACE ASSESSMENT CHECKLIST

1. Can an employee enter & perform work either with or without permission?		Yes		No
2. Do people occupy the space even though it was not designed for it?		Yes		No
3. Is entry and or egress limited or present unusual rescue problems?		Yes		No
4. Does the space have any potential for a hazardous atmosphere?		Yes		No
5. Does the space contain a material or liquid that could engulf an entrant?		Yes		No
6. Does the internal space configuration present the hazard of entrapment?		Yes		No
7. Does the space contain any other recognized safety and or health hazards?		Yes		No
8. Is previous and or current entry hazard data available for review		Yes		No
9. Does entry hazard data confirm designation as a permit space?		Yes		NA
10 Were there any "yes" answers to 4-7 which cannot be controlled?		Yes		No

11. IF "9 & or 10" are YES, the space must be designated as a permit required confined space!

ASSESSED HAZARDS & REQUIRED PERSONAL PROTECTIVE EQUIPMENT

XX	HAZARDS	REMARKS	PPE REQUIRED/OTHER EQUIPMENT
	Restricted Entry/Egress		
	Oxygen Deficiency	Less than 19.5%	
	Oxygen Enrichment	More than 23.5%	
	Flammable Gases or Vapors	More than 10% LEL	
	Toxic Gases or Vapors	More than PEL	
	Chemical Hazards		
	Mechanical Hazards		
	Electrical Hazards		
	Engulfment Hazards		
	Entrapment Hazards		
	Fall Hazards		
	Skin Hazards		
	Hot/Cold Hazards		
	Radiation Hazards		
	Biological Hazards		
	Toxic Liquids		
	Potential High Liquid Level		
	Internal Baffles		

DIAGRAM OR PHOTOS OF SPACE (Indicate Portals)

CONFIGURATION OF SPACE

❑ VESSEL	❑ PIT	❑ VAULT	❑ SILO	❑ HOPPER	❑ BIN
❑ TANK	❑ RAIL CAR	❑ TANK CAR	❑ SEWER	❑ WELL	❑ TUNNEL
❑ DIGESTER	❑ TANKER	❑ PIPELINE	❑ SHIPS HOLD	❑ OTHER:	☑

DIMENSIONS OF SPACE

DEPTH/HEIGHT:	WIDTH/INNER DIAMETER:		LENGTH:
VOLUME/CAPACITY:	SHAPE:		
❑ ELEVATED	❑ ABOVE GROUND	❑ BELOW GROUND	❑

ANTICIPATED RESCUE

☑ VERTICAL EXTRACTION	❑ HORIZONTAL EXTRACTION	❑ OTHER:

REMARKS/RECOMMENDATIONS

Computer File Name:

❑ APPROVED

AUTHORIZATION

I certify that I have conducted a confined space assessment of the above designated space. To the best of my knowledge, I believe the information contained herein to be true and accurate as of the time of the assessment.

NAME:	TITLE:	
SIGNATURE:	DATE:	TIME: ❑ AM ❑ PM

FURTHER DETAILED ON ATTACHMENT(S) ❑ YES ❑ NO

ASSESSMENT FORM RETENTION INFORMATION

PERMANENT RETENTION FILE:

FILE LOCATION:	DATE FILED:	TIME: ❑ AM ❑ PM
ATTACHMENT(S) INCLUDED: ❑ YES ❑ NO	FILED BY:	

CONFINED SPACE ENTRY PROGRAM

DATE: _____________

1. **Written program.** Review and evaluate this standard practice instruction on an annual basis, or when changes occur to 29 CFR 1910.146, that prompt revision of this document, or when facility operational changes occur that require a revision of this document. Additionally, review the permit-required confined space program, using the canceled permits retained within 1 year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

2. **General requirements**. Establish confined space operational procedures through the use of this document.

2.1 After facility evaluation, spaces that meet the following criteria will be designated as a **confined space**:

2.1.1 It is large enough and so configured that an employee can bodily enter and perform assigned work.

2.1.2 Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.)

2.1.3 Is not designed for continuous employee occupancy.

2.1A. A **Permit-Required Confined Space** will meet the criteria as mentioned in 2.1 in addition to meeting the following criteria:

2.1.4 Contains or has a potential to contain a hazardous atmosphere.

2.1.5 Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.

2.1.6 Contains any other recognized serious safety or health hazard.

2.1B. A **Non-permit confined space** will meet the criteria mentioned in 2.1 but does not contain or have the potential to contain a serious, acute hazard.

2.2 Facility Evaluation. Evaluate our facility(s) to determine if any spaces meet the criteria for designation as a confined space. The decision flow chart in Section 5 of this Module can be used to facilitate this requirement.

2.3 Confined Space Identification.

2.3.1 Permit-required confined spaces. Those spaces meeting the criteria defined in paragraph 2.1 All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Inform exposed employees, by posting danger signs, conducting awareness training, or by any other equally effective means, of the existence and location of and the danger posed by the permit-required confined spaces. A sign reading "DANGER PERMIT REQUIRED CONFINED SPACE, DO NOT ENTER" or similar language will be used to satisfy the requirement for identification.

2.4 Confined Space listing. Once having evaluated our facility(s) will maintain a detailed listing that permanently identifies locations meeting the criteria for a confined space. A sample form can be found in section 5 of this Module.

2.5 If (Member) decides that only specific employees will enter permitted spaces, this employer shall take effective measures to prevent non-trained employees from entering the permit-required confined spaces.

2.6 For employees that are required to perform work in permit-required confined spaces, this employer shall implement the permit-required confined space entry program as delineated within this instruction. This written program will be available for inspection by employees, their authorized representatives, and authorized government inspectors.

2.7 Non-permit required confined spaces. Non-permit required confined spaces will be designated where the atmosphere and safety conditions can be controlled. Confined spaces may be entered without the need for a written permit or attendant provided that: 1. The space is determined to be a non-permit-required confined space. 2. The space can be maintained in a safe condition for entry by mechanical ventilation alone. All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Ensure that any employee required or permitted to pre-check or enter a confined space shall have successfully completed the training as required by this instruction. A written copy of operating and rescue procedures as required by this instruction shall be at the work site for the duration of the job. A site specific Confined Space Pre-Entry CheckList must be completed by the LEAD WORKER before entry into a confined space. This list will verify completion of the items required to verify safe entry. This checklist shall be kept at the job site for the duration of the job. If circumstances dictate an interruption in the work, the permit-required confined space must be re-evaluated and a new checklist must be completed.

2.7.1 It can be demonstrated that the only hazard posed by the permitted space is an actual or potentially hazardous atmosphere.

2.7.2 It can be demonstrated that continuous forced air ventilation alone is sufficient to maintain the space safe for entry.

2.7.3 Monitoring and inspection data supports the demonstrations required by paragraphs 2.7.1 and 2.7.2.

2.8 If an initial entry of the permit space is necessary to obtain monitoring and inspection data. Worst case will be assumed and the full provisions of permit-required confined space entry procedures will be implemented.

2.10 Reclassification of a permit space after all hazards within the space have been eliminated. The following requirements apply to entry into permit spaces that meet the conditions set forth in paragraphs 2.7.1, 2.7.2, and 2.7.3. No personnel will enter the confined space unless:

2.10.1 Conditions making it unsafe to remove an entrance cover are eliminated before the cover is removed.

2.10.2 The opening at entrance covers are guarded by a railing, temporary cover, or other temporary barrier that will prevent accidental fall-through and will protect each employee working in the space from foreign objects entering the space.

2.10.3 The internal atmosphere has been tested, with a calibrated direct-reading instrument, for the following conditions in the order given:

(1) Oxygen content. (19.5% - 23.5%)	OSHA Mandated
(2) Flammable gases and vapors. (Less than 10% of the Lower Explosive Limit (LEL)	OSHA Mandated
(3) Potential toxic air contaminants.	OSHA Mandated

2.11 There may be no hazardous atmosphere within the space whenever any employee is inside the space.

2.12 Continuous forced air ventilation shall be used, as follows:

2.12.1 No employee may enter the space until testing confirms that the forced air ventilation has eliminated any hazardous atmosphere.

2.12.2 The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space.

2.12.3 The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

2.12.4 The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere.

2.12.5 If a hazardous atmosphere is detected during entry:

(1) All employees will evacuate.

(2) The space shall be evaluated to determine how the hazardous atmosphere developed.

(3) Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

2.13 Permit Required Confined Space Certification. Verify that the space is safe for entry and that the measures required by a written certification permit meeting the criteria in 29 CFR 1910.146 are accomplished. This written certification will contain as a minimum; the date, the location of the space, and the signature of the person providing the certification. The certification shall be made before entry and shall be made available to each employee entering the space.

2.13.1 The following personnel are qualified to certify safe entry for (Member) personnel entering confined spaces.

	Name	**Title**
(1)	______________________________	________________________________
(2)	______________________________	________________________________
(3)	______________________________	________________________________
(4)	______________________________	________________________________
(5)	______________________________	________________________________

2.14 Non-Permit Required Confined Space Certification. When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, this employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

2.15 Permit to Non-Permit Reclassification. A space classified by this employer as a permit-required confined space will be reclassified as a non-permit confined space under the following conditions:

2.15.1 If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.

2.15.2 If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed under the assumption that a hazard exists. If testing and inspection during that entry demonstrate that the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

Note: Control of atmospheric hazards through forced air ventilation alone does not constitute elimination of the hazards. Periodic monitoring will be conducted to ensure forced air ventilation maintains a safe worker environment for reclassification to a non-permit confined space.

2.16 Responsibilities Regarding Contractor Operations in Permitted Confined Spaces. When this employer arranges to have employees of another employer (contractor) perform work that involves permit space entry, this employer shall:

2.16.1 Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with the (Member's) permit space program meeting the requirements of this instruction.

2.16.2 Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space.

2.16.3 Apprise the contractor of any precautions or procedures implemented for the protection of employees in or near permit spaces where contractor personnel will be working.

2.16.4 Coordinate entry operations with the contractor, when both (Member) personnel and contractor personnel will be working in or near permit spaces.

2.16.5 Debrief the contractor at the conclusion of the entry operation regarding the permit space program, and any hazards confronted or created in the concerned permit spaces during entry operations.

2.17 Contractor Responsibilities Regarding Contractor Operations in Permitted Confined Spaces. In addition to complying with the permit space requirements that apply to all employees, each contractor who is retained to perform permit space entry operations shall:

2.17.1 Obtain any available information regarding permit space hazards and entry operations.

2.17.2 Coordinate entry operations when both employees and contractor personnel will be working in or near permit spaces.

2.17.3 Inform (Member) of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces within this facility or others, either through a debriefing or during the entry operation.

3. Permit-required confined space program. Under the permit-required confined space program required by 29 CFR 1910.146, this employer shall:

3.1 Implement the measures necessary to prevent unauthorized entry.

3.2 Identify and evaluate the hazards of permit spaces before employees enter them.

3.3 Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

3.3.1 Specifying acceptable entry conditions.

3.3.2 Isolating the permit space.

3.3.3 Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards.

3.3.4 Provide pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards.

3.3.5 Verify that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

3.3.6 Develop and utilize checklists based on this standard practice instruction and 29 CFR 1910.146.

3.4 Provide the following equipment at no cost to employees, maintain that equipment properly, and ensure that employees are trained in the proper use of the equipment:

3.4.1 Testing and monitoring equipment needed to determine if hazardous conditions exist or to verify that they do not exist.

3.4.2 Ventilating equipment needed to obtain acceptable air quality for entry.

3.4.3 Communication equipment necessary for personnel involved in the entry operation.

3.4.4 Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees.

3.4.5 Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency.

3.4.6 Barriers and shields as required to protect workers from pedestrian and vehicular traffic.

3.4.7 Ladders, needed for safe access and egress by authorized entrants.

3.4.8 Rescue, Retrieval, and Emergency equipment needed to extract or treat injured personnel, except to the extent that the equipment and or service is provided by rescue services that are immediately available.

3.4.9 Any other equipment necessary for safe entry into and rescue from permitted spaces at our facility.

3.4.10 Principal equipment needed to conduct confined space operations. The below listed intrinsically safe equipment as a minimum will be maintained where required for confined space operations.

(1) Multi-gas monitors
(2) Ventilation equipment
(3) Rescue tripod/davit arm and winch system
(4) Body harnesses
(5) Extraction cable and lanyards
(6) Air compressors (as required)
(7) Supplied-air respirators (as required)
(8) Air purifying respirators (as required)
(9) SCBA equipment (as required)
(10) Emergency escape breathing app. (as required)
(11) Radio communication system (as required)
(12) Signage (as required)
(13) Lockout/Tagout equipment (as required)
(14) Intrinsically safe lighting equipment
(15) Personal protective clothing
(16) Hearing protection equipment
(17) Head protection equipment
(18) Eye protection equipment
(19) First aid kits
(20) Time keeping equipment
(21) Hand tools
(22) Escape ladders for depths of four feet or shoulder height
(23) ____
(24) ____
(25) ____

3.5 Evaluation of Permitted Space Conditions. Evaluate permit space conditions as follows when entry operations are conducted:

3.5.1 Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working.

3.5.2 Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations.

3.5.3 When testing for atmospheric hazards, use the following protocol; first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.

Note: Attendants may be assigned to monitor more than one permit space provided their duties can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as their duties can be effectively performed for each permit space that is monitored.

3.5.4 If multiple spaces are monitored by a single attendant, the permit will be annotated to provide the means and procedures by which the attendant is to respond to an emergency affecting one or more of the permit spaces being monitored.

3.5.5 When a confined space entry is to take place, as part of the preplanning process, designate in advance the persons who are to have active roles in the entry operation. Additionally the duties of each such employee will be identified, and provided with the required training required by the training section of this instruction. The confined space entry team will include but is not limited to the following:

(1) Authorized entrants
(2) Attendants
(3) Entry supervisors

3.5.6 Develop procedures ***prior*** to the commencement of confined space operations for the following:

(1) Notify rescue and emergency services of intent to enter so they can be on standby
(2) Summoning rescue and emergency services
(3) Rescuing entrants from permit spaces
(4) Providing necessary emergency services for rescue
(5) Preventing unauthorized personnel from attempting a rescue

3.5.7 Development and implementation for the preparation, issuance, use, and cancellation of entry permits will be as follows:

3.5.7.1 When employees of contractor personnel or non-company employees are working simultaneously as authorized entrants in a permit space, the certifying official of the permit (or predesignated representative) will ensure that all parties concerned are aware of the accepted entry procedures for the specific operation. This will ensure entry operations are properly coordinated.

3.5.7.2 The certifying official of the permit (or predesignated representative) will ensure that all parties concerned are aware of the accepted procedures necessary for concluding the entry after entry operations have been completed (such as closing off a permit space and canceling the permit).

3.5.7.3 Immediately review and as necessary halt and revise entry operations when there is reason to believe that the measures taken under the permit space program may not protect employees. The focus will be directed at the correction of deficiencies found to exist before subsequent entries are authorized. Examples of circumstances requiring the review of the permit-required confined space program are as a minimum:

(1) Any unauthorized entry of a permit space.
(2) The detection of a permit space hazard not covered by the permit.
(3) The detection of a condition prohibited by the permit.
(4) The occurrences of an injury or near miss during entry.
(5) A change in the use or configuration of a permit space.
(6) Employee complaints about the effectiveness of the program.

3.5.7.4 Review of the permit-required confined space program, using the canceled permits retained will be accomplished within 1 year after each entry and the program revised as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

Note: Single annual reviews covering all entries performed during a 12-month period will be accomplished. If no entry is performed during a 12-month period, no review is necessary.

4. <u>Permit system</u>. To comply with the permit-system:

4.1 Before entry is authorized, document the completion of the following measures:

4.1.1 Specifying acceptable entry conditions.

4.1.2 Isolating the permit space.

4.1.3 Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards.

4.1.4 Provide pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards.

4.1.5 Verify that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

4.1.6 Develop and utilize checklists based on this standard practice instruction and 29 CFR 1910.146.

4.2 Before entry begins, the entry supervisor identified on the permit shall sign the entry permit to authorize entry.

4.3 The completed permit shall be made available at the time of entry to all authorized entrants, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed.

4.4 The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit.

4.5 The entry supervisor shall terminate entry and cancel the entry permit when:

4.5.1 The entry operations covered by the entry permit have been completed.

4.5.2 A condition that is not allowed under the entry permit arises in or near the permit space.

4.6 This employer shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit-required confined space program. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

5. Entry permit. Develop or use a standardized entry permit form (see section 5 this Module) that documents compliance with this section and authorizes entry to a permit space. As a minimum the permit in use shall identify the following:

5.1 The permit space to be entered.

5.2 The purpose of the entry.

5.3 The date and the authorized duration of the entry permit.

5.4 The authorized entrants within the permit space, by name or by such other means (for example, through the use of rosters or tracking systems) will enable the attendant to determine quickly and accurately for the duration of the permit, which authorized entrants are inside the permit space. If a tracking system is used for certain entries this requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

5.5 The personnel, by name, currently serving as attendants.

5.6 The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry.

5.7 The hazards of the permit space to be entered.

5.8 The measures used to isolate the permit space and to eliminate or control permit space hazards before entry. Such as, the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

5.9 The acceptable entry conditions.

5.10 The results of initial and periodic atmospheric tests performed, accompanied by the names or initials of the testers and by an indication of when the tests were performed.

5.11 The rescue and emergency services that can be summoned and the means (such as the equipment to use and the numbers to call) for summoning those services.

5.12 The communication procedures used by authorized entrants and attendants to maintain contact during the entry.

5.13 Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with the permit requirement.

5.14 Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety.

5.15 Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.

5.16 Provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this section.

6. Training. Develop a standardized training format to meet the requirement for a safe confined space entry.

6.1 Training shall be provided to each affected employee:

6.1.1 Before the employee is first assigned duties that require a confined space entry.

6.1.2 Before there is a change in assigned duties.

6.1.3 Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained.

6.1.4 Whenever this employer has reason to believe that there are deviations from the permit space entry procedures required by this instruction or inadequacies in the employee's knowledge or use of these procedures.

6.2 The training shall establish employee proficiency in the duties required by this instruction and shall introduce new or revised procedures, as necessary, for compliance with this instruction or when future revisions occur.

6.3 Certify that the training required by this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.

7. <u>Duties of authorized entrants.</u> Ensure that all authorized entrants:

7.1 Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

7.2 Properly use equipment as required.

7.3 Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required by this section.

7.4 Alert the attendant whenever:

7.4.1 The entrant recognizes any warning sign or symptom of exposure to a dangerous situation.

7.4.2 The entrant detects a prohibited condition.

7.5 Exit from the permit space as quickly as possible whenever:

7.5.1 An order to evacuate is given by the attendant or the entry supervisor.

7.5.2 The entrant recognizes any warning sign or symptom of exposure to a dangerous situation.

7.5.3 The entrant detects a prohibited condition.

7.5.4 An evacuation alarm is activated.

8. <u>Duties of authorized attendants</u>. Ensure that each attendant:

8.1 Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

8.2 Is aware of possible behavioral effects of hazard exposure in authorized entrants.

8.3 Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under this section accurately identifies who is in the permit space.

8.4 Remains in a predesignated location outside the permit space during entry operations until relieved by another attendant.

Note: When this employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by the "rescue and emergency services" section of this instruction and only if they have been relieved as required by this section.

8.5 Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space.

8.6 Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions.

8.6.1 If the attendant detects a prohibited condition.

8.6.2 If the attendant detects the behavioral effects of hazard exposure in an entrant.

8.6.3 If the attendant detects a situation outside the space that could endanger the entrants.

8.6.4 If the attendant cannot effectively and safely perform all the duties required under this section.

8.7 Summon rescue and other emergency services as soon as the attendant determines that entrants may need assistance to escape from permit space hazards.

8.8 Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

8.8.1 Warn the unauthorized persons that they must stay away from the permit space.

8.8.2 Advise the unauthorized persons that they must exit immediately if they have entered the permit space.

8.8.3 Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.

8.9 Performs non-entry rescues as specified by this employer's rescue procedure.

8.10 Performs no duties that might interfere with the attendant's primary duty to monitor and protect the entrants.

9. Duties of entry supervisors. Ensure that each entry supervisor:

9.1 Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

9.2 Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.

9.3 Terminates the entry and cancels the permit as required in accordance with the "permit section" this instruction.

9.4 Verifies that rescue services are available and that the means for summoning them are operable.

9.5 Ensures removal of unauthorized individuals who enter or who attempt to enter the permit space during entry operations.

9.6 Determines, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

10. Rescue and emergency services. The following requirements apply to personnel who enter permit spaces to perform rescue services.

10.1 Ensure that each member of the rescue service is provided with, and is trained to use properly, the personal protective equipment and rescue equipment necessary for making rescues from permit spaces.

10.2 Each member of the rescue service shall be trained to perform the assigned rescue duties. Each member of the rescue service shall also receive the training required of authorized entrants under the "duties of authorized entrants" section of this instruction.

10.3 Each member of the rescue service shall practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, mannequins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which this company anticipates rescue is to be performed.

10.4 Each member of the rescue service shall be trained in basic first aid and in cardiopulmonary resuscitation (CPR). At least one member of the rescue service holding current certification in first aid and in CPR shall be available.

10.5 When rescue personnel not employed by (Member) are designated to perform permit space rescue, this employer shall:

10.5.1 Contact the rescue service to be used, prior to entry into a confined space to ensure their availability if needed.

10.5.2 Inform the rescue service of the hazards they may confront when called on to perform rescue.

10.5.3 Provide the rescue service with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

10.6 To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems used by this company shall meet the following requirements.

10.6.1 Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head. Wristlets may be used in lieu of the chest or full body harness if it is demonstrated that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

10.6.2 The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet deep.

10.7 If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

11. Procedures for Atmospheric Testing. Provide entrants, or their authorized representatives, an opportunity to observe any testing of a space prior to entry or subsequent to entry. Atmospheric testing for confined space entry is required for two distinct purposes: Evaluation of the hazards of the permit space and verification that acceptable entry conditions for entry into that space exists.

11.1 Evaluation testing. Ensure that the atmosphere of a confined space is analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise. This is required to ensure that appropriate permit entry procedures specific to the operation can be developed and acceptable entry conditions stipulated for that specific space. Evaluation and interpretation of these data, and development of the entry procedure, will be done by, or reviewed by, a technically qualified professional based on evaluation of all serious hazards. The internal atmosphere will be tested, with a calibrated direct-reading instrument, for the following conditions in the order given:

(1) Oxygen content. (19.5% - 23.5%)	OSHA Mandated
(2) Flammable gases and vapors.	OSHA Mandated
(3) Potential toxic air contaminants.	OSHA Mandated

11.2 Verification testing. The atmosphere of a permit space which may contain a hazardous atmosphere will be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions. Results of testing (i.e., actual concentration, etc.) will be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition. The atmosphere will be verified, with a calibrated direct-reading instrument, for the following conditions in the order given:

(1) Oxygen content. (19.5% - 23.5%)	OSHA Mandated
(2) Flammable gases and vapors.	OSHA Mandated
(3) Potential toxic air contaminants.	OSHA Mandated

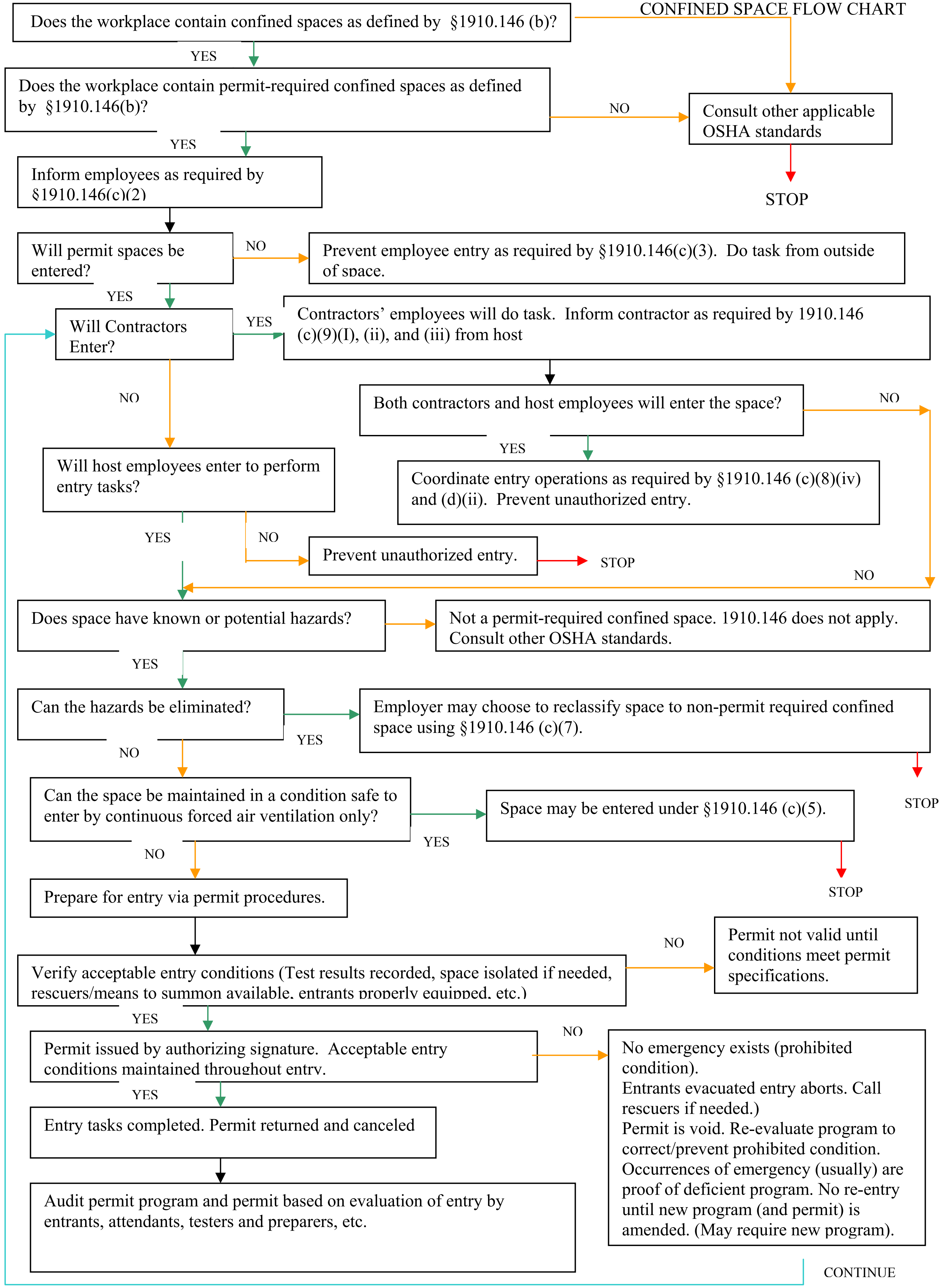
11.3 Duration of testing. Measurement of values for each atmospheric parameter will be made for at least the minimum response time of the test instrument specified by the manufacturer.

11.4 Testing stratified atmospheres. When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope will be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress will be slowed to accommodate the sampling speed and detector response. The stratified atmosphere will be tested, with a calibrated direct-reading instrument, for the following conditions in the order given:

(1) Oxygen content. (19.5% - 23.5%)	OSHA Mandated
(2) Flammable gases and vapors.	OSHA Mandated
(3) Potential toxic air contaminants.	OSHA Mandated

12. <u>Employee Involvement in the Confined Space Program</u>. 29 CFR 1910.146 requires that employers consult with their employees regarding the employer's efforts in the development and implementation of the Confined Space Program. The Standard also requires us to train and educate our employees and to inform affected employees of the findings from incident investigations conducted under the Confined Space Program. It is our policy that not only will we consult with our employees regarding efforts to develop, implement and maintain the Confined Space Program programs, but that we will, where ever possible, integrally involve our employees in the entire process. This is essential because employees comprise the best determination of confined space operational procedures, and solutions to confined space operations problems peculiar to our operation(s). This will be accomplished through a "Confined Space Safety Committee." This committee will be responsible for developing Confined Space policy and procedures.

PERMIT-REQUIRED
CONFINED SPACE FLOW CHART



HOT-WORK PERMIT

NOTE: Hot Work will be performed only after a careful and complete review of all safety precautions and site preparation actions have proven it safe to begin work.

Permit Number:			**Permit Location:**		
Permit Validity Period:					
Date:		**Start Time**		**Stop Time**	
Work to be completed:					

☐ **Hot Work Completed: Hot Work was performed under this permit during the period:**

DATE:		**START TIME:**		**STOP TIME:**	

☐ **Not Approved**	**Estimated Approval: Date/Time:**

Reason:

Name:	**Signature:**	
Title:	**Date:**	**Time:**

☐ **Approved for Hot Work**	**AUTHORIZATION**

I certify that I have inspected the site and that the required precautions (1, 2, 3, and 4) on the reverse of this page have been completed. Arrangements have been made for item 5. Permission is granted to perform the work.

Name:	**Signature:**	
Title:	**Date:**	**Time:**
PERMIT RETENTION INFORMATION		
Permanent Retention File:	Location:	
Date Filed:	Filed By:	

HOT WORK SAFETY REQUIREMENTS

IF EMERGENCY OCCURS CALL:	
CONTACT:	

EMERGENCY/FIRE/RESCUE PROCEDURES

Location of written Emergency Actions Plan:	
Evacuation/Relocation Information:	

Additional Information:

HOT WORK SAFETY CHECKLIST

WORK CANNOT BEGIN UNTIL THE FOLLOWING SAFETY PRECAUTIONS HAVE BEEN COMPLETED

Requirement	Completed	
1. The location of the work to be done will be examined.		
- Are Sprinklers, where provided, operational and will remain operable until the work is completed?	☐ Yes	☐ No
- Have all flammable dusts, lint, vapors or liquids been cleared from the hot work area?	☐ Yes	☐ No
- Have all unpurged tanks or equipment previously containing flammable material been removed?	☐ Yes	☐ No
- Will the work be confined to the area specified in this permit?	☐ Yes	☐ No
2. The following safeguards will be provided.		
- Have all floors and surroundings been swept clean and wet down if required?	☐ Yes	☐ No
- Has ample portable fire extinguishing equipment been provided and strategically located?	☐ Yes	☐ No
- Have all unpurged tanks or equipment previously containing flammable material been removed?	☐ Yes	☐ No
3. If the work involves spark producing equipment the following will been done.		
- Have all combustibles been located 30 to 40 feet from the operation?	☐ Yes	☐ No
- Have all non-moveable combustibles been protected with fireproof curtains, flameproof covers etc.?	☐ Yes	☐ No
- Has a firewatch been appointed to watch for dangerous sparks in the area above and below floors?	☐ Yes	☐ No
4. Has flame- or spark-producing equipment been inspected and in good repair?	☐ Yes	☐ No
5. Have arrangements been made for area patrol, including above and below floors, during rest periods and for at least one half hour after work completion?	☐ Yes	☐ No
6. Were there any "no" answers in questions 1-5?	*☐ Yes	☐ No

*** IF YES--REPORT TO YOUR SUPERVISOR - DO NOT PERFORM HOT WORK!**

POLICY ADOPTION STATEMENT

(Member)

WHEREAS, The Occupational Safety and Health Act of 1970 requires employers to provide a safe place to work, a place free from hazards that might cause injury, disability or even death.

WHEREAS, It is the policy of **(Member)** that every employee is entitled to work under the safest conditions possible. Every reasonable effort will be made to promote accident prevention for protection and health preservation.

WHEREAS, It is our belief that accidents that injure people, damage equipment or property, or destroy materials causing needless personal suffering inconvenience and expense. We believe that taking common sense precautions can prevent practically all accidents.

THEREFORE, BE IT RESOLVED, by the **(Board/Council of the Member)** through its appointed managers, will endeavor to maintain a safe and healthful work place. The **(type of entity)** will provide safe working equipment, necessary personal protection and, in the case of injury, the appropriate first aid and medical services will be available.

The **(Responsible person & title)** will head the implementation of the Confined Space Entry Program and will communicate pertinent information to all departments. **(Responsible person)** will undertake such duties as may be required in the day-to-day operation of the safety program.

CONFINED SPACE ENTRY PERMIT

SPACE: ______________________________ DEPARTMENT: ______________________________ DATE: _______________

PERMIT STATUS: 1)-*(Date/Time Issued)* _______/_______ 2)-*(Date/Time Expires – 12 hours maximum)* _________/__________

REASON for ENTRY: ____

1 – RESPONSIBILITY: (Print Names)
(Each reviews the permit and initials by name prior to entry)

Supervisor: ____________________ _______
Attendant(s): ____________________ _______
____________________ _______
____________________ _______
____________________ _______
Entrant(s): ____________________ _______
____________________ _______
____________________ _______

2 – NATURE OF HAZARDS:

N/A	Yes		N/A	Yes	
❒	❒	Electrical	❒	❒	O_2 deficiency
❒	❒	Engulfment	❒	❒	Flammable atmosphere
❒	❒	Configuration	❒	❒	Toxic atmosphere
❒	❒	Contact dermatitis	❒	❒	Mechanical hazards

Comments: _______________ Comments: _______________

3 – PREPARATION: **NOTE-** ***(Entry is not permitted if any items are answered with a "No")***

Procedures

N/A	Yes	No	
❒	❒	❒	Rescue Services Notified (*24 hours prior or ASAP)
❒	❒	❒	Involved Personnel Authorized (trained)
❒	❒	❒	Source Isolation (without entry)
❒	❒	❒	Zero Energy State
❒	❒	❒	Mechanical/Natural Ventilation (specify by circling)
❒	❒	❒	Space Cleaned/Purged
❒	❒	❒	Atmospheric Tests Completed
❒	❒	❒	Excavation/Trench protection
❒	❒	❒	Area Secure
❒	❒	❒	Hot-Work Permits/Procedure
❒	❒	❒	Employees informed of Procedures and Hazards

Comments: ____

Equipment

N/A	Yes	No	
❒	❒	❒	Monitor Calibration Valid
❒	❒	❒	Monitor Checked Prior to Testing
❒	❒	❒	Retrieval Equipment Available
❒	❒	❒	Hoisting Equipment Available
❒	❒	❒	Communications Available
❒	❒	❒	PPE Available and Utlized
❒	❒	❒	Proper Equipment for Hazards

- Non Sparking Tools, etc.
- Intrinsically safe if needed, etc.

Comments: ____

PERIODIC ATMOSPHERE TESTS: *(Initial and continuous monitoring results; recorded here every hour)*

Tester's Initials	______	______	______	______	______	______	______	______	______
Time (specify a.m. or p.m.):	______	______	______	______	______	______	______	______	______
Oxygen (19.5%-23.5%):	______	______	______	______	______	______	______	______	______
LEL (<10%):	______	______	______	______	______	______	______	______	______
H_2S (<10ppm):	______	______	______	______	______	______	______	______	______
CO (<35ppm):	______	______	______	______	______	______	______	______	______

Comments: ____

This documentation verifies I have reviewed this permit for accuracy and completeness. All sections must be complete and There must not be any "No" responses in Section 3 for entry to be authorized.

Permit Prepared by:	*(Print)*	*(Signature)*	*(Date)*
Supervisor Approval:	*(Print)*	*(Signature)*	*(Date)*
Safety Review:	*(Print)*	*(Signature)*	*(Date)*

CONFINED SPACE PERMIT INSTRUCTIONS

The Confined Space Permit must be fully completed for each permit-required entry!

Status Section: (Top of the form) -This section must be fully completed to establish status.

SPACE: (fill in space location) DEPARTMENT: (department performing entry) DATE: (date of entry)
PERMIT STATUS: 1)- *(Date/Time Issued)* 2)- *(Date/Time Expires - 12 hours maximum)*
REASON for ENTRY:

Section 1: (RESPONSIBILITY)

- Print the names of the Entry Supervisor, each attendant and each entrant. Print names wherever it applies - for example, the supervisor may also be an attendant and that name goes in each category.
- Upon completion of the permit each person listed on the permit must review the operation staging, completed permit and be briefed on details of the operation. Following this each person listed must initial beside their printed name to signify that they understand and agree to the safety measures taken.

Section 2: (NATURE OF HAZARDS)

Use this section as a checklist to recognize hazards that may be actually or potentially be present. However, do not limit hazard analysis to the examples given. Identifying hazards will allow you to determine what preparation is necessary to eliminate or control the hazard; otherwise, entry is prohibited.

- If the hazard exists, mark "Yes".
- If the listed hazard does not exist or have the potential to exist, mark "N/A".
- Comments can be added below as the form suggests.
- Operations must be continually monitored to ensure hazards do not develop during the entry operation.

Section 3: (PREPARATION)

The "Preparation" section is your action plan to eliminate or control hazards. The importance of this section can not be emphasized enough. Use your knowledge and Section 2 to guide what preparation is necessary.

N/A, Yes, or No:

- **N/A** means that the hazard does not exist. If the particular safety preparation procedure or equipment does not apply because there is no respective hazard mark "N/A".
- **Yes** means (1)-the hazard exists and (2)-the safety procedure has been taken to eliminate or control. If the particular safety preparation procedure or equipment applies and is correctly implemented, mark "Yes".
- **No** means that the hazard exists but the safety procedure has not been taken or can not be taken successfully. If the safety preparation procedure or equipment applies but has not been correctly implemented, mark "No".

★ NOTE - Entry is not permitted if any items are answered with a "No"!!!

Section 4: (PERIODIC ATMOSPHERIC TESTS)

The atmosphere must be tested prior to entry and shall be monitored continuously during entry operations (at least one entrant will wear a monitor in the work area). Initial atmospheric tests will be documented in this section and then continuous testing results will be documented at least hourly following entry.

Comments should be included below this section as needed.

Signing the Permit:

This documentation verifies that the permit preparer and the entry supervisor have reviewed the permit for accuracy and completeness and approve the safety provided.

- The person preparing the permit must print their name, sign and date the permit as indicated at the bottom.
- The entry supervisor must print their name, sign and date the permit as indicated to verify their approval of the safety of the operation.
- A safety review needs to be accomplished at least a year following each entry. The "Safety Review" signature line needs to be filled out by the lead person performing the review and the date of the review filled in.

Post Entry Review:

A safety evaluation is included in the debriefing. Suggestions for improvement regarding specific space and entry operations will be made on the Confined Space Entry Permit.

Retention of the Permit: - Permits must be kept a minimum of one year and subject to a safety review.

(DATE)

(Name)
(Address)

Re: Confined Space Entry Program

To all employees:

The policy at **(Member)** is that every employee is entitled to work under the safest conditions possible. To this end, every reasonable effort will be made to promote accidents prevention for protection and health preservation.

It is the sincere desire of management to promote a safety program that is functional and effective. This will assist to eliminate potential safety hazards, detect unsafe acts, and instill safety awareness for every job and activity. Therefore, the **(Member)** has adopted the Confined Space Entry Program to enhance and improve the overall safety commitment. **(Name of responsible person & title)** will have responsibility for implementing and training of the Confined Space Entry Program

To attain the maximum results from this program, every employee must be dedicated to the idea that every accident and unnecessary loss can be prevented and that the many facets of this program are in place to reduce losses. The elimination of unnecessary loss is a responsibility we all share.

Sincerely,

(Chief Administrator)

OSHA Regulations (Standards - 29 CFR)
Permit-required confined spaces - 1910.146

http://www.osha.gov

Standard Number: 1910.146
Standard Title: Permit-required confined spaces
SubPart Number: J
SubPart Title: General Environmental Controls
Applicable Standard: Applicable Standard:

(a)

Scope and application. This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. This section does not apply to agriculture, to construction, or to shipyard employment (Parts 1928, 1926, and 1915 of this chapter, respectively).

(b)

Definitions.

"Acceptable entry conditions" means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.

"Attendant" means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

"Authorized entrant" means an employee who is authorized by the employer to enter a permit space.

"Blanking or blinding" means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

"Confined space" means a space that:

(1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and

(2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and

(3) Is not designed for continuous employee occupancy.

"Double block and bleed" means the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

"Emergency" means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

"Engulfment" means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

"Entry" means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

"Entry permit (permit)" means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.

"Entry supervisor" means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.

NOTE: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

"Hazardous atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);

(2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.

(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;

(4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;

(5) NOTE: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

(6) Any other atmospheric condition that is immediately dangerous to life or health.

NOTE: For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets that comply with the Hazard Communication Standard, section 1910.1200 of this Part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

"Hot work permit" means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

"Immediately dangerous to life or health (IDLH)" means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

NOTE: Some materials -- hydrogen fluoride gas and cadmium vapor, for example -- may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

"Inerting" means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

NOTE: This procedure produces an IDLH oxygen-deficient atmosphere.

"Isolation" means the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

"Line breaking" means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

"Non-permit confined space" means a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

"Oxygen deficient atmosphere" means an atmosphere containing less than 19.5 percent oxygen by volume.

"Oxygen enriched atmosphere" means an atmosphere containing more than 23.5 percent oxygen by volume.

"Permit-required confined space (permit space)" means a confined space that has one or more of the following characteristics:

(1) Contains or has a potential to contain a hazardous atmosphere;

(2) Contains a material that has the potential for engulfing an entrant;

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

(4) Contains any other recognized serious safety or health hazard.

"Permit-required confined space program (permit space program)" means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

"Permit system" means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

"Prohibited condition" means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

"Rescue service" means the personnel designated to rescue employees from permit spaces.

"Retrieval system" means the equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

"Testing" means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

NOTE: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

(c)

General requirements.

(c)(1)

The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces.

NOTE: Proper application of the decision flow chart in Appendix A to section 1910.146 would facilitate compliance with this requirement.

(c)(2)

If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

NOTE: A sign reading DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER or using other similar language would satisfy the requirement for a sign.

..1910.146(c)(3)

(c)(3)

If the employer decides that its employees will not enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with paragraphs (c)(1), (c)(2), (c)(6), and (c)(8) of this section.

(c)(4)

If the employer decides that its employees will enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.

(c)(5)

An employer may use the alternate procedures specified in paragraph (c)(5)(ii) of this section for entering a permit space under the conditions set forth in paragraph (c)(5)(i) of this section.

(c)(5)(i)

An employer whose employees enter a permit space need not comply with paragraphs (d) through (f) and (h) through (k) of this section, provided that:

(c)(5)(i)(A)

The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;

(c)(5)(i)(B)

The employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;

..1910.146(c)(5)(i)(C)

(c)(5)(i)(C)

The employer develops monitoring and inspection data that supports the demonstrations required by paragraphs (c)(5)(i)(A) and (c)(5)(i)(B) of this section;

(c)(5)(i)(D)

If an initial entry of the permit space is necessary to obtain the data required by paragraph (c)(5)(i)(C) of this section, the entry is performed in compliance with paragraphs (d) through (k) of this section;

(c)(5)(i)(E)

The determinations and supporting data required by paragraphs (c)(5)(i)(A), (c)(5)(i)(B), and (c)(5)(i)(C) of this section are documented by the employer and are made available to each employee who enters the permit space under the terms of paragraph (c)(5) of this section or to that employee's authorized representative; and

(c)(5)(i)(F)

Entry into the permit space under the terms of paragraph (c)(5)(i) of this section is performed in accordance with the requirements of paragraph (c)(5)(ii) of this section.

NOTE: See paragraph (c)(7) of this section for reclassification of a permit space after all hazards within the space have been eliminated.

(c)(5)(ii)

The following requirements apply to entry into permit spaces that meet the conditions set forth in paragraph (c)(5)(i) of this section.

(c)(5)(ii)(A)

Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.

..1910.146(c)(5)(ii)(B)

(c)(5)(ii)(B)

When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

(c)(5)(ii)(C)

Before an employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for oxygen content, for flammable gases and vapors, and for potential toxic air contaminants, in that order. Any employee who enters the space, or that employee's authorized representative, shall be provided an opportunity to observe the pre-entry testing required by this paragraph.

(c)(5)(ii)(C)(1)

Oxygen content,

(c)(5)(ii)(C)(2)

Flammable gases and vapors, and

(c)(5)(ii)(C)(3)

Potential toxic air contaminants.

(c)(5)(ii)(D)

There may be no hazardous atmosphere within the space whenever any employee is inside the space.

(c)(5)(ii)(E)

Continuous forced air ventilation shall be used, as follows:

(c)(5)(ii)(E)(1)

An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

(c)(5)(ii)(E)(2)

The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space;

(c)(5)(ii)(E)(3)

The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

..1910.146(c)(5)(ii)(F)

(c)(5)(ii)(F)

The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Any employee who enters the space, or that employee's authorized representative, shall be provided with an opportunity to observe the periodic testing required by this paragraph.

(c)(5)(ii)(G)

If a hazardous atmosphere is detected during entry:

(c)(5)(ii)(G)(1)

Each employee shall leave the space immediately;

(c)(5)(ii)(G)(2)

The space shall be evaluated to determine how the hazardous atmosphere developed; and

(c)(5)(ii)(G)(3)

Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

(c)(5)(ii)(H)

The employer shall verify that the space is safe for entry and that the pre-entry measures required by paragraph (c)(5)(ii) of this section have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing the certification. The certification shall be made before entry and shall be made available to each employee entering the space or to that employee's authorized representative .

(c)(6)

When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, the employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

..1910.146(c)(7)

(c)(7)

A space classified by the employer as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

(c)(7)(i)

If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.

(c)(7)(ii)

If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed under paragraphs (d) through (k) of this section. If testing and inspection during that entry demonstrate that the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

NOTE: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Paragraph (c)(5) covers permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

(c)(7)(iii)

The employer shall document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. The certification shall be made available to each employee entering the space or to that employee's authorized representative.

..1910.146(c)(7)(iv)

(c)(7)(iv)

If hazards arise within a permit space that has been declassified to a non-permit space under paragraph (c)(7) of this section, each employee in the space shall exit the space. The employer shall then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with other applicable provisions of this section.

(c)(8)

When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall:

(c)(8)(i)

Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section;

(c)(8)(ii)

Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space;

(c)(8)(iii)

Apprise the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working;

(c)(8)(iv)

Coordinate entry operations with the contractor, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

..1910.146(c)(8)(v)

(c)(8)(v)

Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

(c)(9)

In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

(c)(9)(i)

Obtain any available information regarding permit space hazards and entry operations from the host employer;

(c)(9)(ii)

Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

(c)(9)(iii)

Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation.

(d)

Permit-required confined space program (permit space program). Under the permit space program required by paragraph (c)(4) of this section, the employer shall:

(d)(1)

Implement the measures necessary to prevent unauthorized entry;

..1910.146(d)(2)

(d)(2)

Identify and evaluate the hazards of permit spaces before employees enter them;

(d)(3)

Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

(d)(3)(i)

Specifying acceptable entry conditions;

(d)(3)(ii)

Providing each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces;

(d)(3)(iii)

Isolating the permit space;

(d)(3)(iv)

Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

(d)(3)(v)

Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

(d)(3)(vi)

Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

(d)(4)

Provide the following equipment (specified in paragraphs (d)(4)(i) through (d)(4)(ix) of this section) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

..1910.146(d)(4)(i)

(d)(4)(i)

Testing and monitoring equipment needed to comply with paragraph (d)(5) of this section;

(d)(4)(ii)

Ventilating equipment needed to obtain acceptable entry conditions;

(d)(4)(iii)

Communications equipment necessary for compliance with paragraphs (h)(3) and (i)(5) of this section;

(d)(4)(iv)

Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees;

(d)(4)(v)

Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;

(d)(4)(vi)

Barriers and shields as required by paragraph (d)(3)(iv) of this section;

(d)(4)(vii)

Equipment, such as ladders, needed for safe ingress and egress by authorized entrants;

(d)(4)(viii)

Rescue and emergency equipment needed to comply with paragraph (d)(9) of this section, except to the extent that the equipment is provided by rescue services; and

(d)(4)(ix)

Any other equipment necessary for safe entry into and rescue from permit spaces.

..1910.146(d)(5)

(d)(5)

Evaluate permit space conditions as follows when entry operations are conducted:

(d)(5)(i)

Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

(d)(5)(ii)

Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and

(d)(5)(iii)

When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.

(d)(5)(iv)

Provide each authorized entrant or that employee's authorized representative an opportunity to observe the pre-entry and any subsequent testing or monitoring of permit spaces;

(d)(5)(v)

Reevaluate the permit space in the presence of any authorized entrant or that employee's authorized representative who requests that the employer conduct such reevaluation because the entrant or representative has reason to believe that the evaluation of that space may not have been adequate;

(d)(5)(vi)

Immediately provide each authorized entrant or that employee's authorized representative with the results of any testing conducted in accord with paragraph (d) of this section.

NOTE: Atmospheric testing conducted in accordance with Appendix B to section 1910.146 would be considered as satisfying the requirements of this paragraph. For permit space operations in sewers, atmospheric testing conducted in accordance with Appendix B, as supplemented by Appendix E to section 1910.146, would be considered as satisfying the requirements of this paragraph.

(d)(6)

Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;

NOTE: Attendants may be assigned to monitor more than one permit space provided the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored.

..1910.146(d)(7)

(d)(7)

If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under paragraph (i) of this section;

(d)(8)

Designate the persons who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee with the training required by paragraph (g) of this section;

(d)(9)

Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue;

(d)(10)

Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section;

(d)(11)

Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer;

..1910.146(d)(12)

(d)(12)

Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed;

(d)(13)

Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and

NOTE: Examples of circumstances requiring the review of the permit space program are: any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

(d)(14)

Review the permit space program, using the canceled permits retained under paragraph (e)(6) of this section within 1 year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

NOTE: Employers may perform a single annual review covering all entries performed during a 12-month period. If no entry is performed during a 12-month period, no review is necessary.

Appendix C to section 1910.146 presents examples of permit space programs that are considered to comply with the requirements of paragraph (d) of this section.

(e)

Permit system.

(e)(1)

Before entry is authorized, the employer shall document the completion of measures required by paragraph (d)(3) of this section by preparing an entry permit.

NOTE: Appendix D to section 1910.146 presents examples of permits whose elements are considered to comply with the requirements of this section.

(e)(2)

Before entry begins, the entry supervisor identified on the permit shall sign the entry permit to authorize entry.

(e)(3)

The completed permit shall be made available at the time of entry to all authorized entrants or their authorized representatives, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed.

..1910.146(e)(4)

(e)(4)

The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with paragraph (f)(2) of this section.

(e)(5)

The entry supervisor shall terminate entry and cancel the entry permit when:

(e)(5)(i)

The entry operations covered by the entry permit have been completed; or

(e)(5)(ii)

A condition that is not allowed under the entry permit arises in or near the permit space.

(e)(6)

The employer shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit-required confined space program required by paragraph (d)(14) of this section. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

(f)

Entry permit. The entry permit that documents compliance with this section and authorizes entry to a permit space shall identify:

(f)(1)

The permit space to be entered;

(f)(2)

The purpose of the entry;

..1910.146(f)(3)

(f)(3)

The date and the authorized duration of the entry permit;

(f)(4)

The authorized entrants within the permit space, by name or by such other means (for example, through the use of rosters or tracking systems) as will enable the attendant to determine quickly and accurately, for the duration of the permit, which authorized entrants are inside the permit space;

NOTE: This requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

(f)(5)

The personnel, by name, currently serving as attendants;

(f)(6)

The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry;

(f)(7)

The hazards of the permit space to be entered;

(f)(8)

The measures used to isolate the permit space and to eliminate or control permit space hazards before entry;

NOTE: Those measures can include the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

(f)(9)

The acceptable entry conditions;

(f)(10)

The results of initial and periodic tests performed under paragraph (d)(5) of this section, accompanied by the names or initials of the testers and by an indication of when the tests were performed;

..1910.146(f)(11)

(f)(11)

The rescue and emergency services that can be summoned and the means (such as the equipment to use and the numbers to call) for summoning those services;

(f)(12)

The communication procedures used by authorized entrants and attendants to maintain contact during the entry;

(f)(13)

Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with this section;

(f)(14)

Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety; and (15) Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.

(g)

Training.

(g)(1)

The employer shall provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this section.

(g)(2)

Training shall be provided to each affected employee:

(g)(2)(i)

Before the employee is first assigned duties under this section;

..1910.146(g)(2)(ii)

(g)(2)(ii)

Before there is a change in assigned duties;

(g)(2)(iii)

Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

(g)(2)(iv)

Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures required by paragraph (d)(3) of this section or that there are inadequacies in the employee's knowledge or use of these procedures.

(g)(3)

The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.

(g)(4)

The employer shall certify that the training required by paragraphs (g)(1) through (g)(3) of this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.

(h)

Duties of authorized entrants. The employer shall ensure that all authorized entrants:

..1910.146(h)(1)

(h)(1)

Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(h)(2)

Properly use equipment as required by paragraph (d)(4) of this section;

(h)(3)

Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required by paragraph (i)(6) of this section;

(h)(4)

Alert the attendant whenever:

(h)(4)(i)

The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or

(h)(4)(ii)

The entrant detects a prohibited condition; and

(h)(5)

Exit from the permit space as quickly as possible whenever:

(h)(5)(i)

An order to evacuate is given by the attendant or the entry supervisor,

(h)(5)(ii)

The entrant recognizes any warning sign or symptom of exposure to a dangerous situation,

..1910.146(h)(5)(iii)

(h)(5)(iii)

The entrant detects a prohibited condition, or

(h)(5)(iv)

An evacuation alarm is activated.

(i)

Duties of attendants. The employer shall ensure that each attendant:

(i)(1)

Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(i)(2)

Is aware of possible behavioral effects of hazard exposure in authorized entrants;

(i)(3)

Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under paragraph (f)(4) of this section accurately identifies who is in the permit space;

(i)(4)

Remains outside the permit space during entry operations until relieved by another attendant;

NOTE: When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by paragraph (k)(1) of this section and if they have been relieved as required by paragraph (i)(4) of this section.

(i)(5)

Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under paragraph (i)(6) of this section;

..1910.146(i)(6)

(i)(6)

Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions;

(i)(6)(i)

If the attendant detects a prohibited condition;

(i)(6)(ii)

If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;

(i)(6)(iii)

If the attendant detects a situation outside the space that could endanger the authorized entrants; or

(i)(6)(iv)

If the attendant cannot effectively and safely perform all the duties required under paragraph (i) of this section;

(i)(7)

Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;

(i)(8)

Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

(i)(8)(i)

Warn the unauthorized persons that they must stay away from the permit space;

..1910.146(i)(8)(ii)

(i)(8)(ii)

Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and

(i)(8)(iii)

Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;

(i)(9)

Performs non-entry rescues as specified by the employer's rescue procedure; and

(i)(10)

Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

(j)

Duties of entry supervisors. The employer shall ensure that each entry supervisor:

(j)(1)

Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(j)(2)

Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin;

..1910.146(j)(3)

(j)(3)

Terminates the entry and cancels the permit as required by paragraph (e)(5) of this section;

(j)(4)

Verifies that rescue services are available and that the means for summoning them are operable;

(j)(5)

Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and

(j)(6)

Determines, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

(k)

Rescue and emergency services.

(k)(1)

An employer who designates rescue and emergency services, pursuant to paragraph (d)(9) of this section, shall:

(k)(1)(i)

Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified;

Note to paragraph (k)(l)(i): What will be considered timely will vary according to the specific hazards involved in each entry. For example, §1910.134, Respiratory Protection, requires that employers provide a standby person or persons capable of immediate action to rescue employee(s) wearing respiratory protection while in work areas defined as IDLH atmospheres.

..1910.146(k)(1)(ii)

(k)(1)(ii)

Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified;

(k)(1)(iii)

Select a rescue team or service from those evaluated that:

(k)(1)(iii)(A)

Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified;

(k)(1)(iii)(B)

Is equipped for and proficient in performing the needed rescue services;

(k)(1)(iv)

Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and

(k)(1)(v)

Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

Note to paragraph (k)(1): Non-mandatory Appendix F contains examples of criteria which employers can use in evaluating prospective rescuers as required by paragraph (k)(l) of this section.

(k)(2)

An employer whose employees have been designated to provide permit space rescue and emergency services shall take the following measures:

(k)(2)(i)

Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;

(k)(2)(ii)

Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant, as provided by paragraphs (g) and (h) of this section;

(k)(2)(iii)

Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available; and

(k)(2)(iv)

Ensure that affected employees practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

..1910.146(k)(3)

(k)(3)

To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.

(k)(3)(i)

Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, above the entrant's head, or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant. Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

(k)(3)(ii)

The other end of the retrieval line shall be attached to a mecanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet (1.52 m) deep

(k)(4)

If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

..1910.146(l)

(l)

Employee participation.

(l)(1)

Employers shall consult with affected employees and their authorized representatives on the development and implementation of all aspects of the permit space program required by paragraph (c) of this section.

(l)(2)

Employers shall make available to affected employees and their authorized representatives all information required to be developed by this section.

[58 FR 4549, Jan. 14, 1993; 58 FR 34845, June 29, 1993; 59 FR 26115, May 19, 1994; 63 FR 66038, Dec. 1, 1998]

APPENDIX 2 -RUTLEDGE CREEK WWTP EQUIPMENT NUMBERS

Equipment Number	Equipment Description	Year in Service	Remarks
10-0001	Plant Grounds Old Site	1975	
10-0002	Plant Grounds New Site	2004	
10-0003	Old Plant Control Building	1975	
10-0004	New Plant Control Building	2004	
10-0005	Pump Station Building	2004	
10-0006	Degritter Pump Vault	2004	
10-0007	Septage Receiving Structure	2005	
10-0008	Sludge Transfer Station	2004	
10-0009	Polymer Feed Building	1997	
10-0010	Polymer Sludge Vault Stucture	1997	
10-0011	NPW Building	2005	
10-0012	Alkalinity Feed Building	2004	
10-0013	Headworks Structure	2004	
10-0014	Influent Distributor Structure	2004	
10-0015	Oxidation Ditch # 1 Structure	2004	
10-0016	Oxidation Ditch # 2 Structure	2004	
10-0017	WAS Vault # 1 Structure	2004	
10-0018	WAS Vault # 2 Structure	2004	
10-0019	Disc Filter Structure	2004	
10-0020	UV Channel Structure	2004	
10-0021	Post Aeration Channel	2004	
10-0022	Effluent Headwall Structure	2004	
10-0023	Mechanical Stepscreen Unit	2004	
10-0024	Bypass Bar Screen Unit	2004	
10-0025	Screenings Compactor	2004	
10-0026	Vortex Grit Separator Motor	2004	
10-0027	Grit Pump	2004	
10-0028	Grit Pump Motor	2004	
10-0029	Grit Pump Vault Sump Pump	2004	
10-0030	Grit Pump Vault Exhaust Fan	2004	
10-0031	Grit Classifier	2004	
10-0032	Wetwell Air Bubbler Pump # 1	2004	
10-0033	Wetwell Air Bubbler Pump # 2	2004	
10-0034	Influent MCC Pump Panel	2004	
10-0035	Pump # 1 Electrical VS Panel	2004	
10-0036	Pump # 2 Electrical VS Panel	2004	
10-0037	Pump # 3 Electrical VS Panel	2004	
10-0038	GR # 1 Influent Pump	2004	
10-0039	GR # 2 Influent Pump	2004	
10-0040	GR # 3 Influent Pump	2004	
10-0041	# 1 Influent Pump Motor	2004	
10-0042	# 2 Influent Pump Motor	2004	
10-0043	# 3 Influent Pump Motor	2004	
10-0044	# 1 Influent Pump Check Valve	2004	
10-0045	# 2 Influent Pump Check Valve	2004	
10-0046	# 3 Influent Pump Check Valve	2004	
10-0047	# 1 Influent Pump Gate Valve	2004	
10-0048	# 2 Influent Pump Gate Valve	2004	
10-0049	# 3 Influent Pump Gate Valve	2004	
10-0050	# 1 Influent Pump Air Relief Valve	2004	

APPENDIX 2 -RUTLEDGE CREEK WWTP EQUIPMENT NUMBERS

Equipment Number	Equipment Description	Year in Service	Remarks
10-0052	# 3 Influent Pump Air Relief Valve	2004	
10-0053	Main Influent Line 2" Air Relief Valve	2004	
10-0054	Influent Flow Meter	2004	
10-0055	Influent Distributor Actuator	2004	
10-0056	Lime Feeder	2004	
10-0057	Lime Feeder Solution Tank Mixer Motor	2004	
10-0058	Oxidation Ditch Center Wall Hydro Gate	2004	
10-0059	# 1 Oxidation Ditch Drain Valve	2004	
10-0060	# 2 Oxidation Ditch Drain Valve	2004	
10-0061	# 1 Oxidation Ditch Rotor 1	2004	
10-0062	# 1 Oxidation Ditch Rotor Motor 1	2004	
10-0063	# 1 Oxidation Ditch Rotor Gear Box 1	2004	
10-0064	# 1 Ox Ditch Rotor Elect Controls 1	2004	
10-0065	# 1 Oxidation Ditch Rotor 2	2004	# 1 Oxidation Ditch Rotor 2
10-0066	# 1 Ox Ditch Rotor Motor 2	2004	# 1 Oxidation Ditch Rotor Motor 2
10-0067	# 1 Ox Ditch Rotor Gear Box 2	2004	# 1 Oxidation Ditch Rotor Gear Box 2
10-0068	# 1 Ox Ditch Rot Ele Control 2	2004	# 1 Ox Ditch Rotor Elect. Controls 2
10-0069	# 2 Oxidation Ditch Rotor 1	2004	# 2 Oxidation Ditch Rotor 1
10-0070	# 2 Ox Ditch Rotor Motor 1	2004	# 2 Oxidation Ditch Rotor Motor 1
10-0071	# 2 Ox Ditch Rotor Gear Box 1	2004	# 2 Oxidation Ditch Rotor Gear Box 1
10-0072	# 2 Ox Ditch Rot EleControls 1	2004	# 2 Ox Ditch Rotor Elect Controls 1
10-0073	# 2 Oxidation Ditch Rotor 2	2004	# 2 Oxidation Ditch Rotor 2
10-0074	# 2 Ox Ditch Rotor Motor 2	2004	# 2 Oxidation Ditch Rotor Motor 2
10-0075	# 2 Ox Ditch Rotor Gear Box 2	2004	# 2 Oxidation Ditch Rotor Gear Box 2
10-0076	# 2 Ox Ditch Rot Ele Control 2	2004	# 2 Ox Ditch Rotor Elect Controls 2
10-0077	# 1 Oxidation Ditch Mixer	2004	# 1 Oxidation Ditch Mixer
10-0078	# 1 Ox Mixer Elect Panel	2004	# 1 Ox Mixer Elect Panel
10-0079	# 2 Oxidation Ditch Mixer	2004	# 2 Oxidation Ditch Mixer
10-0080	# 2 Ox Mixer Elect Panel	2004	# 2 Ox Mixer Elect Panel
10-0081	# 1 Ox Ditch Scum Pipe	2004	# 1 Ox Ditch Scum Pipe
10-0082	# 2 Ox Ditch Scum Pipe	2004	# 2 Ox Ditch Scum Pipe
10-0083	# 1 Ox Ditch Effluent Weir	2004	# 1 Oxidation Ditch Effluent Weir
10-0084	# 1 Ox Ditch Weir Elect Panel	2004	# 1 Ox Ditch Weir Elect Panel
10-0085	# 2 Ox Ditch Effluent Weir	2004	# 2 Oxidation Ditch Effluent Weir
10-0086	# 2 Ox Ditch Weir Elect Panel	2004	# 2 Ox Ditch Weir Elect Panel
10-0087	# 1 Ox Ditch Weir Actuator	2004	# 1 Ox Ditch Weir Actuator
10-0088	# 2 Ox Ditch Weir Actuator	2004	# 2 Ox Ditch Weir Actuator
10-0089	# 1 WAS Actuator	2004	# 1 WAS Actuator
10-0090	# 2 WAS Actuator	2004	# 2 WAS Actuator
10-0091	WAS Meter	2004	WAS Meter
10-0092	# 1 Disc Filter	2004	# 1 Disc Filter
10-0093	# 1 Disc Filter Backwash Pump	2004	# 1 Disc Filter Backwash Pump
10-0094	# 1 Disc Filter Elect Panel	2004	# 1 Disc Filter Elect Panel
10-0095	# 2 Disc Filter	Future	# 2 Disc Filter
10-0096	# 2 Disc Filter Backwash Pump	Future	# 2 Disc Filter Backwash Pump
10-0097	# 2 Disc Filter Elect Panel	Future	# 2 Disc Filter Elect Panel
10-0098	# 1 Disc Filter Drain Valve	2004	# 1 Disc Filter Drain Valve
10-0099	# 2 Disc Filter Drain Valve	2004	# 2 Disc Filter Drain Valve
10-0100	Disc Filter Structure Drain Valve	2004	Disc Filter Structure Drain Valve
10-0101	UV Lights Electrical Panel	2004	UV Lights Electrical Panel

APPENDIX 2 -RUTLEDGE CREEK WWTP EQUIPMENT NUMBERS

Equipment Number	Equipment Description	Year in Service	Remarks
10-0103	C-1 UV Bank 1 Module 2	2004	C-1 UV Bank 1 Module 2
10-0104	C-1 UV Bank 1 Module 3	2004	C-1 UV Bank 1 Module 3
10-0105	C-1 UV Bank 1 Module 4	2004	C-1 UV Bank 1 Module 4
10-0106	C-1 UV Bank 1 Module 5	2004	C-1 UV Bank 1 Module 5
10-0107	C-1 UV Bank 2 Module 1	2004	C-1 UV Bank 2 Module 1
10-0108	C-1 UV Bank 2 Module 2	2004	C-1 UV Bank 2 Module 2
10-0109	C-1 UV Bank 2 Module 3	2004	C-1 UV Bank 2 Module 3
10-0110	C-1 UV Bank 2 Module 4	2004	C-1 UV Bank 2 Module 4
10-0111	C-1 UV Bank 2 Module 5	2004	C-1 UV Bank 2 Module 5
10-0112	C-2 UV Bank 1 Module 1	Future	C-2 UV Bank 1 Module 1
10-0113	C-2 UV Bank 1 Module 2	Future	C-2 UV Bank 1 Module 2
10-0114	C-2 UV Bank 1 Module 3	Future	C-2 UV Bank 1 Module 3
10-0115	C-2 UV Bank 1 Module 4	Future	C-2 UV Bank 1 Module 4
10-0116	C-2 UV Bank 1 Module 5	Future	C-2 UV Bank 1 Module 5
10-0117	C-2 UV Bank 2 Module 1	Future	C-2 UV Bank 2 Module 1
10-0118	C-2 UV Bank 2 Module 2	Future	C-2 UV Bank 2 Module 2
10-0119	C-2 UV Bank 2 Module 3	Future	C-2 UV Bank 2 Module 3
10-0120	C-2 UV Bank 2 Module 4	Future	C-2 UV Bank 2 Module 4
10-0121	C-2 UV Bank 2 Module 5	Future	C-2 UV Bank 2 Module 5
10-0122	UV Channel Drain Valve # 1	2004	UV Channel Drain Valve # 1
10-0123	UV Channel Drain Valve # 2	2004	UV Channel Drain Valve # 2
10-0124	Effluent Flow Meter	2004	Effluent Flow Meter
10-0125	Post Aeration Structure	2004	Post Aeration Structure
10-0126	Parshall Flume	2004	Parshall Flume
10-0127	Refrigerated Sampler	2004	Refrigerated Sampler
10-0128	Sampler	2004	Sampler
10-0129	NPW Chemical Feed Pump	2004	NPW Chemical Feed Pump
10-0130	NPW Pump	2004	NPW Pump
10-0131	NPW Electrical Pump Panel	2004	NPW Electrical Pump Panel
10-0132	Generator	2004	Generator
10-0133	Generator Engine	2004	Generator Engine
10-0134	Generator Electrical Panel	2004	Generator Electrical Panel
10-0135	Transfer Station Pump	2004	Transfer Station Pump
10-0136	#1 Digester Mixer	2005	
10-0137	#1 Digest Mix Motor	2005	
10-0138	#1 Digest Decant Pump	2005	
10-0139	#1 Digest Elect. Panel	2005	
10-0140	#2 Digester Mixer	2005	
10-0141	#2 Digest Mix Motor	2005	
10-0142	#2 Digest Decant Pump	2005	
10-0143	#2 Digest Elect. Panel	2005	
10-0144	Splitter Box	1975	
10-0145	#1 Digester Blower	2005	
10-0146	#2 Digester Blower	2005	
10-0147	#1 Digester Blower Motor	2005	
10-0148	#2 Digester Blower Motor	2005	
10-0150	#2 Drying Bed	2005	
10-0151	#3 Drying Bed	2005	

APPENDIX 2 -RUTLEDGE CREEK WWTP EQUIPMENT NUMBERS

Equipment Number	Equipment Description	Year in Service	Remarks
10-0153	Polymer Feed Pump	1998	
10-0154	Polymer Room RPZ	1998	
10-0155	Polymer 1/2" Static Mixer	1998	
10-0156	Polymer Vault Static Mixer	1998	
10-0157	#1 Old Lab RPZ	1975	
10-0158	#2 Old Lab RPZ	1975	
10-0159	New Lab RPZ	2004	
10-0160	#1 Blower Elect. Panel	2005	
10-0161	#2 Blower Elect. Panel	2005	
10-0162	Intake Elect. Panel #1	2004	
10-0163	Intake Elect. Panel #2	2004	

APPENDIX 2
PIPING COLOR CODE
RUTLEDGE CREEK WWTP

Description	Color	Code
Plant Flow	Black	PF
Sanitary Sewer	Green	SAN
Force Main	Light Green	FM
Supernatant	Light Green	SN
Scum	Light Green	SCUM
Pump Suction	White	PS
Pump Discharge	White	PD
Sludge	Dark Brown	SL
Drain	Dark Brown	D
Sludge Drain	Dark Brown	SLD
Waste Activated Sludge	Orange	WAS
Digested Sludge	Red	DS
Nonpotable Water	Gray	NPW
Potable Water	Dark Blue	PW
Sodium Hypochlorite Solution	Yellow	SH
Lime Solution	Light Blue	SAN
Polymer Solution	Purple	P
Effluent Filter Backwash	Dark Brown	BW

APPENDIX 2
RUTLEDGE CREEK WWTP VALVE INDEX

Valve Number	Type	Location	Flow System	Normal Position	Remarks
10-0044	6" Check Valve	Influent Pump Station	Wastewater	-------------------	Pump #1
10-0045	6" Check Valve	Influent Pump Station	Wastewater	-------------------	Pump #2
10-0046	6" Check Valve	Influent Pump Station	Wastewater	-------------------	Pump #3
10-0047	6" Plug Valve	Influent Pump Station	Wastewater	open	Pump #1
10-0048	6" Plug Valve	Influent Pump Station	Wastewater	open	Pump #2
10-0049	6" Plug Valve	Influent Pump Station	Wastewater	open	Pump #3
10-0050	1" Air Release Valve	Influent Pump Station	Wastewater	-------------------	Pump #1
10-0051	1" Air Release Valve	Influent Pump Station	Wastewater	-------------------	Pump #2
10-0052	1" Air Release Valve	Influent Pump Station	Wastewater	-------------------	Pump #3
10-0053	2" Air Release Valve	Influent Pump Station	Wastewater	-------------------	Main Influent Line
10-0059	12" Mud Valve	Oxidation Ditch #1	Wastewater	closed	-------------------
10-0060	12" Mud Valve	Oxidation Ditch #2	Wastewater	closed	-------------------
10-0089	6" Telescoping Valve	W.A.S. Vault #1	Sludge	closed	Oxidation Ditch #1
10-0090	6" Telescoping Valve	W.A.S. Vault #1	Sludge	closed	Oxidation Ditch #2
10-0098	8" Mud Valve	Filtration	Wastewater	closed	
10-0099	8" Mud Valve	Filtration	Wastewater	closed	
10-0100	8" Mud Valve	Filtration	Wastewater	closed	
10-0122	8" Mud Valve	UV Disinfection Channel	Wastewater	closed	
10-0123	8" Mud Valve	UV Disinfection Channel	Wastewater	closed	
10-0164	Stopgate	Headworks	Wastewater	open	Mechanical Barscreen channel
10-0165	Stopgate	Headworks	Wastewater	open	Mechanical Barscreen channel
10-0166	Stopgate	Headworks	Wastewater	open	Mechanical Barscreen channel
10-0167	Stopgate	Headworks	Wastewater	closed	
10-0168	Stopgate	Headworks	Wastewater	closed	Manual Barscreen channel
10-0169	Stopgate	Headworks	Wastewater	closed	Manual Barscreen channel
10-0170	Stopgate	Headworks	Wastewater	closed	
10-0171	Stopgate	Headworks	Wastewater	open	isolates the vortex grit unit
10-0172	Stopgate	Headworks	Wastewater	open	prevents flow to wetwell
10-0173	4" Plug Valve	Grit Pump Vault	Grit	open	isolates grit flow from grit pump vault
10-0174	2" Solenoid Valve	Grit Pump Vault	Non-Potable Water	varies	
10-0175	6" Plug Valve	Influent Pump Station	Wastewater	closed	
10-0058	Sluice Gate	Oxidation Ditch	Wastewater	open	
10-0081	12" Rotating Scum Pipe	Oxidation Ditch	Sludge	varies	Oxidation Ditch #1
10-0082	12" Rotating Scum Pipe	Oxidation Ditch	Sludge	varies	Oxidation Ditch #2
10-0083	Effluent Weir	Oxidation Ditch	Wastewater	varies	Oxidation Ditch #1

APPENDIX 2
RUTLEDGE CREEK WWTP VALVE INDEX

Valve Number	Type	Location	Flow System	Normal Position	Remarks
10-0085	Effluent Weir	Oxidation Ditch	Wastewater	varies	Oxidation Ditch #2
10-0181	4" Plug Valve	W.A.S. Vault #2	Sludge	open	close to isolate MAG meter
10-0182	4" Plug Valve	W.A.S. Vault #2	Sludge	open	close to isolate MAG meter
10-0183	Stopgate	Filtration	Wastewater	open	
10-0184	Stopgate	Filtration	Wastewater	closed	for future filter
10-0185	Adjustable Weir	Filtration	Wastewater	open	weir height is adjustable
10-0186	Stopgate	UV Disinfection Channel	Wastewater	open	close to isolate channel 1
10-0187	Stopgate	UV Disinfection Channel	Wastewater	closed	close to isolate channel 2
10-0188	6" Plug Valve	Aerobic Digester #1	Sludge	open	
10-0189	6" Plug Valve	Aerobic Digester #2	Sludge	open	
10-0190	6" Butterfly Valve	Aerobic Digester #1	Sludge	open	
10-0191	6" Butterfly Valve	Aerobic Digester #2	Sludge	open	
10-0192	4" Butterfly Valve	Digester Basin Blowers	Air	varies	isolates blower #1when closed
10-0193	4" Butterfly Valve	Digester Basin Blowers	Air	varies	isolates blower #2 when closed
10-0194	4" Check Valve	Digester Basin Blowers	Air	-------------------	Blower #1
10-0195	4" Check Valve	Digester Basin Blowers	Air	-------------------	Blower #2
10-0196	4" Plug Valve	Septage Receiving Station	Sludge	closed	valve is open for receiving
10-0197	6" Plug Valve	Sludge Transfer Station	Sludge	closed	open valve for drainage to Aerobic Digester #2
10-0198	6" Plug Valve	Sludge Drying Beds	Sludge	open	close to isolate existing drying beds
10-0199	6" Plug Valve	Sludge Drying Beds	Sludge	open	close to isolate new drying beds
10-0200	Sheargate	Sludge Drying Beds	Sludge	open	Existing Sludge Drying Bed
10-0201	Stopgate	Sludge Drying Beds	Sludge	varies	Existing Sludge Drying Bed
10-0202	Stopgate	Sludge Drying Beds	Sludge	varies	Existing Sludge Drying Bed
10-0203	Stopgate	Sludge Drying Beds	Sludge	varies	Existing Sludge Drying Bed
10-0204	Stopgate	Sludge Drying Beds	Sludge	varies	Existing Sludge Drying Bed
10-0205	Sheargate	Sludge Drying Beds	Sludge	open	New Sludge Drying Bed
10-0206	Stopgate	Sludge Drying Beds	Sludge	varies	New Sludge Drying Bed
10-0207	Stopgate	Sludge Drying Beds	Sludge	varies	New Sludge Drying Bed
10-0208	Stopgate	Sludge Drying Beds	Sludge	varies	New Sludge Drying Bed
10-0209	Stopgate	Sludge Drying Beds	Sludge	varies	New Sludge Drying Bed
10-0210	Stopgate	Splitter Box	Sludge	open	Aerobic Digester #1
10-0211	Stopgate	Splitter Box	Sludge	open	Aerobic Digester #2

Equipment	Manufacturer	Representative
Effluent Filter	US Filter 1901 S. Prairie Avenue Waukesha, WI 53189 (262)547-0141	Heyward 10146 W. Broad Street Glen Allen, VA 23060 (804)965-0086
Aerobic Digester Blowers	Huber Technology 582 Glenridge Drive Atlanta, GA 30328 (404) 250-3582	Combs & Associates 10191 Durhams Ferry Place Mechanicsville, VA 23116 (804)559-4259
Automatic Transfer Switch	G.E. Zenith Controls 830 West 40th Street Chicago, IL (773) 299-6600	Carter Manufacturing Co. 971 Russell Drive Salem, Va 24153 (540) 562-5133
HVAC System	Trane 10408 Lakeridge Pway Suite 100 Ashland, Va 23005 (804) 747-3588	Design Equipment Co., Inc. 303 Ashcake Rd., Suite G Ashland, VA 23005 (804) 752-2720
Parshall Flume	Plasti-Fab (888)446-5377	Johnston, Inc. 132 Corporate Blvd. P.O. Box 580 Indian Trail, NC 28079 (800)947-0852
Bubbler Flow Meter	Isco, Inc. P.O. Box 82531 Lincoln, NE 68501 (800)228-4373	Johnston, Inc. 132 Corporate Blvd P.O. Box 580 Indian Trail, NC 28079 (800)947-0852

Equipment	Manufacturer	Representative
Battery Backed Power Packs	Isco, Inc. P.O. Box 82531 Lincoln, NE 68501 (800)228-4373	Johnston, Inc. 132 Corporate Blvd. P.O. Box 580 Indian Trail, NC 28079 (800)947-0852
Refridgerated Composite Sampler	Isco, Inc. P.O. Box 82531 Lincoln, NE 68501 (800)228-4373	Johnston, Inc. 132 Corporate Blvd. P.O. Box 580 Indian Trail, NC 28079 (800)947-0852
Multi - Parameter Water Quality Monitor	YSI 1700/1725 Brannum Lane Yellow Springs, Ohio 45387 (800)765-4974	Johnston, Inc. 132 Corporate Blvd. P.O. Box 580 Indian Trail, NC 28079 (800)947-0852
Sluice Gates	Waterman P.O. Box 458 Exeter, California 93221 (559)562-4000	
Limitorque Actuation System	Limitorque 5114 Woodall Rd. P.O. Box 11318 Lynchburg, VA 24506 (434)528-4400	
Diesel Generator	Caterpillar 100 N.E. Adams Street Peoria, Illinois 616219 (309)675-1000	Carter Machinery Co. 10990 Air Park Road Ashland, Va 23005 (804)752-6070

Equipment	Manufacturer	Representative
Grit Pump	Wemco P.O. Box 209 440 West 800 South Salt Lake City, UT 84101 (801)359-8731	Emory Wilson 4110 Sheraton Court Greensboro, NC 27418 (800)948-1033
Centrifugal Pump Control	Gould Pumps 1 Gould Drive Auburn, NY 13021 (315)568-7100	Syndor Hydro P.O. Box 27186 Richmond, Va 23223 (800)552-7714
Oxidation Ditch Equipment	U.S. Filter 1901 S. Prairie Avenue Waukesha, WI 53189 (262)547-0141	Heyward 10146 W. Broad St. Glen Allen, VA 23060 (804) 965-0086
Submersible Solids Handling Pumps	Fairbanks Morse 3601 Fairbanks Avenue Kansas City, KS 66106 (913)371-5000	Syndor Hydro P.O. Box 27186 Richmond, Va 23223 (800)552-7714
Wemco Torque Flow Pumps	Wemco Pump 440 West 800 South Salt Lake City, UT 84101 (801)359-8731	Emory Wilson 4110 Sheraton Drive Greensboro, NC 27410 (336)854-0603
NPW Disinfection Equipment	Idex Corporation 27101 Airport Road Punta Gorda, Florida 33982 (800)333-6677	

Equipment	Manufacturer	Representative
Hydrated Lime Feed System	Acrison, Inc. 20 Empire Blvd Moonachie, NJ 07074 (201)440-8300	Combs & Associates 10191 Durhams Ferry Place Mechanicsville, VA 23116 (804)559-4259
Magnetic Flow Transmitter	Isco. Inc. P.O. Box 82531 Lincoln, NE 68501 (800)228-4373	Johnston, Inc. 132 Corporate Blvd. P.O. Box 580 Indian Trail, NC 28079 (800)947-0852
Submersible Pumps	ITT Flygt Corporation 2330 Yellow Springs Road Malvern, PA 19355 (610)647-1617	Sherwood Logan & Associates 1811 Hugenot Road, Suite 304 Midlothian, VA 23113 (804)897-1361
Portable Pump	Godwin Pumps of America, Inc. One Floodgate Road Bridgeport, NJ 08014 (800)563-1093	Russ Waymack (804)266-3614
Dissolved Oxygen Meter	Danfoss Water & Wastewater Design 8800 W. Bradley Road Milwaukee, WI 53224 (414)355-8800	
UV Disinfection	ONDEO Degremont P.O. Box 71390 Richmond, VA 23255 (804)756-7600	

Equipment	Manufacturer	Representative
Horizontal Open Channel UV System	Infilco Degremont Inc. P.O. Box 71390 Richmond, VA 23255 (804)756-7600	
Influent Pump Station	The Gorman Rupp P.O. Box 1217 Mansfield, OHIO 44901 (419)755-1011	Emory & Wilson 4110 Sheraton Court Greensboro, NC 27410 (336)854-0603
Magnetic Flowmeters	Isco Inc. P.O. Box 82531 Lincoln, NE 68501	Johnston, Inc.. 132 Corporate Blvd. P.O. Box 580 Indian Trail, NC 28079 (800)947-0852
Telescoping Valve & Electric Motor Oper.	Waterman Industries 25500 Road 204 Exeter, CA 93221 (559)562-4000	
Static Mixer	Westfall Manufacturing Co. 381 Metacom Av. P.O. Box 7 Bristol, Rhode Island 02809 (401)253-3799	PNUCOR Process Engineers William Toney (704)588-3333
NPW Pumps & Controls	Gould's Pumps 1 Gould's Drive Auburn, NY 13021 (315)568-7100	Syndor Hydro P.O. Box 27186 Richmond, VA 23223 (800)552-7714

Equipment	Manufacturer	Representative
Hoist & Trolley	Yale Liftch Hoist 1334 Thornton Ave SW Pacific, WA 98047 (800)304-6661	RDE System 986 Winzig Lane Lebanon, OHIO 45306

APPENDIX 4
DETAILED DESIGN CRITERIA
RUTLEDGE CREEK WWTP

1. Oxidation Ditch
   a. Influent Flow
      (1) Average Design .... 0.6 mgd
      (2) Peak Design .... 1.2 mgd
   b. BOD_5
      (1) Influent .... 140 mg/l
      (2) Effluent .... 7.4 mg/l
   c. Total Suspended Solids
      (1) Influent .... 170 mg/l
      (2) Effluent .... 30 mg/l
   d. TKN
      (1) Influent .... 40 mg/L
   e. Ammonia Nitrogen
      (1) Effluent (Dec. – May) .... 31.5 mg/l
      (2) Effluent (June – Nov.) .... 14.3 mg/l
   f. Temperature
      (1) Influent, minimum .... 10 ^oC mg/l
      (2) Influent, maximum .... 25 ^oC mg/l
   g. Dissolved Oxygen
      (1) Effluent .... 25 ^oC mg/l

2. Mechanical Screen
   a. Type .... Mechanical Step Screen w/Manual Bar Screen Backup
   b. Fine Mesh Opening .... ¼-inch
   c. Channel Depth .... 4 ft
   d. Screenings Wash Press Motor .... 4 HP
   e. Manual Bar Screen Openings 1-½-inch

3. Grit Removal
   a. Type .... Vortex Grit Removal w/Grit Pump and Classifier
   b. Grit Pump .... 7.5 HP
   c. Grit Classifier .... 1.5 HP

DETAILED DESIGN CRITERIA

4. Influent Pump Station
   a. Type .... Centrifugal Suction Lift w/Variable Speed Drives
   b. Quantity 3
   c. Design Capacity .... 860 gpm at 88 TDH
   d. Pump Speed .... 1,050 RPM
   e. Motor Drive System .... 40 HP
   f. Wetwell Diameter .... 10 ft
   g. Wetwell Depth .... 12 ft

5. Oxidation Ditch
   a. Type .... Kruger Double Ditch w/Influent Distributor
   b. Number of Basins 2
   c. Total Ditch Volume .... 600,000 gal.
   d. Total Hydraulic Retention Time .... 24 hours
   e. Design MLSS 4,000 mg/L
   f. MLVSS/MLSS 70
   g. Sludge Retention Time, Total (SRT) .... 16 days
   h. Sludge Retention Time, Oxic (SRT) .... 12 days
   i. Waste Sludge, WAS .... 650 lbs/day
   j. Total F/M .... 0.05 lbs/lbs/lbs
   k. Dissolved Oxygen .... 1.0 mg/l
   l. Inside Ditch Length .... 100 ft
   m. Ditch Width per Ditch .... 29 ft
   n. Channel Width .... 14 ft
   o. Side Water Depth .... 15 ft
   p. Mixer Motors .... 2 x 6 HP
   q. Rotor Motors .... 2 x 15 HP
   r. Effluent Weirs .... 2 x Motor Actuated

7. Effluent Filtration
   a. Type .... Kruger Disk Filter

8. UV Disinfection
   a. Number of UV Banks 2
   b. Number of Channels .... 1 (expands to 2)
   c. Peak Flow Capacity .... 1.8 mgd

DETAILED DESIGN CRITERIA

9. Post Aeration
   a. Type .... Cascade Aerator
   b. Number of Steps 12
   c. Height of Steps .... 9 in

10. Effluent Metering
   a. Type .... Parshall Flume
   b. Throat Width .... 6 in
   c. Head at 0.6 mgd .... 0.2 ft
   d. Head at 1.8 mgd .... 0.6 ft

11. Aerobic Digesters
   a. Type .... Truncated Pyramid
   b. Number of Basins 2
   c. Basin Volume .... 219,000 gal/tank
   d. Blowers .... 20 HP
   e. Open Tank Agitator .... 25 HP
   f. Supernatant Transfer Pumps .... 3 HP

12. Septage Station
   a. Type .... Manual Bar Screen
   b. Screen Openings .... 1 in

13. Sludge Drying Beds
   a. Type .... Sand Filled w/Underdrain
   b. Width x Length .... 22’ x 22’
   c. Total Drying Beds 8

13. Non-Potable Water System
   a. Pump Type .... Non-Clog Submersible
   b. Pump Quantity 1
   c. Primary Design Condition .... 90 gpm at 140 feet TDH
   d. Secondary Design Condition .... 60 gpm at 220 TDH
   e. Motor Drive System .... 5 HP @ 3450 RPM
   f. Diaphragm Tank Capacity .... 115.9 gallon

DETAILED DESIGN CRITERIA

14. Chemical Feed System
    a. Lime Dissolving Tank .... 50 gal
    b. Lime Mixing Motor .... 900 RPM
    c. NPW Chemical Feed Pump .... 44 gpd @ 100 psi

APPENDIX 5
LIST OF RECORD DRAWINGS
RUTLEDGE CREEK WWTP

SHEET NO.	DWG. NO.	DISCIPLINE	TITLE
1 of 17	C-1	CIVIL	DEMOLITION AND EROSION CONTROL PLAN
2 of 17	C-2	CIVIL	DEMOLITION AND EROSION CONTROL PLAN
3 of 17	C-3	CIVIL	DEMOLITION AND EROSION CONTROL PLAN
4 of 17	C-4	CIVIL	SITE UTILITY AND DIMENSION PLAN
5 of 17	C-5	CIVIL	WWTP SITE UTILITY AND DIMENSION PLAN
6 of 17	C-6	CIVIL	WWTP SITE UTILITY AND DIMENSION PLAN
7 of 17	C-7	CIVIL	GRADING PLAN
8 of 17	C-8	CIVIL	WWTP GRADING PLAN
9 of 17	C-9	CIVIL	WWTP GRADING PLAN
10 of 17	C-10	CIVIL	EROSION CONTROL DETAILS
11 of 17	C-11	CIVIL	MISCELLANEOUS DETAILS
12 of 17	C-12	CIVIL	MISCELLANEOUS DETAILS
13 of 17	C-13	CIVIL	NOTES & DETAILS
14 of 17	C-14	CIVIL	PROFILES
15 of 17	C-15	CIVIL	WWTP PROFILES
16 of 17	C-16	CIVIL	WWTP PROFILES
17 of 17	C-17	CIVIL	WWTP PROFILES
1 of 20	M-1	MECHANICAL	PROCESS FLOW DIAGRAM AND HYDRAULIC PROFILE
2 of 20	M-2	MECHANICAL	TYPICAL DETAIL SHEET
3 OF 20	M-3	MECHANICAL	HEADWORKS PLAN AND SECTION
4 of 20	M-4	MECHANICAL	HEADWORKS SECTION
5 of 20	M-5	MECHANICAL	GRIT PUMP VAULT
6 of 20	M-6	MECHANICAL	PUMP STATION PLAN
7 of 20	M-7	MECHANICAL	PUMP STATION SECTIONS
7a of 20	M-7A	MECHANICAL	ALKALINITY FEED BUILDING

SHEET NO.	DWG. NO.	DISCIPLINE	TITLE
8 of 20	M-8	MECHANICAL	PHASED OXIDATION DITCH-PLAN
9 of 20	M-9	MECHANICAL	PHASED OXIDATION DITCH - SECTIONS
10 of 20	M-10	MECHANICAL	PHASED OXIDATION DITCH-INFLUENT DISTRIBUTION BOX, W.A.S.VAULTS 1 & 2
11 of 20	M-11	MECHANICAL	PHASED OXIDATION DITCH-EFFLUENT WEIR & MISCELLANEOUS DETAILS
12 of 20	M-12	MECHANICAL	FILTRATION PLAN AND SECTIONS
13 of 20	M-13	MECHANICAL	UV DISINFECTION PLAN & SECTION
13A of 20	M-13A	MECHANICAL	NON-POTABLE WATER DISINFECTION SYSTEM
14 of 20	M-14	MECHANICAL	FLOW MONITORING & POST AERATION
15 of 20	M-15	MECHANICAL	AEROBIC DIGESTER MODIFICATIONS EXISTING CONDITIONS AND DEMOLITION PLAN
16 of 20	M-16	MECHANICAL	AEROBIC DIGESTER MODIFICATIONS PROPOSED PIPING AND EQUIPMENT LAYOUT
17 of 20	M-17	MECHANICAL	SEPTAGE RECEIVING STATION AND SLUDGE TRANSFER STATION
18 of 20	M-18	MECHANICAL	SLUDGE DRYING BEDS
19 of 20	M-19	MECHANICAL	LAB / CONTROL BUILDING PLUMBING PLAN
20 of 20	M-20	MECHANICAL	LAB / CONTROL BUILDING HVAC PLAN
20A of 20	M-20A	MECHANICAL	NPW BUILDING & ALKALINITY FEED BUILDING HVAC PLAN
1 of 17	S-1	STRUCTURAL	TYPICAL STRUCTURAL DETAILS AND NOTES
2 of 17	S-2	STRUCTURAL	TYPICAL STRUCTURAL DETAILS
3 of 17	S-3	STRUCTURAL	HEADWORKS - PLAN & SECTION
4 of 17	S-4	STRUCTURAL	HEADWORKS - SECTIONS & DETAILS
5 of 17	S-5	STRUCTURAL	PUMP STATION FOUNDATION & ROOF FRAMING PLAN
6 of 17	S-6	STRUCTURAL	PUMP STATION - DETAILS
7 of 17	S-7	STRUCTURAL	PUMP STATION - SECTIONS & NOTES
8 of 17	S-8	STRUCTURAL	PUMP STATION - SECTIONS & DETAILS
9 of 17	S-9	STRUCTURAL	LAB / CONTROL BUILDING - FLOOR PLAN, ELEVATIONS SECTIONS & DETAILS
9A of 17	S-9A	STRUCTURAL	LAB / CONTROL BUILDING - FLOOR PLAN, ELEVATIONS SECTIONS & DETAILS
10 of 17	S-10	STRUCTURAL	LAB / CONTROL BUILDING - FOUNDATION & ROOF FRAMING PLANS

SHEET NO.	DWG. NO.	DISCIPLINE	TITLE
10A of 17	S-10A	STRUCTURAL	ALKALINITY FEED BUILDING
11 of 17	S-11	STRUCTURAL	OXIDATION DITCH - FOUNDATION PLAN
12 of 17	S-12	STRUCTURAL	OXIDATION DITCH - PLAN AT TOP
13 of 17	S-13	STRUCTURAL	OXIDATION DITCH - REINFORCING SCHEDULE, SECTIONS & DETAILS
14 of 17	S-14	STRUCTURAL	U.V. CHANNEL & DISC FILTER UNIT PLANS AND SECTIONS
15 of 17	S-15	STRUCTURAL	PARSHALL FLUME / STEP AERATOR PLANS, SECTIONS & DETAILS
15A of 17	S-15A	STRUCTURAL	SEPTAGE RECEIVING STATION AND SLUDGE TRANSFER STATION
16 of 17	S-16	STRUCTURAL	SLUDGE DRYING BEDS - STRUCTURE
17 of 17	S-17	STRUCTURAL	SLUDGE DRYING BEDS - DETAILS
1 of 13	E-1	ELECTRICAL	ELECTRICAL - SITE PLAN
2 of 13	E-2	ELECTRICAL	ONE LINE DIAGRAM - ELECTRICAL
3 of 13	E-3	ELECTRICAL	LAB / CONTROL BUILDING - POWER AND LIGHTING PLAN
4 of 13	E-4	ELECTRICAL	OXIDATION DITCH - ELECTRICAL
5 of 13	E-5	ELECTRICAL	CONTROL WIRING DIAGRAMS
6 of 13	E-6	ELECTRICAL	FILTER AND UV DISINFECTION, EFFLUENT FLOW METER, AND WAS VAULT 2 - ELECTRICAL
7 of 13	E-7	ELECTRICAL	HEADWORKS PLAN - ELECTRICAL
8 of 13	E-8	ELECTRICAL	INFLUENT PUMP STATION PLAN - ELECTRICAL
9 of 13	E-9	ELECTRICAL	AEROBIC DIGESTER - ELECTRICAL
10 of 13	E-10	ELECTRICAL	ELECTRICAL DETAILS
11 of 13	E-11	ELECTRICAL	ELECTRICAL SCHEDULES AND DETAILS
12 of 13	E-12	ELECTRICAL	NPW BUILDING - ELECTRICAL
13 of 13	E-13	ELECTRICAL	ALKALINITY FEED BUILDING - ELECTRICAL

VIRGINIA BOARD FOR WATERWORKS AND WASTEWATER WORKS OPERATORS REGULATIONS

PART I

GENERAL.

18 VAC 160-20-10. Definitions.

The following words and terms when used in this chapter shall have the following meanings, unless the context clearly indicates otherwise:

"Board" means the Board for Waterworks and Wastewater Works Operators.

"Category" means the two divisions of waterworks and wastewater works operators' licenses, one being waterworks and the second being wastewater works.

"Classification" means the divisions of each category of waterworks and wastewater works operators' licenses into classes where Class "I" represents the highest classification.

"Contact hour" means 50 minutes of participation in a structured training activity.

"Continuing Professional Education (CPE)" means participation in a structured training activity that enables a licensed waterworks operator to maintain and increase the competence required to assure the public's protection.

"Department" means the Virginia Department of Professional and Occupational Regulation.

"Experience" means time spent learning how to physically and theoretically operate the waterworks or wastewater works as an operator-in-training or time spent operating a waterworks or wastewater works for which the operator is currently licensed.

"Licensed operator" means an operator with a license in the category and with a classification equal to or higher than the classification of the waterworks or wastewater works being operated.

"Licensee" means an individual holding a valid license issued by the board.

"Licensure" means a method of regulation whereby the Commonwealth, through the issuance of a license, authorizes a person possessing the character and minimum skills to engage in the practice of a profession or occupation that is unlawful to practice without a license.

"Operate" means any act of an individual, which may impact on the finished water quality at a waterworks or the plant effluent at a wastewater works.

"Operating staff" means individuals employed or appointed by an owner to work at a waterworks or wastewater works.

"Operator" means any individual employed or appointed by any owner, and who is designated by such owner to be the person in responsible charge, such as a supervisor, a shift operator, or a substitute in charge, and whose duties include testing or evaluation to control waterworks or wastewater works operations. Not included in this definition are superintendents or directors of public works, city engineers, or other municipal or industrial officials whose duties do not include the actual operation or direct supervision of waterworks or wastewater works.

"Operator-in-training" means an individual employed by an owner to work under the direct supervision and direction of an operator holding a valid license in the proper category and classification for the purpose of gaining experience and knowledge in the duties and responsibilities of an operator of a waterworks or wastewater works. An operator-in-training is not an operator.

"Owner" means the Commonwealth of Virginia, or any political subdivision thereof, any public or private institution, corporation, association, or any other entity organized or existing under the laws of this Commonwealth or of any other state or nation, or any person or group of persons acting individually or as a group, who own, manage, or maintain waterworks or wastewater works.

"Renewal" means continuing the effectiveness of a license for another period of time.

"Responsible charge" means the designation by the owner of any individual to have the duty and the authority to operate a waterworks or wastewater works.

"Structured training activity" means a formal educational process designed to permit a participant to learn a given subject or subjects through interaction with an instructor in a course, seminar, conference or other performance-oriented format.

"Wastewater works" means a system of (i) sewerage systems or sewage treatment works serving more than 400 persons, as set forth in § 62.1-44.18 of the Code of Virginia; (ii) sewerage systems or sewage treatment works serving fewer than 400 persons, as set forth in § 62.1-44.18 of the Code of Virginia, if so certified by the State Water Control Board; and (iii) facilities for discharge into state waters of industrial wastes or other wastes, if certified by the State Water Control Board.

"Waterworks" means a system that serves piped water for drinking or domestic use to (i) at least 15 connections or (ii) at least 25 of the same individuals for more than six months out of the year. The term waterworks shall include all structures, equipment, and appurtenances used in the storage, collection, purification, treatment and distribution of pure water, except the piping and fixtures inside the building where such water is delivered.

PART II.

LICENSE REQUIREMENTS.

18 VAC 160-20-74. License required.

To serve as an operator of a waterworks or wastewater works, it shall be necessary to hold a valid license issued by the board for a classification equal to or greater than the classification of the waterworks or wastewater works to be operated and in the appropriate category. Issuance of a new classification of license shall void all previously issued licenses in the same category. No licensee shall hold two licenses of different classifications in the same category. The board shall issue a license only after an individual has met all experience and examination requirements as set forth in this chapter.

18 VAC 160-20-76. Application.

A. Individuals desiring to be issued a license shall apply on forms supplied by the board. The application shall be completed according to the instructions provided with the application. Incomplete applications will be returned to the applicant. Fees shall remain valid for 90 days and shall not be refunded.

B. Individual applicants shall be at least 18 years of age.

C. The applicant shall disclose the following information about himself:

1. Any conviction by a court in any jurisdiction of any felony or of any misdemeanor involving lying, cheating or stealing, or of any misrepresentation while engaged in waterworks or wastewater works activities. Any plea of nolo contendere shall be considered a conviction for purposes of this subsection. A certified copy of a final order, decree or case decision by a court or regulatory agency with the lawful authority to issue such order, decree or case decision shall be prima facia evidence of such conviction or discipline.

2. Any disciplinary action taken by the board or another jurisdiction in connection with the applicant's activities as a waterworks or wastewater works operator, including but not limited to, monetary penalties, fines, suspension, revocation, or surrender of a license in connection with a disciplinary action.

3. His physical address. A post office box shall not be accepted in lieu of a physical address.

D. The fee established by 18 VAC 160-20-102 shall accompany the application and shall not be refunded.

E. The receipt of an application and the deposit of fees in no way indicates approval of the application by the board.

18 VAC 160-20-80. Individuals certified or licensed in other jurisdictions.

Any applicant holding a valid license or certificate in another jurisdiction who meets the requirements of this chapter, including experience and education, may take the examination in the Virginia category and classification comparable to the license or certificate held in the other jurisdiction.

18 VAC 160-20-85. Restricted License of Class VI Waterworks.

A. The board shall issue a restricted license to operate a Class VI waterworks to the Class VI waterworks owner or the Class VI waterworks owner's designee upon application for such restricted license by the waterworks owner or his designee and provided said application is received by February 15, 2003. Waterworks owners or their designees who fail to apply by February 15, 2003, must apply for a license pursuant to 18 VAC 160-20-90. A restricted license shall be limited to one license per Class VI waterworks facility. The restricted license is site specific and nontransferable. The restricted license expires three years from the date of issuance and is not subject to renewal.

B. Each applicant for a restricted license to operate a Class VI waterworks shall apply on the application form provided by the board which establishes that the applicant:

1. Is at least 18 years of age;

2. Has a high school diploma or G.E.D. and six months experience, or has no high school diploma or G.E.D. and has 12 months experience;

3. Is the current operator of a specific Class VI system and does not hold a waterworks license issued by the board; and

4. Understands that the restricted Class VI license that may be issued becomes invalid if he leaves the facility for which the license is sought or is issued a waterworks operator license in any other class.

18 VAC 160-20-90. Licensure by experience and examination.

Licensure is based upon having applicable experience and demonstrating minimum required knowledge, skills and abilities through an examination. Education, training, and experience in the other category may be substituted for the required experience as specified in this section.

A. Experience. For purposes of this chapter, experience requirements are expressed in terms of calendar periods of full-time employment as an operator or as an operator-in-training at a waterworks or wastewater works in the same category as the license being applied for. All experience claimed on the application for licensure must be certified by the individual's immediate supervisor.

1. A year of full-time employment is defined as a minimum of 1,760 hours during a 12-month period or a minimum of 220 workdays in a 12-month period. A workday is defined as attendance at a waterworks or wastewater works to the extent required for proper operation. More than 1,760 hours or 220 work days during a 12-month period will not be considered as more than one year of full-time employment.

2. Experience gained as an operator-in-training must be obtained under the supervision of an operator holding a valid license of the same category and of a classification equal to or higher than the classification of the waterworks or wastewater works at which the experience is gained. The supervising operator shall certify the experience on the application form as accurate and relevant to the classification and category of license for which the application is being submitted.

3. Partial credit may be given for actual hours of work or workdays experience if the applicant works as an operator or as an operator-in-training less than full time.

4. Experience solely limited to the operation and maintenance of wastewater collection systems and water distribution systems, laboratory work, plant maintenance, and other nonoperating duties shall not be counted as experience as an operator or as an operator-in-training.

5. Experience limited to water distribution system operation and maintenance shall be considered only when applying for a Class V or Class VI waterworks operator license.

B. Specific requirements for licenses.

1. Specific requirements for a Class VI license. Applicants for licensure as a Class VI waterworks operator shall meet one of the following requirements and pass a board-approved examination:

   a. Have (i) a high school diploma or GED and (ii) at least six months of experience as an operator-in-training in a Class VI, Class V, Class IV, Class III, Class II, or Class I waterworks; or

   b. Have (i) no high school diploma and (ii) at least one year of experience as an operator-in-training in a Class VI, Class V, Class IV, Class III, Class II, or Class I waterworks.

2. Specific requirements for a Class V license. Applicants for licensure as a Class V waterworks operator shall meet one of the following requirements and pass a board-approved examination:

   a. Have (i) a high school diploma or GED and (ii) at least six months of experience as an operator-in-training in a Class V, Class IV, Class III, Class II, or Class I waterworks; or

   b. Have (i) no high school diploma and (ii) at least one year of experience as an operator-in-training in a Class V, Class IV, Class III, Class II, or Class I waterworks.

3. Specific requirements for a Class IV license. Applicants for licensure as either a Class IV waterworks or wastewater works operator shall meet one of the following requirements and pass a board-approved examination:

   a. Have (i) a high school diploma or GED and (ii) at least six months of experience as an operator-in-training in a Class IV, Class III, Class II, or Class I waterworks or wastewater works (as appropriate); or

   b. Have (i) no high school diploma and (ii) at least one year of experience as an operator-in-training in a Class IV, Class III, Class II, or Class I waterworks or wastewater works (as appropriate).

4. Specific requirements for a Class III license. Applicants for licensure as either a Class III waterworks or wastewater works operator shall meet one of the following requirements and pass a board-approved examination:

   a. Have (i) a bachelor's degree in engineering or engineering technology, or in physical, biological or chemical science; and (ii) at least one year of experience as an operator-in-training in a Class IV, Class III, Class II, or Class I waterworks or wastewater works (as appropriate); or

   b. Have (i) a bachelor's degree in engineering or engineering technology, or in physical, biological or chemical science; (ii) a Class IV license; and (iii) a total of at least one year of experience as an operator or operator-in-training in a Class IV waterworks or wastewater works (as appropriate) or as an operator-in-training in a Class III, Class II, or Class I waterworks or wastewater works (as appropriate); or

   c. Have (i) a high school diploma or GED and (ii) at least two years of experience as an operator-in-training in a Class IV, Class III, Class II, or Class I waterworks or wastewater works (as appropriate); or

   d. Have (i) a high school diploma or GED, (ii) a Class IV license, and (iii) a total of at least two years of experience as an operator or operator-in-training in a Class IV waterworks or wastewater works (as appropriate) or as an operator-in-training in a Class III, Class II, or Class I waterworks or wastewater works (as appropriate); or

e. Have (i) no high school diploma, (ii) a Class IV license, and (iii) a total of at least four years of experience as an operator or operator-in-training in a Class IV waterworks or wastewater works (as appropriate) or as an operator-in-training n a Class III, Class II, or Class I waterworks or wastewater works (as appropriate).

5. Specific requirements for a Class II license. Applicants for licensure as either a Class II waterworks or wastewater works operator shall meet one of the following requirements and pass a board-approved examination:

   a. Have (i) a bachelor's degree in engineering or engineering technology, or in physical, biological or chemical science; and (ii) a total of at least 1-1/2 years of experience, of which at least six months without substitutions shall be as an operator-in-training in a Class III, Class II or Class I waterworks or wastewater works (as appropriate); or

   b. Have (i) a bachelor's degree in engineering or engineering technology, or in physical, biological or chemical science; (ii) a Class IV license; and (iii) a total of at least 1-1/2 years of experience, of which at least six months without substitutions shall be as an operator-in-training in a Class III, Class II or Class I waterworks or wastewater works (as appropriate); or

   c. Have (i) a bachelor's degree in engineering or engineering technology, or in physical, biological or chemical science; (ii) a Class III license; and (iii) a total of at least 1-1/2 years of experience, of which at least six months, without substitutions shall be as an operator or operator-in-training in a Class III waterworks or wastewater works (as appropriate) or as an operator-in-training in a Class II or Class I waterworks or wastewater works (as appropriate); or

   d. Have (i) a high school diploma or GED, (ii) a Class III license, and (iii) a total of at least four years of experience of which at least two years without substitutions shall be as an operator or operator-in-training in a Class III waterworks or wastewater works (as appropriate) or as an operator-in-training in a Class II or Class I waterworks or wastewater works (as appropriate); or

   e. Have (i) no high school diploma, (ii) a Class III license, and (iii) a total of at least seven years of experience of which at least three years without substitutions shall be as an operator or operator-in-training in a Class III waterworks or wastewater works (as appropriate) or as an operator-in-training in a Class II or Class I waterworks or wastewater works (as appropriate).

6. Specific requirements for a Class I license. Applicants for licensure as either a Class I waterworks or wastewater works operator shall meet one of the following requirements and pass a board-approved examination:

a. Have (i) a bachelor's degree in engineering or engineering technology, or in physical, biological or chemical science; (ii) a Class II license; and (iii) a total of at least 2-1/2 years of experience, of which at least one year without substitutions shall be as an operator or operator-in-training in a Class II waterworks or wastewater works (as appropriate) or as an operator-in-training in a Class I waterworks or wastewater works (as appropriate); or

b. Have (i) a high school diploma or GED, (ii) a Class II license and (iii) a total of at least six years of experience of which at least two years without substitutions shall be as an operator or operator-in-training in a Class II waterworks or wastewater works (as appropriate) or as an operator-in-training in a Class I waterworks or wastewater works (as appropriate); or

c. Have (i) no high school diploma, (ii) a Class II license, and (iii) a total of at least 10 years of experience of which at least three years without substitutions shall be as an operator or operator-in-training in a Class II waterworks or wastewater works (as appropriate) or as an operator-in-training in a Class I waterworks or wastewater works (as appropriate).

C. Substitutions for required experience. For the purpose of meeting the experience requirements for Class III, Class II, and Class I licenses, experience in the other category, relevant training in waterworks and wastewater works operation, and formal education may be substituted for actual hands-on experience in the category being applied for.

1. Category experience substitution. One half of the actual experience gained in the other category may be substituted for required experience in the category of the license being applied for.

2. Education substitution. Education may be substituted for part of the required experience in the category of the license being applied for, subject to the following limitations:

a. Education used to meet the educational requirements for any class of license may not be substituted for experience.

b. Formal education courses at a post-secondary level in physical, biological or chemical science; engineering or engineering technology; waterworks or wastewater works operation; or public health may be substituted for part of the required experience.

(1) All education substituted for experience must be relevant to the category and classification of the license being applied for.

(2) Education may be substituted for experience at a rate of up to one month experience for each semester hour of college credit approved by the board. One quarter hour of college credit will be considered equal to two thirds of a semester hour.

(3) Substitution of formal education experience will be approved by the board only for applicants who submit a transcript from the institution where the course was taken.

c. Training substitution. Waterworks or wastewater works operator training courses, seminars, workshops, or similar training, specifically approved by the board, may be substituted for part of the required experience.

(1) All training substituted for experience must be relevant to the category and classification of the license being applied for.

(2) Training may be substituted for experience at a rate of one month experience for each training credit approved by the board. Up to one training credit is awarded for each 10 hours of classroom contact time or for each 20 hours of laboratory exercise and field trip contact time. No credit towards training credits is granted for breaks, meals, receptions, and time other than classroom, laboratory and field trip contact time.

(3) All courses used for substitution must be approved by utilizing the criteria set forth in Part VI (18 VAC 160-20-160) of this chapter.

(4) Substitution of training for experience will be approved by the board only for applicants who submit a copy of an appropriate certificate identifying the subject matter of the course and the training credit value, and signed by a representative of the organization sponsoring the training.

3. Limitations on substitution.

a. Under no circumstances shall category experience, education, and training substitutions exceed 50% of the total experience required under this subsection.

b. No category experience, education, or training substitutions are permitted for the experience required to obtain a Class VI, Class V or a Class IV license as specified in subsection B of this section.

D. Examination. A board-approved examination shall be administered at least twice a year.

1. An individual may take the examination prior to fulfilling the education and experience requirements, provided all requirements will be met within three months after the date the applicant will take the examination. The license shall not be issued until all applicable requirements have been met and satisfactorily verified.

2. An individual who is unable to take an examination at the time scheduled shall notify the board prior to the date of the examination; such an individual shall be rescheduled for the next examination. Failure to notify the board may require the submittal of a new application and payment of fees.

3. Upon submission of an application for reexamination form provided by the board and payment of the reexamination fee, an applicant who is unsuccessful in passing an examination will be allowed to retake the examination up to two times within two years of the date of notification of initial unsuccessful examination results. If the two-year period elapses, or if an applicant fails to pass both reexaminations, then the applicant will be required to submit a new application with fee in accordance with this chapter in order to take an examination.

4. Applications for examination and reexamination must be received by the Department of Professional and Occupational Regulation at least 60 days prior to a scheduled examination in order to be eligible to sit for that examination.

18 VAC 160-20-102. Fees.

A. All fees are nonrefundable.

B. The date of receipt of the fee by the board is the date that shall be used to determine whether the fee is timely received.

C. The following fees shall apply:

Application fee	$85
Renewal fee	$45
Late renewal fee	$25
Reexamination fee	$75
Bad check or other instrument penalty	$25

D. A fee of $25 will be charged, in addition to the fees established in this section, for submitting a check to the board which is dishonored by the institution upon which it is drawn.

18 VAC 160-20-104. Maintenance of license.

A. The licensee shall notify the board in writing within 30 days of any change of name or address.

B. All licensees shall operate under the name in which the license is issued.

PART III.

RENEWAL.

18 VAC 160-20-106. Renewal.

A. Licenses for waterworks operators shall expire on the last day of February of each odd-numbered year. Licenses for wastewater works operators shall expire on the last day of February of each even-numbered year.

B. The Department of Professional and Occupational Regulation shall mail a renewal notice to the licensee outlining the procedures for renewal. Renewal notices shall be mailed to the licensee at the last known address of record. Failure to receive written notice shall not relieve the licensee of the obligation to renew and pay the required fee outlined in 18 VAC 160-20-102.

C. Each licensee applying for renewal shall return the renewal notice, fee, and, in the case of waterworks licensees only, a statement that the applicant for license renewal has met the CPE requirement established in 18 VAC 160-20-109 prior to the expiration date shown on the license. If the licensee fails to receive the renewal notice, a copy of the expired license may be submitted in place of the renewal notice along with the required fee and, in the case of waterworks licensees only, a statement that the licensee has met the CPE requirement in 18 VAC 160-20-109.

D. The date on which the renewal fee and any required forms are actually received by the board or its agent shall determine whether an additional fee is due.

E. If the requirements of subsection C of this section are met more than 30 days but less than 12 months after the expiration date on the license, a late penalty fee shall be required as established in 18 VAC 160-20-102. The date on which the renewal application, any required documentation and the required fees are actually received by the board or its agent shall determine whether the licensee is eligible for renewal and whether an additional fee is due.

F. Any individual who fails to renew his license within 12 months after the expiration date printed on the license shall apply for a new license by examination in accordance with Part II (18 VAC 160-20-74 et seq.) of this chapter. Such individual shall be deemed to be eligible to sit for the examination for the same category and class of license as the expired license.

G. The board may deny renewal of a license for the same reasons as it may refuse initial licensure or discipline a licensee.

18 VAC 160-20-109. Waterworks operator continuing profession education (CPE).

A. Effective with the February 2003 license renewal cycle, each licensed waterworks operator shall have completed the following number of CPE contact hours required for his class of license:

1. Class I, II, and III operators shall obtain a minimum of 20 contact hours during each license renewal cycle.

2. Class IV operators shall obtain a minimum of 16 contact hours during each license renewal cycle.

3. Class V operators shall obtain a minimum of eight contact hours during each license renewal cycle.

4. Class VI operators shall obtain a minimum of four contact hours during each license renewal cycle.

CPE provisions do not apply for the renewal of licenses that were held for less than two years on the date of expiration.

B. The subject matter addressed during CPE contact hours shall be limited to the content areas covered by the board's examination.

C. Any course approved by the board for substitution as training credits or formal education semester hours, as provided for in 18 VAC 160-20-160, shall also be acceptable on an hour-for-hour basis for CPE contact hours. One semester hour of college credit shall equal 15 CPE contact hours, and one quarter hour of college credit shall equal 10 CPE credit hours.

D. The following evidence shall be maintained to document completion of the hours of CPE specified in subsection A of this section:

1. Evidence of completion of a structured training activity which shall consist of the name, address and telephone number of the sponsor;

2. The dates the applicant participated in the training;

3. Descriptive material of the subject matter presented; and

4. A statement from the sponsor verifying the number of hours completed.

E. Each licensee shall maintain evidence of the satisfactory completion of CPE for a period of at least one year following the end of the license renewal cycle for which the CPE was taken.

Such documentation shall be in the form required by subsection D of this section and shall be provided to the board or its duly authorized agents upon request.

F. The licensee shall not receive CPE credit for the same training course or structured training activity more than once during a single license renewal cycle to meet the CPE requirement unless the same training course or structured training activity is an annual requirement established by Virginia or federal regulations.

G. The licensee may receive CPE credit for a training course or structured training activity which has been mandated by Virginia or federal regulation towards fulfilling the CPE requirement.

H. The licensee may petition the board for additional time to meet the CPE requirement. However, CPE hours earned during a license renewal cycle to satisfy the CPE requirement of the preceding license renewal cycle shall be valid only for that preceding license renewal cycle.

PART IV.

CLASSIFICATION REQUIREMENTS.

18 VAC 160-20-120. Waterworks.

A. A Class VI waterworks licensee may operate any waterworks as follows:

1. A waterworks providing no treatment and serving fewer than 400 persons; or

2. A waterworks classified by the Virginia Department of Health as a Class VI waterworks.

B. A Class V waterworks licensee may operate any waterworks as follows:

1. A waterworks serving 400 or more persons which (i) provides no treatment or (ii) employs hypochlorination for disinfection; or

2. A waterworks classified by the Virginia Department of Health as either a Class V or Class VI waterworks.

C. A Class IV waterworks licensee may operate any waterworks as follows:

1. A waterworks serving fewer than 5,000 persons or having a design hydraulic capacity of less than 0.5 MGD, employing one or more of the following (i) disinfection other than with hypochlorination, (ii) corrosion control, (iii) iron and manganese removal, (iv) ion exchange, (v) membrane technology without pretreatment, (vi) slow sand filtration, (vii) aeration, (viii) rechlorination other than with hypochlorination, or (ix) activated carbon contactors; or

2. A waterworks classified by the Virginia Department of Health as either a Class IV, V, or VI waterworks.

D. A Class III waterworks licensee may operate any waterworks as follows:

1. A waterworks serving fewer than 5,000 persons or having a design capacity less than 0.5 MGD, employing chemical coagulation or lime softening in combination with one or more of the following (i) sedimentation, (ii) rapid sand filtration with a filtration rate of 2 gpm/square foot or less, (iii) fluoridation, (iv) disinfection, (v) aeration, (vi) corrosion control, or (vii) membrane technologies;

2. A waterworks serving 5,000 or more persons or having a design hydraulic capacity of 0.5 MGD, employing one or more of the following; (i) disinfection other than with hypochlorination, (ii) corrosion control, (iii) iron and manganese removal, (iv) ion

exchange, (v) membrane technology without pretreatment, (vi) slow sand filtration, (vii) aeration, (viii) rechlorination other than with hypochlorination, or (ix) activated carbon contactors;

3. A waterworks employing (i) membrane technology requiring pretreatment consisting of pH adjustment; or (ii) diatomaceous earth filtration, coupled with aeration, corrosion control, disinfection, or fluoridation;

4. A waterworks employing fluoridation which is not under a higher classification; or

5. A waterworks classified by the Virginia Department of Health as either a Class III, IV, V or VI waterworks.

E. A Class II waterworks licensee may operate any waterworks as follows:

1. A waterworks serving 5,000 or more persons but fewer than 50,000 persons or having a design hydraulic capacity of 0.5 MGD or more but less than 5.0 MGD employing chemical coagulation or lime softening in combination with one or more of the following; (i) sedimentation, (ii) rapid sand filtration, (iii) fluoridation, (iv) disinfection, (v) aeration, (vi) corrosion control, or (vii) membrane technologies;

2. A waterworks serving fewer than 50,000 persons or having a design hydraulic capacity of less than 5.0 MGD which employs chemical coagulation or lime softening coupled with multimedia granular filtration or granular filtration at rates above 2.0 gpm/square foot (high rate filtration) in combination with one or more of the following: (i) sedimentation, (ii) fluoridation, (iii) disinfection, (iv) aeration, or (v) corrosion control;

3. A waterworks employing biological activated carbon contactors or membrane technology requiring pretreatment other than pH adjustment; or

4. A waterworks classified by the Virginia Department of Health as either a Class II, III, IV, V or VI waterworks.

F. A Class I waterworks licensee may operate any waterworks.

G. The term membrane technologies includes (i) electrical dialysis reversal, (ii) reverse osmosis, (iii) ultra filtration, (iv) micro filtration, and (v) nano filtration.

18 VAC 160-20-130. Wastewater works.

A. A Class IV wastewater works licensee may operate any wastewater works as follows:

1. A wastewater works employing natural treatment methods (i.e., those not utilizing aerated or mixed flows and not using electrical or outside energy sources to accomplish treatment) with a design hydraulic capacity greater than 0.4 MGD but equal to or less than 1.0 MGD; or

2. A wastewater works classified by the Virginia Department of Health or the Virginia Department of Environmental Quality as a Class IV wastewater works.

B. A Class III wastewater works licensee may operate any wastewater works as follows:

1. A wastewater works using biological treatment methods consisting of but not limited to (i) suspended growth reactors, (ii) aerated lagoons, (iii) constructed wetlands, (iv) biological filters or other attached growth contactors, (v) processes utilizing biological nutrient control, or (vi) processes utilizing land application having a design hydraulic capacity greater than 0.04 MGD, but equal to or less than 0.5 MGD;

2. A wastewater works using advanced waste treatment methods consisting of but not limited to (i) ammonia stripping, (ii) breakpoint chlorination, (iii) carbon adsorption, (iv) chemical coagulation, (v) flocculation, (vi) precipitation, (vii) filtration, or (viii) demineralization (ion exchange, reverse osmosis or electrodialysis) having a design hydraulic capacity greater than 0.04 MGD, but equal to or less than 0.5 MGD;

3. A wastewater works using combinations of biological and advanced waste treatment methods having a design hydraulic capacity greater than 0.04 MGD, but equal to or less than 0.1 MGD;

4. A wastewater works using natural treatment methods (i.e., those not using aerated or mixed flows and not using electrical or outside energy sources to accomplish treatment) with a design hydraulic capacity greater than 1.0 MGD; or

5. A wastewater works classified by the Virginia Department of Health or the Virginia Department of Environmental Quality as either a Class III or IV wastewater works.

C. A Class II wastewater works licensee may operate any wastewater works as follows:

1. A wastewater works using biological treatment methods consisting of but not limited to (i) suspended growth reactors, (ii) aerated lagoons, (iii) constructed wetlands, (iv) biological filters or other attached growth contactors, (v) processes utilizing biological nutrient control, or (vi) processes utilizing land application having a design hydraulic capacity greater than 0.5 MGD, but equal to or less than 5.0 MGD;

2. A wastewater works using advanced waste treatment methods consisting of but not limited to (i) ammonia stripping, (ii) breakpoint chlorination, (iii) carbon adsorption, (iv)

chemical coagulation, (v) flocculation, (vi) precipitation, (vii) filtration, or (viii) demineralization (ion exchange, reverse osmosis or electrodialysis) having a design hydraulic capacity greater than 0.5 MGD, but equal to or less than 5.0 MGD;

3. A wastewater works using combinations of biological and advanced waste treatment methods, having a design hydraulic capacity greater than 0.1 MGD, but equal to or less than 2.5 MGD; or

4. A wastewater works classified by the Virginia Department of Health or the Virginia Department of Environmental Quality as either a Class II, III or IV wastewater works.

D. A Class I wastewater works licensee may operate any wastewater works.

PART V.

STANDARDS OF PRACTICE.

18 VAC 160-20-140. Discipline.

The board has the power to discipline and fine any licensee and to suspend or revoke or refuse to renew or reinstate any license as well as the power to deny any application for a license under the provisions of Chapter 23 (§ 54.1-2300 et seq.) of Title 54.1 of the Code of Virginia and this chapter for any of the following:

1. Obtaining or renewing a license through fraudulent means or misrepresentation;

2. Having been convicted or found guilty by a court in any jurisdiction of any felony or of any misdemeanor involving lying, cheating or stealing, or for activities carried out while engaged in waterworks or wastewater works activities, there being no appeal pending therefrom or the time for appeal having lapsed. Any plea of nolo contendere shall be considered a conviction for purposes of this subsection. A certified copy of a final order, decree or case decision by a court or regulatory agency with the lawful authority to issue such order, decree or case decision shall be prima facia evidence of such conviction or discipline. The record of conviction certified or authenticated in such form as to be admissible in evidence under the laws of the jurisdiction where convicted shall be admissible as prima facie evidence of such guilt;

3. Not demonstrating reasonable care, judgment, or application of the required knowledge, skill and ability in the performance of the operating duties;

4. Violating or inducing another person to violate any provisions of Chapter 1, 2, 3 or 23 of Title 54.1 of the Code of Virginia, or of any provision of this chapter;

5. Having been found guilty by the board, an administrative body or by a court of any activity in the course of performing his operating duties that resulted in the harm or the threat of harm to human health or the environment;

6. Failing to inform the board in writing within 30 days of pleading guilty or nolo contendere or being convicted or found guilty, regardless of adjudication, of any felony which resulted in the harm or the threat of harm to human health or the environment. Failing to inform the board in writing within 30 days of pleading guilty or nolo contendere or being convicted of or found guilty, regardless of adjudication, of any felony or of any misdemeanor for activities carried out while engaged in waterworks or wastewater works activities or involving lying, cheating or stealing; or

7. Negligence, or a continued pattern of incompetence, in the practice as a waterworks or wastewater works operator.

PART VI.

APPROVAL OF TRAINING.

18 VAC 160-20-160. Approval of training.

A. Waterworks and wastewater works operator training for all licenses may be substituted for some of the experience required for Class III, Class II and Class I licenses, subject to the limitations in this section. Training courses that may be substituted for required experience must be approved by the board except those provided by federal or state agencies, institutions, schools and universities approved by the State Council of Higher Education for Virginia, for which continuing education units are awarded. Training courses requiring board approval shall be approved by the board prior to commencing in accordance with the following:

B. Training courses for which experience credit may be granted must be conducted in general conformance with the guidelines of the International Association for Continuing Education and Training (Association). The board reserves the right to waive any of the requirements of the association's guidelines on a case-by-case basis. Only classroom, laboratory and field trip contact time will be used to compute training credits. No credit will be given for breaks, meals, or receptions.

1. Organization. The board will only approve training offered by a sponsor who is an identifiable organization with a mission statement outlining its functions, structure, process and philosophy, and that has a staff of one or more persons with the authority to administer and coordinate a training credit (TC) program.

2. TC records. The board will only approve training offered by a sponsor who maintains TC records for all participants for a minimum of seven years, and who has a written policy on retention and release of TC records.

3. Instructors. The board will only approve training conducted by personnel who have demonstrated competence in the subject being taught, an understanding of the learning objective, a knowledge of the learning process to be used, and a proven ability to communicate.

4. Objectives. The board will only approve courses that have a series of stated objectives that are consistent with the job requirements of waterworks and wastewater works operators. The training course content must be consistent with those objectives.

5. Course completion requirements. For successful completion of a training course, participants must attend 90% or more of the class contact time and must demonstrate

their learning through written examinations, completion of a project, self-assessment, oral examination, or other assessment technique.

C. The board shall consider the following information, to be submitted by the course sponsor or instructor on forms provided by the board, at least 45 days prior to the scheduled training course:

1. Course information.

   a. Course title;

   b. Planned audience;

   c. Name of sponsor;

   d. Name, address, phone number of contact person;

   e. Scheduled presentation dates;

   f. Detailed course schedule, hour-by-hour;

   g. List of planned breaks;

   h. Scheduled presentation location; and

   i. Relevancy of course to waterworks or wastewater works operator licensing.

2. Instructor qualifications.

   a. Name of instructor;

   b. Title, employer; and

   c. Summary of qualifications to teach this course.

3. Training materials.

   a. Course objectives. A listing of the course objectives stated in terms of the skills, knowledge, or attitude the participant will be able to demonstrate as a result of the training.

   b. Course outline. A detailed outline showing the planned activities that will occur during the training course, including major topics, planned presentation sequence, laboratory and field activities, audio-visual presentation, and other major activities.

c. Course reference materials. A list of the name, publisher and publication date for commercially available publications. For reference materials developed by the course sponsor or available exclusively through the course, a copy of the reference.

d. Audio-visual support materials. A listing of any commercially available audio-visual support material that will be used in the program. A brief description of any sponsor or instructor generated audio-visual material that will be used.

e. Handouts. Identification of all commercially available handout materials that will be used; as well as copies of all other planned handouts.

4. Determination of successful completion. A description of the means that will be used to assess the learning of each participant to determine successful completion of the training program, such as examinations, projects, personal evaluations by the instructor, or other recognized evaluation techniques.

D. Recurring training programs. If there are plans to present the same course of instruction routinely at multiple locations with only minor modifications and changes, the board may approve the overall program rather than individual presentations if so requested by the sponsor.

1. The board shall consider all of the information listed above except those items related to specific offerings of the course.

2. Board approval may be granted for a specific period of time or for an indefinite period.

3. Board approval will apply only to those specific offerings certified by the sponsoring organization as having been conducted by instructors meeting the established criteria and in accordance with the board-approved course outlines and objectives.

4. To maintain approval of the program, changes made to the program since its approval must be submitted.

SUBCHAPTER D—WATER PROGRAMS (Continued)

PART 136—GUIDELINES ESTABLISHING TEST PROCEDURES FOR THE ANALYSIS OF POLLUTANTS

AUTHORITY: Secs. 301, 304(h), 307 and 501(a), Pub. L. 95–217, 91 Stat. 1566, et seq. (33 U.S.C. 1251, et seq.) (the Federal Water Pollution Control Act Amendments of 1972 as amended by the Clean Water Act of 1977).

§ 136.1 Applicability.

The procedures prescribed herein shall, except as noted in § 136.5, be used to perform the measurements indicated whenever the waste constituent specified is required to be measured for:

(a) An application submitted to the Administrator, or to a State having an approved NPDES program for a permit under section 402 of the Clean Water Act of 1977, as amended (CWA), and/or to reports required to be submitted under NPDES permits or other requests for quantitative or qualitative effluent data under parts 122 to 125 of title 40, and,

(b) Reports required to be submitted by discharges under the NPDES established by parts 124 and 125 of this chapter, and,

(c) Certifications issued by States pursuant to section 401 of the CWA, as amended.

[38 FR 28758, Oct. 16, 1973, as amended at 49 FR 43250, Oct. 26, 1984]

§ 136.2 Definitions.

As used in this part, the term:

(a) *Act* means the Clean Water Act of 1977, Pub. L. 95–217, 91 Stat. 1566, et seq. (33 U.S.C. 1251 et seq.) (The Federal Water Pollution Control Act Amendments of 1972 as amended by the Clean Water Act of 1977).

(b) *Administrator* means the Administrator of the U.S. Environmental Protection Agency.

(c) *Regional Administrator* means one of the EPA Regional Administrators.

(d) *Director* means the Director of the State Agency authorized to carry out an approved National Pollutant Discharge Elimination System Program under section 402 of the Act.

(e) *National Pollutant Discharge Elimination System (NPDES)* means the national system for the issuance of permits under section 402 of the Act and includes any State or interstate program which has been approved by the Administrator, in whole or in part, pursuant to section 402 of the Act.

(f) *Detection limit* means the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure set forth at appendix B of this part.

[38 FR 28758, Oct. 16, 1973, as amended at 49 FR 43250, Oct. 26, 1984]

§ 136.3 Identification of test procedures.

(a) Parameters or pollutants, for which methods are approved, are listed together with test procedure descriptions and references in Tables IA, IB, IC, ID, IE, and IF. The full text of the referenced test procedures are incorporated by reference into Tables IA, IB, IC, ID, IE, and IF. The references and the sources which are available are given in paragraph (b) of this section. These test procedures are incorporated as they exist on the day of approval and a notice of any change in these test procedures will be published in the FEDERAL REGISTER. The discharge parameter values for which reports are required must be determined by one of the standard analytical test procedures incorporated by reference and described in Tables IA, IB, IC, ID, IE, and IF, or by any alternate test procedure which has been approved by the Administrator under the provisions of paragraph (d) of this section and §§ 136.4 and 136.5. Under certain circumstances (paragraph (b) or (c) of this section or 40 CFR 401.13) other test procedures may be used that may be more advantageous when such other test procedures have been previously approved by the Regional Administrator of the Region in which the discharge will occur, and providing the Director of the State in which such discharge will occur does not object to the use of such alternate test procedure.

TABLE IA.—LIST OF APPROVED BIOLOGICAL METHODS

Parameter and units	Method [1]	EPA	Standard methods, 18th Ed.	ASTM	USGS
Bacteria:					
1. Coliform (fecal), number per 100 mL.	Most Probable Number (MPN), 5 tube	p. 132 [3]	9221C E [4]	....	
	3 dilution, or Membrane filter (MF) [2], single step	p. 124 [3]	9222D [4]		B–0050–85 [5]
2. Coliform (fecal) in presence of chlorine, number per 100 mL.	MPN, 5 tube, 3 dilution, or	p. 132 [3]	9221C E [4]	....	
	MF, single step [6]	p. 124 [3]	9222D [4]		
3. Coliform (total), number per 100 mL.	MPN, 5 tube, 3 dilution, or	p. 114 [3]	9221B [4]	....	
	MF [2] single step or two step	p. 108 [3]	9222B [4]		B–0025–85 [5]
4. Coliform (total), in presence of chlorine, number per 100 mL.	MPN, 5 tube, 3 dilution, or	p. 114 [3]	9221B [4]	....	
	MF [2] with enrichment	p. 111 [3]	9222(B+B.5c) [4]		
5. Fecal streptococci, number per 100 mL.	MPN, 5 tube, 3 dilution	p. 139 [3]	9230B [4]	....	
	MF [2], or	p. 136 [3]	9230C [4]		B–0055–85 [5]
	Plate count	p. 143 [3]			
Aquatic Toxicity:					
6. Toxicity, acute, fresh water organisms, LC50, percent effluent.	Daphnia, Ceriodaphnia, Fathead Minnow, Rainbow Trout, Brook Trout, or Bannerfish Shiner mortality.	Sec. 9 [7]		....	
7. Toxicity, acute, estuarine and marine organisms, LC50, percent effluent.	Mysid, Sheepshead Minnow, or Menidia spp. mortality	Sec. 9 [7]		....	
8. Toxicity, chronic, fresh water organisms, NOEC or IC25, percent effluent.	Fathead minnow larval survival and growth	1000.0 [8]		....	
	Fathead minnow embryo-larval survival and teratogenicity	1001.0 [8]			
	Ceriodaphnia survival and reproduction				
	Selenastrum growth	1002.0 [8]			
		1003.0 [8]			
9. Toxicity, chronic, estuarine and marine organisms, NOEC or IC25, percent effluent.	Sheepshead minnow larval survival and growth	1004.0 [9]		....	
	Sheepshead minnow embryo-larval survival and teratogenicity	1005.0 [9]			
	Menidia beryllina larval and growth				
	Mysidopsis bahia survival, growth, and fecundity	1006.0 [9]			
	Arbacia punctulata fertilization	1007.0 [9]			
	Champia parvula reproduction	1008.0 [9]			
		1009.0 [9]			

Notes to Table IA:

[1] The method must be specified when results are reported.

[2] A 0.45 um membrane filter (MF) or other pore size certified by the manufacturer to fully retain organisms to be cultivated and to be free of extractables which could interfere with their growth.

[3] USEPA. 1978. Microbiological Methods for Monitoring the Environment, Water, and Wastes. Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. EPA/600/8–78/017.

[4] APHA. 1992. Standard Methods for the Examination of Water and Wastewater. American Public Health Association. 18th Edition. Amer. Publ. Hlth. Assoc., Washington, DC.

[5] USGS. 1989. U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Laboratory Analysis, Chapter A4, Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples, U.S. Geological Survey, U.S. Department of Interior, Reston, Virginia.

[6] Because the MF technique usually yields low and variable recovery from chlorinated wastewaters, the Most Probable Number method will be required to resolve any controversies.

[7] USEPA. 1993. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. Fourth Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. August 1993, EPA/600/4–90/027F.

[8] USEPA. 1994. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. Third Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency USEPA. 1994, Cincinnati, Ohio (July 1994, EPA/600/4–91/002).

[9] Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms. Second Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio (July 1994, EPA/600/4–91/003). These methods do not apply to marine waters of the Pacific Ocean.

TABLE IB.—LIST OF APPROVED INORGANIC TEST PROCEDURES

Parameter, units and method	Reference (method number or page)				
	EPA [1,35]	STD methods 18th ed.	ASTM	USGS [2]	Other
1. Acidity, as $CaCO_3$, mg/L:					
Electrometric endpoint or phenolphthalein endpoint	305.1	2310 B(4a)	D1067–92		
2. Alkalinity, as $CaCO_3$, mg/L:					
Electrometric or Colorimetric titration to pH 4.5, manual or automated.	310.1 310.2	2320 B	D1067–92	I–1030–85 I–2030–85	973.43.[3]
3. Aluminum—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration [36]	202.1	3111 D	...	I–3051–85	
AA furnace	202.2	3113 B			
Inductively Coupled Plasma/Atomic Emission Spectrometry (ICP/AES) [36].	[5] 200.7	3120 B			
Direct Current Plasma (DCP) [36]	...	...	D4190–82(88)	...	Note 34.
Colorimetric (Eriochrome cyanine R)	...	3500–Al D			
4. Ammonia (as N), mg/L:					
Manual, distillation (at pH 9.5),[6] followed by	350.2	4500–NH_3B	...	...	973.49.[3]
Nesslerization	350.2	4500–NH_3C	D1426–93(A)	I–3520–85	973.49.[3]
Titration	350.2	4500–NH_3E			
Electrode	350.3	4500–NH_3F or G	D1426–93(B)		
Automated phenate, or	350.1	4500–NH_3H	...	I–4523–85	
Automated electrode	...	...	...	...	Note 7.
5. Antimony-Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration [36]	204.1	3111 B			
AA furnace	204.2	3113 B			
ICP/AES [36]	[5] 200.7	3120 B			
6. Arsenic-Total,[4] mg/L:					
Digestion [4] followed by	206.5				
AA gaseous hydride	206.3	3114 B 4.d	D2972–93(B)	I–3062–85	
AA furnace	206.2	3113 B	D2972–93(C)		
ICP/AES,[36] or	[5] 200.7	3120 B			
Colorimetric (SDDC)	206.4	3500–As C	D2972–93(A)	I–3060–85	
7. Barium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration [36]	208.1	3111 D	...	I–3084–85	
AA furnace	208.2	3113 B	D4382–91		
ICP/AES [36]	[5] 200.7	3120 B			
DCP [36]	...	...	...	...	Note 34.
8. Beryllium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	210.1	3111 D	D3645–93(88)(A)	I–3095–85	
AA furnace	210.2	3113 B	D3645–93(88)(B)		
ICP/AES	[5] 200.7	3120 B			
DCP, or	...	...	D4190–82(88)	...	Note 34.

Colorimetric (aluminon)		3500–Be D			
9. Biochemical oxygen demand (BOD_5), mg/L:					
Dissolved Oxygen Depletion	405.1	5210 B		I–1578–78[8]	973.44,[3] p. 17.[9]
10. Boron[37]—Total, mg/L:					
Colorimetric (curcumin)	212.3	4500–B B		I–3112–85	
ICP/AES, or	[5] 200.7	3120 B			
DCP			D4190–82(88)		Note 34
11. Bromide, mg/L:					
Titrimetric	320.1		D1246–82(88)(C)	I–1125–85	p. S44.[10]
12. Cadmium—Total,[4] mg/L; Digestion[4] followed by:					
AA direct aspiration[36]	213.1	3111 B or C	D3557–90(A or B)	I–3135–85 or I–3136–85	974.27,[3] p. 37.[9]
AA furnace	213.2	3113 B	D3557–90(D)		
ICP/AES[36]	[5] 200.7	3120 B		I–1472–85	
DCP[36]			D4190–82(88)		Note 34.
Voltametry,[11] or			D3557–90(C)		
Colorimetric (Dithizone)		3500–Cd D			
13. Calcium—Total,[4] mg/L; Digestion[4] followed by:					
AA direct aspiration	215.1	3111 B	D511–93(B)	I–3152–85	
ICP/AES	[5] 200.7	3120 B			
DCP, or					Note 34.
Titrimetric (EDTA)	215.2	3500–Ca D	D511–93(A)		
14. Carbonaceous biochemical oxygen demand ($CBOD_5$), mg/L[12]:					
Dissolved Oxygen Depletion with nitrification inhibitor.		5210 B			
15. Chemical oxygen demand (COD), mg/L; Titrimetric, or.	410.1 410.2 410.3	5220 C	D1252–88(A)	I–3560–85 I–3562–85	973.46,[3] p. 17.[9]
Spectrophotometric, manual or automated	410.4	5220 D	D1252–88(B)	I–3561–85	Notes 13 or 14.
16. Chloride, mg/L:					
Titrimetric (silver nitrate) or		$4500–Cl^-$ B	D512–89(B)	I–1183–85	
(Mercuric nitrate)	325.3	$4500–Cl^-$ C	D512–89(A)	I–1184–85	973.51.[3]
Colorimetric, manual or				I–1187–85	
Automated (Ferricyanide)	325.1 or 325.2	$4500–Cl^-$ E		I–2187–85	
17. Chlorine—Total residual, mg/L; Titrimetric:					
Amperometric direct	330.1	4500–Cl D	D1253–86(92)		
Iodometric direct	330.3	4500–Cl B			
Back titration ether end- point[15] or	330.2	4500–Cl C			
DPD–FAS	330.4	4500–Cl F			
Spectrophotometric, DPD	330.5	4500–Cl G			
Or Electrode					Note 16.
18. Chromium VI dissolved, mg/L; 0.45 micron filtration followed by:					
AA chelation-extraction or	218.4	3111 C		I–1232–85	
Colorimetric (Diphenylcarbazide)		3500–Cr D	D1687–92(A)	I–1230–85	
19. Chromium—Total,[4] mg/L; Digestion[4] followed by:					
AA direct aspiration[36]	218.1	3111 B	D1687–92(B)	I–3236–85	974.27.[3]
AA chelation-extraction	218.3	3111 C			
AA furnace	218.2	3113 B	D1687–92(C)		

TABLE IB.—LIST OF APPROVED INORGANIC TEST PROCEDURES—Continued

Parameter, units and method	Reference (method number or page)				
	EPA [1,35]	STD methods 18th ed.	ASTM	USGS [2]	Other
ICP/AES [36]	[5] 200.7	3120 B			
DCP,[36] or			D4190–82(88)		Note 34.
Colorimetric (Diphenylcarbazide)		3500–Cr D			
20. Cobalt—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	219.1	3111 B or C	D3558–90(A or B)	I–3239–85	p. 37.[9]
AA furnace	219.2	3113 B	D3558–90(C)		
ICP/AES	[5] 200.7	3120 B			
DCP			D4190–82(88)		Note 34.
21. Color platinum cobalt units or dominant wavelength, hue, luminance purity:					
Colorimetric (ADMI), or	110.1	2120 E			Note 18.
(Platinum cobalt), or	110.2	2120 B		I–1250–85	
Spectrophotometric	110.3	2120 C			
22. Copper—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration [36]	220.1	3111 B or C	D1688–90(A or B)	I–3270–85 or I3271–85	974.27 [3] p. 37.[9]
AA furnace	220.2	3113 B	D1688–90(C)		
ICP/AES [36]	[5] 200.7	3120 B			
DCP [36] or			D4190–82(88)		Note 34.
Colorimetric (Neocuproine) or		3500–Cu D			
(Bicinchoninate)		Or E			Note 19.
23. Cyanide—Total, mg/L:					
Manual distillation with $MgCl_2$ followed by		4500–CN C	D2036–91(A)		
Titrimetric, or		4500–CN D			p. 22.[9]
Spectrophotometric, manual or	[31] 335.2	4500–CN E	D2036–91(A)	I–3300–85	
Automated [20]	[31] 335.3				
24. Available Cyanide, mg/L					
Cyanide amenable to chlorination (CATC), Manual distillation with $MgCl_2$ followed by titrimetry or spectrophotometry.	335.1	4500–CN G	D2036–91(B).		
Flow injection and ligand exchange, followed by amperometry.					[44] OIA–1677
25. Fluoride—Total, mg/L:					
Manual distillation [6] followed by		4500–F B			
Electrode, manual or	340.2	4500–F C	D1179–93(B)		
Automated				I–4327–85	
Colorimetric (SPADNS)	340.1	4500–F D	D1179–93(A)		
Or Automated complexone	340.3	4500–F E			
26. Gold—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	231.1	3111 B			
AA furnace, or	231.2				
DCP					Note 34.
27. Hardness—Total, as $CaCO_3$, mg/L					
Automated colorimetric,	130.1				

Titrimetric (EDTA), or Ca plus Mg as their carbonates, by inductively coupled plasma or AA direct aspiration. (See Parameters 13 and 33).	130.2	2340 B or C	D1126–86(92)	I–1338–85	973.52B.[3]
28. Hydrogen ion (pH), pH units					
Electrometric measurement, or	150.1	4500–H+ B	D1293–84(90)(A or B)	I–1586–85	973.41.[3]
Automated electrode					Note 21.
29. Iridium—Total,[4] mg/L; Digestion[4] followed by:					
AA direct aspiration or	235.1	3111 B			
AA furnace	235.2				
30. Iron—Total,[4] mg/L; Digestion[4] followed by:					
AA direct aspiration[36]	236.1	3111 B or C	D1068–90(A or B)	I–3381–85	974.27.[3]
AA furnace	236.2	3113 B	D1068–90(C)		
ICP/AES[36]	[5] 200.7	3120 B			
DCP[36] or			D4190–82(88)		Note 34.
Colorimetric (Phenanthroline)		3500–Fe D	D1068–90(D)		Note 22.
31. Kjeldahl Nitrogen—Total, (as N), mg/L:					
Digestion and distillation followed by:	351.3	4500–NH_3B or C	D3590–89(A)		
Titration	351.3	4500–NH_3E	D3590–89(A)		973.48[3].
Nesslerization	351.3	4500–NH_3C	D3590–89(A)		
Electrode	351.3	4500–NH_3F or G			
Automated phenate colorimetric	351.1			I–4551–78[8]	
Semi-automated block digester colorimetric	351.2		D3590–89(B)		
Manual or block digester potentiometric	351.4		D3590–89(A)		
Block Digester, followed by:.					
Auto distillation and Titration, or					Note 39.
Nesslerization					Note 40.
Flow injection gas diffusion					Note 41.
32. Lead—Total,[4] mg/L; Digestion[4] followed by:					
AA direct aspiration[36]	239.1	3111 B or C	D3559–90(A or B)	I–3399–85	974.27.[3]
AA furnace	239.2	3113 B	D3559–90(D)		
ICP/AES[36]	[5] 200.7	3120 B			
DCP[36]			D4190–82(88)		Note 34.
Voltametry[11] or			D3559–90(C)		
Colorimetric (Dithizone)		3500–Pb D			
33. Magnesium—Total,[4] mg/L; Digestion[4] followed by:					
AA direct aspiration	242.1	3111 B	D511–93(B)	I–3447–85	974.27.[3]
ICP/AES	[5] 200.7	3120 B			
DCP, or					Note 34.
Gravimetric		3500–Mg D			
34. Manganese—Total,[4] mg/L; Digestion[4] followed by:					
AA direct aspiration[36]	243.1	3111 B	D858–90(A or B)	I–3454–85	974.27.[3]
AA furnace	243.2	3113 B	D858–90(C)		
ICP/AES[36]	[5] 200.7	3120 B			
DCP[36] or			D4190–82(88)		Note 34.
Colorimetric (Persulfate), or		3500–Mn D			920.203.[3]
(Periodate)					Note 23.
35. Mercury—Total,[4] mg/L:					
Cold vapor, manual, or	245.1	3112 B	D3223–91	I–3462–85	[3] 977.22
Automated	245.2				

TABLE IB.—LIST OF APPROVED INORGANIC TEST PROCEDURES—Continued

Parameter, units and method	Reference (method number or page)				
	EPA [1,35]	STD methods 18th ed.	ASTM	USGS [2]	Other
Oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry (ng/L).	[43] 1631				
36. Molybdenum—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	246.1	3111 D		I–3490–85	
AA furnace	246.2	3113 B			
ICP/AES	[5] 200.7	3120 B			
DCP					Note 34.
37. Nickel—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration [36]	249.1	3111 B or C	D1886–90(A or B)	I–3499–85	
AA furnace	249.2	3113 B	D1886–90(C)		
ICP/AES [36]	[5] 200.7	3120 B			
DCP [36], or			D4190–82(88)		Note 34.
Colorimetric (heptoxime)		3500–Ni D			
38. Nitrate (as N), mg/L:					
Colorimetric (Brucine sulfate), or Nitrate-nitrite N minus Nitrite N (See parameters 39 and 40).	352.1				973.50,[3] 419 D,[17] p. 28.[9]
39. Nitrate-nitrite (as N), mg/L:					
Cadmium reduction, Manual or	353.3	4500–NO_3^- E	D3867–90(B)		
Automated, or	353.2	4500–NO_3^- F	D3867–90(A)	I–4545–85	
Automated hydrazine	353.1	4500–NO_3^- H			
40. Nitrite (as N), mg/L; Spectrophotometric:					
Manual or	354.1	4500–NO_2^- B			Note 25.
Automated (Diazotization)				I–4540–85	
41. Oil and grease—Total recoverable, mg/L: Gravimetric (extraction)	413.1	5520 B[38].			
Oil and grease and non-polar material, mg/L: Hexane extractable material (HEM): *n*-Hexane extraction and gravimetry[42].	1664, Rev. A				
Silica gel treated HEM (SGT–HEM): Silica gel treatment and gravimetry[42].	1664, Rev. A				
42. Organic carbon—Total (TOC), mg/L:					
Combustion or oxidation	415.1	5310 B, C, or D	D2579–93 (A or B)		973.47,[3] p. 14.[24]
43. Organic nitrogen (as N), mg/L:					
Total Kjeldahl N (Parameter 31) minus ammonia N (Parameter 4)					
44. Orthophosphate (as P), mg/L; Ascorbic acid method:					
Automated, or	365.1	4500–P F		I–4601–85	973.56.[3]
Manual single reagent	365.2	4500–P E	D515–88(A)		973.55 [3].
Manual two reagent	365.3				
45. Osmium—Total [4], mg/L; Digestion [4] followed by:					
AA direct aspiration, or	252.1	3111 D			
AA furnace	252.2				
46. Oxygen, dissolved, mg/L:					
Winkler (Azide modification), or	360.2	4500–O C	D888–92(A)	I–1575–78 [8]	973.45B.[3]

Electrode	360.1	4500–O G	D888–92(B)	I–1576–78 [8]	
47. Palladium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration, or	253.1	3111 B			p. S27.[10]
AA furnace	253.2				p. S28.[10]
DCP					Note 34.
48. Phenols, mg/L:					
Manual distillation [26]	420.1				Note 27.
Followed by:					
Colorimetric (4AAP) manual, or	420.1				Note 27.
Automated [19]	420.2				
49. Phosphorus (elemental), mg/L:					
Gas-liquid chromatography					Note 28.
50. Phosphorus—Total, mg/L:					
Persulfate digestion followed by	365.2	4500–P B,5			973.55.[3]
Manual or	365.2 or 365.3	4500–P E	D515–88(A)		
Automated ascorbic acid reduction	365.1	4500–P F		I–4600–85	973.56.[3]
Semi-automated block digestor	365.4		D515–88(B)		
51. Platinum—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	255.1	3111 B			
AA furnace	255.2				
DCP					Note 34.
52. Potassium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	258.1	3111 B		I–3630–85	973.53.[3]
ICP/AES	[5] 200.7	3120 B			
Flame photometric, or		3500–K D			
Colorimetric					317 B.[17]
53. Residue—Total, mg/L:					
Gravimetric, 103–105°	160.3	2540 B		I–3750–85	
54. Residue—filterable, mg/L:					
Gravimetric, 180°	160.1	2540 C		I–1750–85	
55. Residue—nonfilterable (TSS), mg/L:					
Gravimetric, 103–105° post washing of residue	160.2	2540 D		I–3765–85	
56. Residue—settleable, mg/L:					
Volumetric, (Imhoff cone), or gravimetric	160.5	2540 F			
57. Residue—Volatile, mg/L:					
Gravimetric, 550°	160.4			I–3753–85	
58. Rhodium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration, or	265.1	3111 B			
AA furnace	265.2				
59. Ruthenium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration, or	267.1	3111 B			
AA furnace	267.2				
60. Selenium—Total,[4] mg/L; Digestion [4] followed by:					
AA furnace	270.2	3113 B	D3859–93(B)		
ICP/AES,[36] or	[5] 200.7	3120 B			
AA gaseous hydride		3114 B	D3859–93(A)	I–3667–85	
61. Silica [37]—Dissolved, mg/L; 0.45 micron filtration followed by:					
Colorimetric, Manual or	370.1	4500–Si D	D859–88	I–1700–85	

TABLE IB.—LIST OF APPROVED INORGANIC TEST PROCEDURES—Continued

Parameter, units and method	Reference (method number or page)				
	EPA [1,35]	STD methods 18th ed.	ASTM	USGS [2]	Other
Automated (Molybdosilicate), or				I–2700–85	
ICP	[5] 200.7	3120 B			
62. Silver—Total,[4] mg/L; Digestion [4, 29] followed by:					
AA direct aspiration	272.1	3111 B or C		I–3720–85	974.27,[3] p. 37.[9]
AA furnace	272.2	3113 B			
ICP/AES	[5] 200.7	3120 B			
DCP					Note 34.
63. Sodium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	273.1	3111 B		I–3735–85	973.54.[3]
ICP/AES	[5] 200.7	3120 B			
DCP, or					Note 34.
Flame photometric		3500 Na D			
64. Specific conductance, micromhos/cm at 25 °C:					
Wheatstone bridge	120.1	2510 B	D1125–91(A)	I–1780–85	973.40.[3]
65. Sulfate (as SO_4), mg/L:					
Automated colorimetric (barium chloranilate)	375.1				
Gravimetric	375.3	4500–SO_4-2 C or D			925.54.[3]
Turbidimetric, or	375.4		D516–90		426C.[30]
66. Sulfide (as S), mg/L:					
Titrimetric (iodine), or	376.1	4500–S^{-2}E		I–3840–85	
Colorimetric (methylene blue)	376.2	4500–S^{-2}D			
67. Sulfite (as SO_3), mg/L:					
Titrimetric (iodine-iodate)	377.1	4500–SO_3-2 B			
68. Surfactants, mg/L:					
Colorimetric (methylene blue)	425.1	5540 C	D2330–88		
69. Temperature, °C:					
Thermometric	170.1	2550 B			Note 32.
70. Thallium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	279.1	3111 B			
AA furnace	279.2				
ICP/AES, or	[5] 200.7	3120 B			
71. Tin—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	282.1	3111 B		I–3850–78 [8]	
AA furnace, or	282.2	3113 B			
ICP/AES	[5] 200.7				
72. Titanium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	283.1	3111 D			
AA furnace	283.2				
DCP					Note 34.
73. Turbidity, NTU:					
Nephelometric	180.1	2130 B	D1889–88(A)	I–3860–85	
74. Vanadium—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration	286.1	3111 D			
AA furnace	286.2		D3373–93		

ICP/AES	[5] 200.7	3120 B			
DCP, or			D4190–82(88)		Note 34.
Colorimetric (Gallic acid)		3500–V D			
75. Zinc—Total,[4] mg/L; Digestion [4] followed by:					
AA direct aspiration [36]	289.1	3111 B or C	D1691–90 (A or B)	I–3900–85	974.27,[3] p. 37.[9]
AA furnace	289.2				
ICP/AES [36]	[5] 200.7	3120 B			
DCP,[36] or			D4190–82(88)		Note 34.
Colorimetric (Dithizone) or		3500–Zn E			
(Zincon)		3500–Zn F			Note 33.

Table IB Notes:

[1] "Methods for Chemical Analysis of Water and Wastes", Environmental Protection Agency, Environmental Monitoring Systems Laboratory-Cincinnati (EMSL-CI), EPA–600/4–79–020, Revised March 1983 and 1979 where applicable.

[2] Fishman, M.J., et al, "Methods for Analysis of Inorganic Substances in Water and Fluvial Sediments," U.S. Department of the Interior, Techniques of Water—Resource Investigations of the U.S. Geological Survey, Denver, CO, Revised 1989, unless otherwise stated.

[3] "Official Methods of Analysis of the Association of Official Analytical Chemists," methods manual, 15th ed. (1990).

[4] For the determination of total metals the sample is not filtered before processing. A digestion procedure is required to solubilize suspended material and to destroy possible organic-metal complexes. Two digestion procedures are given in "Methods for Chemical Analysis of Water and Wastes, 1979 and 1983". One (section 4.1.3), is a vigorous digestion using nitric acid. A less vigorous digestion using nitric and hydrochloric acids (section 4.1.4) is preferred; however, the analyst should be cautioned that this mild digestion may not suffice for all samples types. Particularly, if a colorimetric procedure is to be employed, it is necessary to ensure that all organo-metallic bonds be broken so that the metal is in a reactive state. In those situations, the vigorous digestion is to be preferred making certain that at no time does the sample go to dryness. Samples containing large amounts of organic materials may also benefit by this vigorous digestion, however, vigorous digestion with concentrated nitric acid will convert antimony and tin to insoluble oxides and render them unavailable for analysis. Use of ICP/AES as well as determinations for certain elements such as antimony, arsenic, the noble metals, mercury, selenium, silver, tin, and titanium require a modified sample digestion procedure and in all cases the method write-up should be consulted for specific instructions and/or cautions.

NOTE TO TABLE IB NOTE 4: If the digestion procedure for direct aspiration AA included in one of the other approved references is different than the above, the EPA procedure must be used.

Dissolved metals are defined as those constituents which will pass through a 0.45 micron membrane filter. Following filtration of the sample, the referenced procedure for total metals must be followed. Sample digestion of the filtrate for dissolved metals (or digestion of the original sample solution for total metals) may be omitted for AA (direct aspiration or graphite furnace) and ICP analyses, provided the sample solution to be analyzed meets the following criteria:

a. has a low COD (<20)
b. is visibly transparent with a turbidity measurement of 1 NTU or less
c. is colorless with no perceptible odor, and
d. is of one liquid phase and free of particulate or suspended matter following acidification.

[5] The full text of Method 200.7, "Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes," is given at Appendix C of this Part 136.

[6] Manual distillation is not required if comparability data on representative effluent samples are on company file to show that this preliminary distillation step is not necessary: however, manual distillation will be required to resolve any controversies.

[7] Ammonia, Automated Electrode Method, Industrial Method Number 379–75 WE, dated February 19, 1976, (Bran & Luebbe (Technicon) Auto Analyzer II, Bran & Luebbe Analyzing Technologies, Inc., Elmsford, NY 10523.

[8] The approved method is that cited in "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments", USGS TWRI, Book 5, Chapter A1 (1979).

[9] American National Standard on Photographic Processing Effluents, Apr. 2, 1975. Available from ANSI, 1430 Broadway, New York, NY 10018.

[10] "Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency", Supplement to the Fifteenth Edition of Standard Methods for the Examination of Water and Wastewater (1981).

[11] The use of normal and differential pulse voltage ramps to increase sensitivity and resolution is acceptable.

[12] Carbonaceous biochemical oxygen demand ($CBOD_5$) must not be confused with the traditional BOD_5 test which measures "total BOD". The addition of the nitrification inhibitor is not a procedural option, but must be included to report the $CBOD_5$ parameter. A discharger whose permit requires reporting the traditional BOD_5 may not use a nitrification inhibitor in the procedure for reporting the results. Only when a discharger's permit specifically states $CBOD_5$ is required can the permittee report data using the nitrification inhibitor.

[13] OIC Chemical Oxygen Demand Method, Oceanography International Corporation, 1978, 512 West Loop, P.O. Box 2980, College Station, TX 77840.

[14] Chemical Oxygen Demand, Method 8000, Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[15] The back titration method will be used to resolve controversy.

[16] Orion Research Instruction Manual, Residual Chlorine Electrode Model 97–70, 1977, Orion Research Incorporated, 840 Memorial Drive, Cambridge, MA 02138. The calibration graph for the Orion residual chlorine method must be derived using a reagent blank and three standard solutions, containing 0.2, 1.0, and 5.0 ml 0.00281 N potassium iodate/100 ml solution, respectively.

[17] The approved method is that cited in Standard Methods for the Examination of Water and Wastewater, 14th Edition, 1976.

[18] National Council of the Paper Industry for Air and Stream Improvement, (Inc.) Technical Bulletin 253, December 1971.

[19] Copper, Biocinchoinate Method, Method 8506, Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[20] After the manual distillation is completed, the autoanalyzer manifolds in EPA Methods 335.3 (cyanide) or 420.2 (phenols) are simplified by connecting the re-sample line directly to the sampler. When using the mainfold setup shown in Method 335.3, the buffer 6.2 should be replaced with the buffer 7.6 found in Method 335.2.

[21] Hydrogen ion (pH) Automated Electrode Method, Industrial Method Number 378–75WA, October 1976, Bran & Luebbe (Technicon) Autoanalyzer II. Bran & Luebbe Analyzing Technologies, Inc., Elmsford, NY 10523.

[22] Iron, 1,10-Phenanthroline Method, Method 8008, 1980, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[23] Manganese, Periodate Oxidation Method, Method 8034, Hach Handbook of Wastewater Analysis, 1979, pages 2–113 and 2–117, Hach Chemical Company, Loveland, CO 80537.

[24] Wershaw, R.L., et al, ''Methods for Analysis of Organic Substances in Water,'' Techniques of Water-Resources Investigation of the U.S. Geological Survey, Book 5, Chapter A3, (1972 Revised 1987) p. 14.

[25] Nitrogen, Nitrite, Method 8507, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[26] Just prior to distillation, adjust the sulfuric-acid-preserved sample to pH 4 with 1 + 9 NaOH.

[27] The approved method is cited in Standard Methods for the Examination of Water and Wastewater, 14th Edition. The colorimetric reaction is conducted at a pH of 10.0±0.2. The approved methods are given on pp 576–81 of the 14th Edition: Method 510A for distillation, Method 510B for the manual colorimetric procedure, or Method 510C for the manual spectophotometric procedure.

[28] R. F. Addison and R.G. Ackman, ''Direct Determination of Elemental Phosphorus by Gas-Liquid Chromatography,'' Journal of Chromatography, vol. 47, No. 3, pp. 421–426, 1970.

[29] Approved methods for the analysis of silver in industrial wastewaters at concentrations of 1 mg/L and above are inadequate where silver exists as an inorganic halide. Silver halides such as the bromide and chloride are relatively insoluble in reagents such as nitric acid but are readily soluble in an aqueous buffer of sodium thiosulfate and sodium hydroxide to pH of 12. Therefore, for levels of silver above 1 mg/L, 20 mL of sample should be diluted to 100 mL by adding 40 mL each of 2 M $Na_2S_2O_3$ and NaOH. Standards should be prepared in the same manner. For levels of silver below 1 mg/L the approved method is satisfactory.

[30] The approved method is that cited in Standard Methods for the Examination of Water and Wastewater, 15th Edition.

[31] EPA Methods 335.2 and 335.3 require the NaOH absorber solution final concentration to be adjusted to 0.25 N before colorimetric determination of total cyanide.

[32] Stevens, H.H., Ficke, J.F., and Smoot, G.F., ''Water Temperature—Influential Factors, Field Measurement and Data Presentation'', Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 1, Chapter D1, 1975.

[33] Zinc, Zincon Method, Method 8009, Hach Handbook of Water Analysis, 1979, pages 2–231 and 2–333, Hach Chemical Company, Loveland, CO 80537.

[34] ''Direct Current Plasma (DCP) Optical Emission Spectrometric Method for Trace Elemental Analysis of Water and Wastes, Method AES0029,'' 1986—Revised 1991, Fison Instruments, Inc., 32 Commerce Center, Cherry Hill Drive, Danvers, MA 01923.

[35] Precision and recovery statements for the atomic absorption direct aspiration and graphite furnace methods, and for the spectrophotometric SDDC method for arsenic are provided in Appendix D of this part titled, ''Precision and Recovery Statements for Methods for Measuring Metals''.

[36] ''Closed Vessel Microwave Digestion of Wastewater Samples for Determination of Metals'', CEM Corporation, P.O. Box 200, Matthews, NC 28106–0200, April 16, 1992. Available from the CEM Corporation.

[37] When determining boron and silica, only plastic, PTFE, or quartz laboratory ware may be used from start until completion of analysis.

[38] Only the trichlorofluoromethane extraction solvent is approved.

[39] Nitrogen, Total Kjeldahl, Method PAI–DK01 (Block Digestion, Steam Distillation, Titrimetric Detection), revised 12/22/94, Perstop Analytical Corporation.

[40] Nitrogen, Total Kjeldahl, Method PAI–DK02 (Block Digestion, Steam Distillation, Colorimetric Detection), revised 12/22/94, Perstop Analytical Corporation.

[41] Nitrogen, Total Kjeldahl, Method PAI–DK03 (Block Digestion, Automated FIA Gas Diffusion), revised 12/22/94, Perstop Analytical Corporation.

[42] Method 1664, Revision A ''n-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractablke Material (SGT–HEM; Non-polar Material) by Extraction and Gravimetry'' EPA–821–R–98–002, February 1999. Available at NTIS, PB–121949, U.S. Department of Commerce, 5285 Port Royal, Springfield, Virginia 22161.

[43] The application of clean techniques described in EPA's draft Method 1669: *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA–821–R–96–011) are recommended to preclude contamination at low-level, trace metal determinations.

[44] Available Cyanide, Method OIA–1677 (Available Cyanide by Flow Injection, Ligand Exchange, and Amperometry), ALPKEM, A Division of OI Analytical, P.O. Box 9010, College Station, TX 77842–9010.

TABLE IC.—LIST OF APPROVED TEST PROCEDURES FOR NON-PESTICIDE ORGANIC COMPOUNDS

Parameter [1]	EPA method number [2,7]					
	GC	GC/MS	HPLC	Standard method 18th Ed.	ASTM	Other
1. Acenaphthene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
2. Acenaphthylene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
3. Acrolein	603	[4] 604, 1624	....			
4. Acrylonitrile	603	[4] 624, 1624	610			
5. Anthracene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
6. Benzene	602	624, 1624	....	6210 B, 6220 B		
7. Benzidine	....	[5] 625, 1625	605			Note 3, p.1.
8. Benzo(a)anthracene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
9. Benzo(a)pyrene	610	625, 1625	610	6410 B, 6440 B	D4657–92	

10. Benzo(b)fluoranthene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
11. Benzo(g, h, i)perylene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
12. Benzo(k)fluoranthene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
13. Benzyl chloride	...	...	...			Note 3, p.130: Note 6, p. S102.
14. Benzyl butyl phthalate	606	625, 1625	...	6410 B		
15. Bis(2-chloroethoxy) methane	611	625, 1625	...	6410 B		
16. Bis(2-chloroethyl) ether	611	625, 1625	...	6410 B		
17. Bis (2-ethylhexyl) phthalate	606	625, 1625	...	6410 B, 6230 B		
18. Bromodichloromethane	601	624, 1624	...	6210 B, 6230 B		
19. Bromoform	601	624, 1624	...	6210 B, 6230 B		
20. Bromomethane	601	624, 1624	...	6210 B, 6230 B		
21. 4-Bromophenylphenyl ether	611	625, 1625	...	6410 B		
22. Carbon tetrachloride	601	624, 1624	...	6230 B, 6410 B		Note 3, p.130.
23. 4-Chloro-3-methylphenol	604	625, 1625	...	6410 B, 6420 B		
24. Chlorobenzene	601, 602	624, 1624	...	6210 B, 6220 B 6230 B		Note 3, p.130.
25. Chloroethane	601	624, 1624	...	6210 B, 6230 B		
26. 2-Chloroethylvinyl ether	601	624, 1624	...	6210 B, 6230 B		
27. Chloraform	601	624, 1624	...	6210 B, 6230 B		Note, p.130.
28. Chloromethane	601	624, 1624	...	6210 B. 6230 B		
29. 2-Chloronaphthalene	612	625, 1625	...	6410 B		
30. 2-Chlorophenol	604	625, 1625	...	6410 B, 6420 B		
31. 4-Chlorophenylphenyl ether	611	625, 1625	...	6410 B		
32. Chrysene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
33. Dibenzo(a,h)anthracene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
34. Dibromochloromethane	601	624, 1624	...	6210 B, 6230 B		
35. 1, 2-Dichlorobenzene	601,602,612	624,625,1625	...	6410 B, 6230 B, 6220 B		
36. 1, 3-Dichlorobenzene	601,602,612	624,625,1625	...	6410 B, 6230 B, 6220 B		
37. 1,4-Dichlorobenzene	601, 602, 612	624, 625, 1625	...	6410 B, 6220 B, 6230 B		
38. 3, 3-Dichlorobenzidine	...	625, 1625	605	6410 B		
39. Dichlorodifluoromethane	601	...	...	6230 B		
40. 1, 1-Dichloroethane	601	624, 1624	...	6230 B, 6210 B		
41. 1, 2-Dichloroethane	601	624, 1624	...	6230 B, 6210 B		
42. 1, 1-Dichloroethene	601	624, 1624	...	6230 B, 6210 B		
43. trans-1, 2-Dichloroethene	601	624, 1624	...	6230 B, 6210 B		
44. 2, 4-Dichlorophenol	604	625, 1625	...	6420 B, 6410 B		
45. 1, 2-Dichloropropane	601	624, 1624	...	6230 B, 6210 B		
46. cis-1, 3-Dichloropropene	601	624, 1624	...	6230 B, 6210 B		
47. trans-1, 3-Dichloropropene	601	624, 1624	...	6230 B, 6210 B		
48. Diethyl phthalate	606	625, 1625	...	6410 B		
49. 2, 4-Dimethylphenol	604	625, 1625	...	6420 B, 6410 B		
50. Dimethyl phthalate	606	625, 1625	...	6410 B		
51. Di-n-butyl phthalate	606	625, 1625	...	6410 B		
52. Di-n-octyl phthalate	606	625, 1625	...	6410 B		
53. 2,4-Dinitrophenol	604	625, 1625	...	6420 B, 6410 B		
54. 2,4-Dinitrotoluene	609	625, 1625	...	6410 B		
55. 2, 6-Dinitrotoluene	609	625, 1625	...	6410 B		

TABLE IC.—LIST OF APPROVED TEST PROCEDURES FOR NON-PESTICIDE ORGANIC COMPOUNDS—Continued

Parameter [1]	EPA method number [2,7]					
	GC	GC/MS	HPLC	Standard method 18th Ed.	ASTM	Other
56. Epichlorohydrin	....	....	....			Note 3, p.130 Note 6, p.S102.
57. Ethylbenzene	602	624, 1624	....	6220 B, 6210 B		
58. Fluoranthene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
59. Fluorene	610	625, 1625	610	6410 B, 6440 B	D4657–92	
60. 1,2,3,4,6,7,8-Heptachlorodibenzofuran	....	1613	....			
61. 1,2,3,4,7,8,9-Heptachlorodibenzofuran	....	1613	....			
62. 1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin	....	1613	....			
63. Hexachlorobenzene	612	625, 1625	....	6410 B		
64. Hexachlorobutadiene	612	625, 1625	....	6410 B		
65. Hexachlorocyclopentadiene	612	625, 1625 [5]	....	6410 B		
66. 1,2,3,4,7,8-Hexachlorodibenzofuran	....	1613	....			
67. 1,2,3,6,7,8-Hexachlorodibenzofuran	....	1613	....			
68. 1,2,3,7,8,9-Hexachlorodibenzofuran	....	1613	....			
69. 2,3,4,6,7,8-Hexachlorodibenzofuran	....	1613	....			
70. 1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin	....	1613	....			
71. 1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin	....	1613	....			
72. 1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin	....	1613	....			
73. Hexachloroethane	616	625, 1625	....	6410 B		
74. Ideno(1,2,3-cd)pyrene	610	625, 1625	610	6410 B, 6440 B	D4657–87	
75. Isophorone	609	625, 1625	....	6410 B		
76. Methylene chloride	601	624, 1624	....	6230 B		Note 3, p. 130.
77. 2-Methyl-4,6-dinitrophenol	604	625, 1625	....	6420 B, 6410 B		
78. Naphthalene	610	625, 1625	610	6410 B, 6440 B		
79. Nitrobenzene	609	625, 1625	....	6410 B	D4657–87	
80. 2-Nitrophenol	604	625, 1625	....	6410 B, 6420 B		
81. 4-Nitrophenol	604	625, 1625	....	6410 B, 6420 B		
82. N-Nitrosodimethylamine	607	625, 1625	....	6410 B		
83. N-Nitrosodi-n-propylamine	607	625, 1625 [5]	....	6410 B		
84. N-Nitrosodiphenylamine	607	625, 1625 [5]	....	6410 B		
85. Octachlorodibenzofuran	....	1613	....			
86. Octachlorodibenzo-*p*-dioxin	....	1613	....			
87. 2,2-Oxybis(1-chloropropane)	611	625, 1625	....	6410 B		
88. PCB–1016	608	625	....	6410 B		Note 3, p. 43.
89. PCB–1221	608	625	....	6410 B		Note 3, p. 43.
90. PCB–1232	608	625	....	6410 B		Note 3, p. 43.
91. PCB 1242	608	625	....	6410 B		Note 3, p. 43.
92. PCB–1248	608	625	....			
93. PCB–1254	608	625	....	6410 B		Note 3, p. 43.
94. PCB–1260	608	625	....	6410 B, 6630 B		Note 3, p. 43.
95. 1,2,3,7,8-Pentachlorodibenzofuran	....	1613	....			
96. 2,3,4,7,8-Pentachlorodibenzofuran	....	1613	....			
97. 1,2,3,7,8-Pentachlorodibenzo-*p-dioxin*	....	1613	....			

98. Pentachlorophenol	604	625, 1625		6410 B, 6630 B		Note 3, p. 140.
99. Phenanthrene	610	625, 1625	610	6410 B, 6440 B	D4657–87	
100. Phenol	604	625, 1625		6420 B, 6410 B		
101. Pyrene	610	625, 1625	610	6410 B, 6440 B	D4657–87	
102. 2,3,7,8-Tetrachlorodibenzofuran		1613				
103. 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin		613, 1613[5]				
104. 1,1,2,2-Tetrachloroethane	601	624, 1624		6230 B, 6210 B		Note 3, p. 130.
105. Tetrachloroethene	601	624, 1624		6230 B, 6410 B		Note 3, p. 130.
106. Toluene	602	624, 1624		6210 B, 6220 B		
107. 1,2,4-Trichlorobenzene	612	625, 1625		6410 B		Note 3, p. 130.
108. 1,1,1-Trichloroethane	601	624, 1624		6210 B, 6230 B		
109. 1,1,2-Trichloroethane	601	624, 1624		6210 B, 6230 B		Note 3, p. 130.
110. Trichloroethene	601	624, 1624		6210 B, 6230 B		
111. Trichlorofluoromethane	601	624		6210 B, 6230 B		
112. 2,4,6-Trichlorophenol	604	625, 1625		6410 B, 6240 B		
113. Vinyl chloride	601	624, 1624		6210 B, 6230 B		

Table 1C notes:

[1] All parameters are expressed in micrograms per liter (µg/L) except for Method 1613 in which the parameters are expressed in picograms per liter (pg/L).

[2] The full text of Methods 601–613, 624, 625, 1624, and 1625, are given at appendix A, "Test Procedures for Analysis of Organic Pollutants," of this part 136. The full text of Method 1613 is incorporated by reference into this part 136 and is available from the National Technical Information Services as stock number PB95–104774. The standardized test procedure to be used to determine the method detection limit (MDL) for these test procedures is given at appendix B, "Definition and Procedures for the Determination of the Method Detection Limit," of this part 136.

[3] "Methods for Benzidine: Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater," U.S. Environmental Protection Agency, September, 1978.

[4] Method 624 may be extended to screen samples for Acrolein and Acrylonitrile. However, when they are known to be present, the preferred method for these two compounds is Method 603 or Method 1624.

[5] Method 625 may be extended to include benzidine, hexachlorocyclopentadiene, N-nitrosodimethylamine, and N-nitrosodiphenylamine. However, when they are known to be present, Methods 605, 607, and 612, or Method 1625, are preferred methods for these compounds.

[5a] 625, Screening only.

[6] "Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency", Supplement to the Fifteenth Edition of Standard Methods for the Examination of Water and Wastewater (1981).

[7] Each Analyst must make an initial, one-time demonstration of their ability to generate acceptable precision and accuracy with Methods 601–603, 624, 625, 1624, and 1625 (See Appendix A of this Part 136) in accordance with procedures each in section 8.2 of each of these Methods. Additionally, each laboratory, on an on-going basis must spike and analyze 10% (5% for Methods 624 and 625 and 100% for methods 1624 and 1625) of all samples to monitor and evaluate laboratory data quality in accordance with sections 8.3 and 8.4 of these Methods. When the recovery of any parameter falls outside the warning limits, the analytical results for that parameter in the unspiked sample are suspect and cannot be reported to demonstrate regulatory compliance.

NOTE: These warning limits are promulgated as an "interim final action with a request for comments."

[8] "Organochlorine Pesticides and PCBs in Wastewater Using Empore TM Disk", 3M Corporation Revised 10/28/94.

TABLE ID.—LIST OF APPROVED TEST PROCEDURES FOR PESTICIDES [1]

Parameter	Method	EPA [2,7]	Standard methods 18th Ed.	ASTM	Other
1. Aldrin	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	625	6410 B		
2. Ametryn	GC				Note 3, p. 83; Note 6, p. S68.
3. Aminocarb	TLC				Note 3, p. 94; Note 6, p. S16.
4. Atraton	GC				Note 3, p. 83; Note 6, p. S68.
5. Atrazine	GC				Note 3, p. 83; Note 6, p. S68.
6. Azinphos methyl	GC				Note 3, p. 25; Note 6, p. S51.
7. Barban	TLC				Note 3, p. 104; Note 6, p. S64.
8. α-BHC	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 8.
	GC/MS	[5] 625	6410 B		

TABLE ID.—LIST OF APPROVED TEST PROCEDURES FOR PESTICIDES 1—Continued

Parameter	Method	EPA [2,7]	Standard methods 18th Ed.	ASTM	Other
9. β-BHC	GC	608	6630 C	D3086–90	Note 8.
	GC/MS	[5] 625	6410 B		
10. δ-BHC	GC	608	6630 C	D3086–90	Note 8.
	GC/MS	[5] 625	6410 B		
11. δ-BHC (Lindane)	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	625	6410 B		
12. Captan	GC		6630 B	D3086–90	Note 3, p. 7.
13. Carbaryl	TLC				Note 3, p. 94: Note 6, p. S60.
14. Carbophenothion	GC				Note 4, p. 30; Note 6, p. S73.
15. Chlordane	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 8.
	GC/MS	625	6410 B		
16. Chloropropham	TLC				Note 3, p. 104; Note 6, p. S64.
17. 2,4–D	GC		6640 B		Note 3, p. 115; Note 4, p. 35.
18. 4,4′–DDD	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	625	6410 B		
19. 4,4′–DDE	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	625	6410 B		
20. 4,4′–DDT	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	625	6410 B		
21. Demeton–O	GC				Note 3, p. 25; Note 6, p. S51.
22. Demeton-S	GC				Note 3, p. 25: Note 6, p. S51.
23. Diazinon	GC				Note 3, p. 25; Note 4, p. 30; Note 6, p. S51.
24. Dicamba	GC				Note 3, p. 115.
25. Dichlofenthion	GC				Note 4, p. 30; Note 6, p. S73.
26. Dichloran	GC		6630 B & C		Note 3, p. 7.
27. Dicofol	GC			D3086–90	
28. Dieldrin	GC	608	6630 B & C		Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	625	6410 B		
29. Dioxathion	GC				Note 4, p. 30; Note 6, p. S73.
30. Disulfoton	GC				Note 3, p. 25; Note 6, p. S51.
31. Diuron	TLC				Note 3, p. 104; Note 6, p. S64.
32. Endosulfan I	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 8.
	GC/MS	[5] 625	6410 B		
33. Endosulfan II	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 8.
	GC/MS	[5] 625	6410 B		
34. Endosulfan Sulfate	GC	608	6630 C		Note 8.
	GC/MS	625	6410 B		
35. Endrin	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	[5] 625	6410 B		
36. Endrin aldehyde	GC	608			Note 8.
	GC/MS	625			

37. Ethion	GC				Note 4, p. 30; Note 6, p. S73.
38. Fenuron	TLC				Note 3, p. 104; Note 6, p. S64.
39. Fenuron–TCA	TLC				Note 3, p. 104; Note 6, p. S64.
40. Heptachlor	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	625	6410 B		
41. Heptachlor epoxide	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 6, p. S73; note 8.
	GC/MS	625	6410 B		
42. Isodrin	GC				Note 4, p. 30; Note 6, p. S73.
43. Linuron	GC				Note 3, p. 104; Note 6, p. S64.
44. Malathion	GC		6630 C		Note 3, p. 25; Note 4, p. 30; Note 6, p. S51.
45. Methiocarb	TLC				Note 3, p. 94; Note 6, p. S60.
46. Methoxychlor	GC		6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
47. Mexacarbate	TLC				Note 3, p. 94; Note 6, p. S60.
48. Mirex	GC		6630 B & C		Note 3, p. 7.
49. Monuron	TLC				Note 3, p. 104; Note 6, p. S64.
50. Monuron	TLC				Note 3, p. 104; Note 6, p. S64.
51. Nuburon	TLC				Note 3, p. 104; Note 6, p. S64.
52. Parathion methyl	GC		6630 C		Note 3, p. 25; Note 4, p. 30.
53. Parathion ethyl	GC		6630 C		Note 3, p. 25.
54. PCNB	GC		6630 B & C		Note 3, p. 7.
55. Perthane	GC			D3086–90	
56. Prometron	GC				Note 3, p. 83; Note 6, p. S68.
57. Prometryn	GC				Note 3, p. 83; Note 6, p. S68.
58. Propazine	GC				Note 3, p. 83; Note 6, p. S68.
59. Propham	TLC				Note 3, p. 104; Note 6, p. S64.
60. Propoxur	TLC				Note 3, p. 94; Note 6, p. S60.
61. Secbumeton	TLC				Note 3, p. 83; Note 6, p. S68.
62. Siduron	TLC				Note 3, p. 104; Note 6, p. S64.
63. Simazine	GC				Note 3, p. 83; Note 6, p. S68.
64. Strobane	GC		6630 B & C		Note 3, p. 7.
65. Swep	TLC				Note 3, p. 104; Note 6, p. S64.
66. 2,4,5–T	GC		6640 B		Note 3, p. 115; Note 4, p. 35.
67. 2,4,5–TP (Silvex)	GC		6640 B		Note 3, p. 115
68. Terbuthylazine	GC				Note 3, p. 83; Note 6, p. S68.
69. Toxaphene	GC	608	6630 B & C	D3086–90	Note 3, p. 7; note 4, p. 30; note 8.
	GC/MS	625	6410 B		
70. Trifluralin	GC		6630 B		Note 3, p. 7.

Table ID notes:
[1] Pesticides are listed in this table by common name for the convenience of the reader. Additional pesticides may be found under Table 1C, where entries are listed by chemical name.
[2] The full text of Methods 608 and 625 are given at Appendix A. ''Test Procedures for Analysis of Organic Pollutants,'' of this Part 136. The standardized test procedure to be used to determine the method detection limit (MDL) for these test procedures is given at Appendix B. ''Definition and Procedure for the Determination of the Method Detection Limit'', of this Part 136.
[3] ''Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater,'' U.S. Environmental Protection Agency, September, 1978. This EPA publication includes thin-layer chromatography (TLC) methods.
[4] ''Methods for Analysis of Organic Substances in Water and Fluvial Sediments,'' Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 5, Chapter A3 (1987).
[5] The method may be extended to include α-BHC, γ-BHC, endosulfan I, endosulfan II, and endrin. However, when they are known to exist, Method 608 is the preferred method.
[6] ''Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency.'' Supplement to the Fifteenth Edition of Standard Methods for the Examination of Water and Wastewater (1981).

[7] Each analyst must make an initial, one-time, demonstration of their ability to generate acceptable precision and accuracy with Methods 608 and 625 (See Appendix A of this Part 136) in accordance with procedures given in section 8.2 of each of these methods. Additionally, each laboratory, on an-going basis, must spike and analyze 10% of all samples analyzed with Method 608 or 5% of all samples analyzed with Method 625 to monitor and evaluate laboratory data quality in accordance with Sections 8.3 and 8.4 of these methods. When the recovery of any parameter falls outside the warning limits, the analytical results for that parameter in the unspiked sample are suspect and cannot be reported to demonstrate regulatory compliance. These quality control requirements also apply to the Standard Methods, ASTM Methods, and other Methods cited.

NOTE: These warning limits are promulgated as an ''Interim final action with a request for comments.''

[8] ''Organochlorine Pesticides and PCBs in Wastewater Using Empore™ Disk'', 3M Corporation, Revised 10/28/94.

TABLE IE.—LIST OF APPROVED RADIOLOGIC TEST PROCEDURES

Parameter and units	Method	Reference (method number or page)			
		EPA[1]	Standard methods 18th Ed.	ASTM	USGS[2]
1. Alpha-Total, pCi per liter	Proportional or scintillation counter	900	7110 B	D1943–90	pp. 75 and 78.[3]
2. Alpha-Counting error, pCi per liter	Proportional or scintillation counter	Appendix B	7110 B	D1943–90	P. 79.
3. Beta-Total, pCi per liter	Proportional counter	900.0	7110 B	D1890–90	pp. 75 and 78.[3]
4. Beta-Counting error, pCi	Proportional counter	Appendix B	7110 B	D1890–90	p. 79.
5. (a) Radium Total pCi per liter	Proportional counter	903.0	7500Ra B	D2460–90	
(b)Ra, pCi per liter	Scintillation counter	903.1	7500Ra C	D3454–91	p. 81.

Table IE notes:

[1] Prescribed Procedures for Measurement of Radioactivity in Drinking Water,'' EPA–600/4–80–032 (1980), U.S. Environmental Protection Agency, August 1980.

[2] Fishman, M.J. and Brown, Eugene,'' Selected Methods of the U.S. Geological Survey of Analysis of Wastewaters,'' U.S. Geological Survey, Open-File Report 76–177 (1976).

[3] The method found on p. 75 measures only the dissolved portion while the method on p. 78 measures only the suspended portion. Therefore, the two results must be added to obtain the ''total''.

TABLE IF.—LIST OF APPROVED METHODS FOR PHARMACEUTICAL POLLUTANTS

Pharmaceuticals pollutants	CAS registry No.	Analytical method number
acetonitrile	75–05–8	1666/1671/D3371/D3695.
n-amyl acetate	628–63–7	1666/D3695.
n-amyl alcohol	71–41–0	1666/D3695
benzene	71–43–2	D4763/D3695/502.2/524.2.
n-butyl-acetate	123–86–4	1666/D3695.
tert-butyl alcohol	75–65–0	1666.
chlorobenzene	108–90–7	502.2/524.2.
chloroform	67–66–3	502.2/524.2/551.
o-dichlorobenzene	95–50–1	1625C/502.2/524.2.
1,2-dichloroethane	107–06–2	D3695/502.2/524.2.
diethylamine	109–89–7	1666/1671.
dimethyl sulfoxide	67–68–5	1666/1671.
ethanol	64–17–5	1666/1671/D3695.
ethyl acetate	141–78–6	1666/D3695.
n-heptane	142–82–5	1666/D3695.
n-hexane	110–54–3	1666/D3695.
isobutyraldehyde	78–84–2	1666/1667.
isopropanol	67–63–0	1666/D3695.
isopropyl acetate	108–21–4	1666/D3695.
isopropyl ether	108–20–3	1666/D3695.
methanol	67–56–1	1666/1671/D3695.
Methyl Cellosolve Δ	109–86–4	1666/1671
methylene chloride	75–09–2	502.2/524.2
methyl formate	107–31–3	1666.
4-methyl-2-pentanone (MIBK)	108–10–1	1624C/1666/D3695/D4763/524.2.
phenol	108–95–2	D4763.
n-propanol	71–23–8	1666/1671/D3695.
2-propanone (acetone)	67–64–1	D3695/D4763/524.2.
tetrahydrofuran	109–99–9	1666/524.2.
toluene	108–88–3	D3695/D4763/502.2/524.2.
triethlyamine	121–44–8	1666/1671.
xylenes	(Note 1)	1624C/1666.

Table 1F note:
1. 1624C: m-xylene 108–38–3, o,p-xylene E–14095 (Not a CAS number; this is the number provided in the Environmental Monitoring Methods Index (EMMI) database.); 1666: m,p-xylene 136777–61–2, o-xylene 95–47–6.

(b) The full texts of the methods from the following references which are cited in Tables IA, IB, IC, ID, IE,and IF are incorporated by reference into this regulation and may be obtained from the sources identified. All costs cited are subject to change and must be verified from the indicated sources. The full texts of all the test procedures cited are available for inspection at the National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, 26 West Martin Luther King Dr., Cincinnati, OH 45268 and the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, DC.

REFERENCES, SOURCES, COSTS, AND TABLE CITATIONS:

(1) The full texts of Methods 601–613, 624, 625, 1613, 1624, and 1625 are printed in appendix A of this part 136. The full text for determining the method detection limit when using the test procedures is given in appendix B of this part 136. The full text of Method 200.7 is printed in appendix C of this part 136. Cited in: Table IB, Note 5; Table IC, Note 2; and Table ID, Note 2.

(2) USEPA. 1978. Microbiological Methods for Monitoring the Environment, Water, and Wastes. Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. EPA/600/8–78/017. Available from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, Publ. No. PB–290329/AS. Cost: $36.95. Table IA, Note 3.

(3) ''Methods for Chemical Analysis of Water and Wastes,'' U.S. Environmental Protection Agency, EPA–600/4–79–020, March 1979, or ''Methods for Chemical Analysis of Water and Wastes,'' U.S. Environmental Protection Agency, EPA–600/4–79–020, Revised March 1983. Available from: ORD Publications, CERI, U.S. Environmental

Protection Agency, Cincinnati, Ohio 45268, Table IB, Note 1.

(4) ''Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater,'' U.S. Environmental Protection Agency, 1978. Available from: ORD Publications, CERI, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268, Table IC, Note 3; Table D, Note 3.

(5) ''Prescribed Procedures for Measurement of Radioactivity in Drinking Water,'' U.S. Environmental Protection Agency, EPA–600/4–80–032, 1980. Available from: ORD Publications, CERI, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268, Table IE, Note 1.

(6) American Public Health Association. 1992. Standard Methods for the Examination of Water and Wastewater. 18th Edition. Amer. Publ. Hlth. Assoc., 1015 15th Street NW, Washington, DC 20005. Cost: $160.00. Table IA, Note 4.

(7) Ibid, 15th Edition, 1980. Table IB, Note 30; Table ID.

(8) Ibid, 14th Edition, 1975. Table IB, Notes 17 and 27.

(9) ''Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency,'' Supplement to the 15th Edition of Standard Methods for the Examination of Water and Wastewater, 1981. Available from: American Public Health Association, 1015 Fifteenth Street NW., Washington, DC 20036. Cost available from publisher. Table IB, Note 10; Table IC, Note 6; Table ID, Note 6.

(10) Annual Book of ASTM Standards, Water and Environmental Technology, Section 11, Volumes 11.01 and 11.02, 1994 in 40 CFR 136.3, Tables IB, IC, ID and IE.

(11) USGS. 1989. U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Laboratory Analysis, Chapter A4, Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples, U.S. Geological Survey, U.S. Department of the Interior, Reston, Virginia. Available from: USGS Books and Open-File Reports Section, Federal Center, Box 25425, Denver, Colorado 80225. Cost: $18.00. Table IA, Note 5.

(12) ''Methods for Determination of Inorganic Substances in Water and Fluvial Sediments,'' by M.J. Fishman and Linda C. Friedman, Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 5 Chapter A1 (1989). Available from: U.S. Geological Survey, Denver Federal Center, Box 25425, Denver, CO 80225. Cost: $108.75 (subject to change). Table IB, Note 2.

(13) ''Methods for Determination of Inorganic Substances in Water and Fluvial Sediments,'' N.W. Skougstad and others, editors. Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 5, Chapter A1 (1979). Available from: U.S. Geological Survey, Denver Federal Center, Box 25425, Denver, CO 80225. Cost: $10.00 (subject to change), Table IB, Note 8.

(14) ''Methods for the Determination of Organic Substances in Water and Fluvial Sediments,'' Wershaw, R.L., et al, Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 5, Chapter A3 (1987). Available from: U.S. Geological Survey, Denver Federal Center, Box 25425, Denver, CO 80225. Cost: $0.90 (subject to change). Table IB, Note 24; Table ID, Note 4.

(15) ''Water Temperature—Influential Factors, Field Measurement and Data Presentation,'' by H.H. Stevens, Jr., J. Ficke, and G.F. Smoot, Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 1, Chapter D1, 1975. Available from: U.S. Geological Survey, Denver Federal Center, Box 25425, Denver, CO 80225. Cost: $1.60 (subject to change). Table IB, Note 32.

(16) ''Selected Methods of the U.S. Geological Survey of Analysis of Wastewaters,'' by M.J. Fishman and Eugene Brown; U.S. Geological Survey Open File Report 76–77 (1976). Available from: U.S. Geological Survey, Branch of Distribution, 1200 South Eads Street, Arlington, VA 22202. Cost: $13.50 (subject to change). Table IE, Note 2.

(17) ''Official Methods of Analysis of the Association of Official Analytical Chemicals'', Methods manual, 15th Edition (1990). Price: $240.00. Available from: The Association of Official Analytical Chemists, 2200 Wilson Boulevard, Suite 400, Arlington, VA 22201. Table IB, Note 3.

(18) ''American National Standard on Photographic Processing Effluents,'' April 2, 1975. Available from: American

National Standards Institute, 1430 Broadway, New York, New York 10018. Table IB, Note 9.

(19) ''An Investigation of Improved Procedures for Measurement of Mill Effluent and Receiving Water Color,'' NCASI Technical Bulletin No. 253, December 1971. Available from: National Council of the Paper Industry for Air and Stream Improvements, Inc., 260 Madison Avenue, New York, NY 10016. Cost available from publisher. Table IB, Note 18.

(20) Ammonia, Automated Electrode Method, Industrial Method Number 379–75WE, dated February 19, 1976. Technicon Auto Analyzer II. Method and price available from Technicon Industrial Systems, Tarrytown, New York 10591. Table IB, Note 7.

(21) Chemical Oxygen Demand, Method 8000, Hach Handbook of Water Analysis, 1979. Method price available from Hach Chemical Company, P.O. Box 389, Loveland, Colorado 80537. Table IB, Note 14.

(22) OIC Chemical Oxygen Demand Method, 1978. Method and price available from Oceanography International Corporation, 512 West Loop, P.O. Box 2980, College Station, Texas 77840. Table IB, Note 13.

(23) ORION Research Instruction Manual, Residual Chlorine Electrode Model 97–70, 1977. Method and price available from ORION Research Incorporation, 840 Memorial Drive, Cambridge, Massachusetts 02138. Table IB, Note 16.

(24) Bicinchoninate Method for Copper. Method 8506, Hach Handbook of Water Analysis, 1979, Method and price available from Hach Chemical Company, P.O. Box 300, Loveland, Colorado 80537. Table IB, Note 19.

(25) Hydrogen Ion (pH) Automated Electrode Method, Industrial Method Number 378–75WA. October 1976. Bran & Luebbe (Technicon) Auto Analyzer II. Method and price available from Bran & Luebbe Analyzing Technologies, Inc. Elmsford, N.Y. 10523. Table IB, Note 21.

(26) 1,10-Phenanthroline Method using FerroVer Iron Reagent for Water, Hach Method 8008, 1980. Method and price available from Hach Chemical Company, P.O. Box 389 Loveland, Colorado 80537. Table IB, Note 22.

(27) Periodate Oxidation Method for Manganese, Method 8034, Hach Handbook for Water Analysis, 1979. Method and price available from Hach Chemical Company, P.O. Box 389, Loveland, Colorado 80537. Table IB, Note 23.

(28) Nitrogen, Nitrite—Low Range, Diazotization Method for Water and Wastewater, Hach Method 8507, 1979. Method and price available from Hach Chemical Company, P.O. Box 389, Loveland, Colorado 80537. Table IB, Note 25.

(29) Zincon Method for Zinc, Method 8009. Hach Handbook for Water Analysis, 1979. Method and price available from Hach Chemical Company, P.O. Box 389, Loveland, Colorado 80537. Table IB, Note 33.

(30) ''Direct Determination of Elemental Phosphorus by Gas-Liquid Chromatography,'' by R.F. Addison and R.G. Ackman, Journal of Chromatography, Volume 47, No. 3, pp. 421–426, 1970. Available in most public libraries. Back volumes of the Journal of Chromatography are available from Elsevier/North-Holland, Inc., Journal Information Centre, 52 Vanderbilt Avenue, New York, NY 10164. Cost available from publisher. Table IB, Note 28.

(31) ''Direct Current Plasma (DCP) Optical Emission Spectrometric Method for Trace Elemental Analysis of Water and Wastes'', Method AES 0029, 1986-Revised 1991, Fison Instruments, Inc., 32 Commerce Center, Cherry Hill Drive, Danvers, MA 01923. Table B, Note 34.

(32) ''Closed Vessel Microwave Digestion of Wastewater Samples for Determination of Metals, CEM Corporation, P.O. Box 200, Matthews, North Carolina 28106–0200, April 16, 1992. Available from the CEM Corporation. Table IB, Note 36.

(33) ''Organochlorine Pesticides and PCBs in Wastewater Using Empore ™ Disk'' Test Method 3M 0222, Revised 10/28/94. 3M Corporation, 3M Center Building 220–9E–10, St. Paul, MN 55144–1000. Method available from 3M Corporation. Table IC, Note 8 and Table ID, Note 8.

(34) USEPA. 1993. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms.

Fourth Edition, December 1993. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio (EPA/600/4–90/027F). Available from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, Publ. No. PB–91–167650. Cost: $31.00. Table IA, Note 17. See changes in the manual, listed in Part V of this rule.

(35) ''Nitrogen, Total Kjeldahl, Method PAI–DK01 (Block Digestion, Steam Distillation, Titrimetric Detection)'', revised 12/22/94. Available from Perstorp Analytical Corporation, 9445 SW Ridder Rd., Suite 310, P.O. Box 648, Wilsonville, OK 97070. Table IB, Note 39.

(36) ''Nitrogen, Total Kjeldahl, Method PAI–DK02 (Block Digestion, Steam Distillation, Colorimetric Detection)'', revised 12/22/94. Available from Perstorp Analytical Corporation, 9445 SW Ridder Rd., Suite 310, P.O. Box 648, Wilsonville, OK 97070. Table IB, Note 40.

(37) ''Nitrogen, Total Kjeldahl, Method PAI–DK03 (Block Digestion, Automated FIA Gas Diffusion)'', revised 12/22/94. Available from Perstorp Analytical Corporation, 9445 SW Ridder Rd., Suite 310, P.O. Box 648, Wilsonville, OK 97070. Table IB, Note 41.

(38) USEPA. 1994. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. Third Edition. July 1994. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. (EPA/600/4–91/002). Available from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, Publ. No. PB–92–139492. Cost: $31.00. Table IA, Note 8.

(39) USEPA. 1994. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms. Second Edition, July 1994. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. EPA/600/4–91/003. Available from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, Publ. No. PB–92–139484. Cost: $45.00. Table IA, Note 9.

(40) EPA Methods 1666, 1667, and 1671 listed in the table above are published in the compendium titled Analytical Methods for the Determination of Pollutants in Pharmaceutical Manufacturing Industry Wastewaters (EPA 821–B–98–016). EPA Methods 502.2 and 524.2 have been incorporated by reference into 40 CFR 141.24 and are in Methods for the Determination of Organic Compounds in Drinking Water, EPA–600/4–88–039, December 1988, Revised, July 1991, and Methods for the Determination of Organic Compounds in Drinking Water-Supplement II, EPA–600/R–92–129, August 1992, respectively. These EPA test method compendia are available from the National Technical Information Service, NTIS PB91–231480 and PB92–207703, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. The toll-free number is 800–553–6847. ASTM test methods D3371, D3695, and D4763 are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428–2959.

EDITORIAL NOTE: At 64 FR 30434, June 8, 1999, the following paragraph (40) was added, effective July 8, 1999; however paragraph (40) was previously added to the 1999 volume.

(40) USEPA. 1999. Method 1631, Revision B, ''Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry.'' May 1999. Office of Water, U.S. Environmental Protection Agency (EPA 821–R–99–005). Available from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. Publication No. PB99–131989. Cost: $25.50. Table IB, Note 43.

(41) USEPA, January 1999 Errata for the Effluent and Receiving Water Testing Manuals: Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms; Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms; and Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms. U.S. Environmental Protection Agency, Office of Research and Development, Duluth, MN. EPA–600/R–98/182.

(43) Method OIA–1677, Available Cyanide by Flow Injection, Ligand Exchange, and Amperometry. August 1999. ALPKEM, OI Analytical, Box 648, Wilsonville, Oregon 97070 (EPA–821–R–99–013). Available from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. Publication No. PB99–132011. Cost: $22.50. Table IB, Note 44.

(c) Under certain circumstances the Regional Administrator or the Director in the Region or State where the discharge will occur may determine for a particular discharge that additional parameters or pollutants must be reported. Under such circumstances, additional test procedures for analysis of pollutants may be specified by the Regional Administrator, or the Director upon the recommendation of the Director of the Environmental Monitoring Systems Laboratory—Cincinnati.

(d) Under certain circumstances, the Administrator may approve, upon recommendation by the Director, Environmental Monitoring Systems Laboratory—Cincinnati, additional alternate test procedures for nationwide use.

(e) Sample preservation procedures, container materials, and maximum allowable holding times for parameters cited in Tables IA, IB, IC, ID, and IE are prescribed in Table II. Any person may apply for a variance from the prescribed preservation techniques, container materials, and maximum holding times applicable to samples taken from a specific discharge. Applications for variances may be made by letters to the Regional Administrator in the Region in which the discharge will occur. Sufficient data should be provided to assure such variance does not adversely affect the integrity of the sample. Such data will be forwarded, by the Regional Administrator, to the Director of the Environmental Monitoring Systems Laboratory—Cincinnati, Ohio for technical review and recommendations for action on the variance application. Upon receipt of the recommendations from the Director of the Environmental Monitoring Systems Laboratory, the Regional Administrator may grant a variance applicable to the specific charge to the applicant. A decision to approve or deny a variance will be made within 90 days of receipt of the application by the Regional Administrator.

TABLE II—REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter No./name	Container [1]	Preservation [2,3]	Maximum holding time [4]
Table IA—Bacteria Tests:			
1–4 Coliform, fecal and total	P,G	Cool, 4C, 0.008% $Na_2S_2O_3$ [5]	6 hours.
5 Fecal streptococci	P,G	Cool, 4C, 0.008% $Na_2S_2O_3$ [5]	6 hours.
Table IA—Aquatic Toxicity Tests:			
6–10 Toxicity, acute and chronic	P,G	Cool, 4 °C [16]	36 hours.
Table IB—Inorganic Tests:			
1. Acidity	P, G	Cool, 4°C	14 days.
2. Alkalinity	P, G	......do	Do.
4. Ammonia	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days.
9. Biochemical oxygen demand	P, G	Cool, 4°C	48 hours.
10. Boron	P, PFTE, or Quartz.	HNO_3 TO pH<2	6 months.
11. Bromide	P, G	None required	28 days.
14. Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours.
15. Chemical oxygen demand	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days.
16. Chloride	P, G	None required	Do.
17. Chlorine, total residual	P, G	......do	Analyze immediately.
21. Color	P, G	Cool, 4°C	48 hours.
23–24. Cyanide, total and amenable to chlorination.	P, G	Cool, 4°C, NaOH to pH>12, 0.6g ascorbic acid [5].	14 days.[6]
25. Fluoride	P	None required	28 days.
27. Hardness	P, G	HNO_3 to pH<2, H_2SO_4 to pH<2	6 months.
28. Hydrogen ion (pH)	P, G	None required	Analyze immediately.
31, 43. Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days.
Metals:[7]			
18. Chromium VI	P, G	Cool, 4°C	24 hours.
35. Mercury	P, G	HNO_3 to pH<2	28 days.

TABLE II—REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES—Continued

Parameter No./name	Container [1]	Preservation [2,3]	Maximum holding time [4]
3, 5–8, 12, 13, 19, 20, 22, 26, 29, 30, 32–34, 36, 37, 45, 47, 51, 52, 58–60, 62, 63, 70–72, 74, 75. Metals, except boron, chromium VI and mercury.	P, G	......do	6 months.
38. Nitrate	P, G	Cool, 4°C	48 hours.
39. Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days.
40. Nitrite	P, G	Cool, 4°C	48 hours.
41. Oil and grease	G	Cool to 4°C, HCl or H_2SO_4 to pH<2.	28 days.
42. Organic Carbon	P, G	Cool to 4 °C HC1 or H_2SO4 or H_3PO4, to pH<2.	28 days.
44. Orthophosphate	P, G	Filter immediately, Cool, 4°C	48 hours.
46. Oxygen, Dissolved Probe	G Bottle and top.	None required	Analyze immediately.
47. Winkler	......do	Fix on site and store in dark	8 hours.
48. Phenols	G only	Cool, 4°C, H_2SO_4 to pH<2	28 days.
49. Phosphorus (elemental)	G	Cool, 4°C	48 hours.
50. Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days.
53. Residue, total	P, G	Cool, 4°C	7 days.
54. Residue, Filterable	P, G	......do	7 days.
55. Residue, Nonfilterable (TSS)	P, G	......do	7 days.
56. Residue, Settleable	P, G	......do	48 hours.
57. Residue, volatile	P, G	......do	7 days.
61. Silica	P, PFTE, or Quartz.	Cool, 4 °C	28 days.
64. Specific conductance	P, G	......do	Do.
65. Sulfate	P, G	......do	Do.
66. Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to pH>9.	7 days.
67. Sulfite	P, G	None required	Analyze immediately.
68. Surfactants	P ,G	Cool, 4°C	48 hours.
69. Temperature	P, G	None required	Analyze.
73. Turbidity	P, G	Cool, 4°C	48 hours.
Table IC—Organic Tests [8]			
13, 18–20, 22, 24–28, 34–37, 39–43, 45–47, 56, 76, 104, 105, 108–111, 113. Purgeable Halocarbons.	G, Teflon-lined septum.	Cool, 4 °C, 0.008% $Na_2S_2O_3$ [5].	14 days.
6, 57, 106. Purgeable aromatic hydrocarbons	......do	Cool, 4 °C, 0.008% $Na_2S_2O_3$,[5] HCl to pH2[9].	Do.
3, 4. Acrolein and acrylonitrile	......do	Cool, 4 °C, 0.008% $Na_2S_2O_3$,[5] adjust pH to 4–5[10].	Do.
23, 30, 44, 49, 53, 77, 80, 81, 98, 100, 112. Phenols [11].	G, Teflon-lined cap..	Cool, 4 °C, 0.008% $Na_2S_2O_3$ [5]	7 days until extraction; 40 days after extraction.
7, 38. Benzidines [11]	......do	......do	7 days until extraction.[13]
14, 17, 48, 50–52. Phthalate esters [11]	......do	Cool, 4 °C	7 days until extraction; 40 days after extraction.
82–84. Nitrosamines [11 14]	......do	Cool, 4 °C, 0.008% $Na_2S_2O_3$,[5] store in dark.	Do.
88–94. PCBs [11]	.....do	Cool, 4 °C	Do.
54, 55, 75, 79. Nitroaromatics and isophorone [11]	......do	Cool, 4 °C, 0.008% $Na_2S_2O_3$,[5] store in dark.	Do.
1, 2, 5, 8–12, 32, 33, 58, 59, 74, 78, 99, 101. Polynuclear aromatic hydrocarbons [11].	......do	......do	Do.
15, 16, 21, 31, 87. Haloethers [11]	......do	Cool, 4 °C, 0.008% $Na_2S_2O_3$ [5]	Do.
29, 35–37, 63–65, 73, 107. Chlorinated hydrocarbons [11].	......do	Cool, 4 °C	Do.
60–62, 66–72, 85, 86, 95–97, 102, 103. CDDs/CDFs [11].			
aqueous: field and lab preservation.	G	Cool, 0–4 °C, pH<9, 0.008% $Na_2S_2O_3$ [5].	1 year.
Solids, mixed phase, and tissue: field preservation..	......do	Cool, <4 °C	7 days.
Solids, mixed phase, and tissue: lab preservation	......do	Freeze, < − 10 °C	1 year.
Table ID—Pesticides Tests:			
1–70. Pesticides [11]	......do	Cool, 4°C, pH 5–9 [15]	Do.
Table IE—Radiological Tests:			
1–5. Alpha, beta and radium	P, G	HNO_3 to pH<2	6 months.

Table II Notes

[1] Polyethylene (P) or glass (G). For microbiology, plastic sample containers must be made of sterilizable materials (polypropylene or other autoclavable plastic).

[2] Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

[3] When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details. The term ''analyze immediately'' usually means within 15 minutes or less of sample collection.

[5] Should only be used in the presence of residual chlorine.

[6] Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

[7] Samples should be filtered immediately on-site before adding preservative for dissolved metals.

[8] Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[9] Sample receiving no pH adjustment must be analyzed within seven days of sampling.

[10] The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

[11] When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6–9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 12, 13 (re the analysis of benzidine).

[12] If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.

[13] Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

[14] For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7–10 with NaOH within 24 hours of sampling.

[15] The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

[16] Sufficient ice should be placed with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, it is necessary to immediately measure the temperature of the samples and confirm that the 4C temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature can not be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature.

[38 FR 28758, Oct. 16, 1973, as amended at 41 FR 52781, Dec. 1, 1976; 49 FR 43251, 43258, 43259, Oct. 26, 1984; 50 FR 691, 692, 695, Jan. 4, 1985; 51 FR 23693, June 30, 1986; 52 FR 33543, Sept. 3, 1987; 55 FR 24534, June 15, 1990; 55 FR 33440, Aug. 15, 1990; 56 FR 50759, Oct. 8, 1991; 57 FR 41833, Sept. 11, 1992; 58 FR 4505, Jan. 31, 1994; 60 FR 17160, Apr. 4, 1995; 60 FR 39588, 39590, Aug. 2, 1995; 60 FR 44672, Aug. 28, 1995; 60 FR 53542, 53543, Oct. 16, 1995; 62 FR 48403, 48404, Sept. 15, 1997; 63 FR 50423, Sept. 21, 1998; 64 FR 4978, Feb. 2, 1999; 64 FR 10392, Mar. 4, 1999; 64 FR 26327, May 14, 1999; 64 FR 30433, 30434, June 8, 1999; 64 FR 73423, Dec. 30, 1999]

§ 136.4 Application for alternate test procedures.

(a) Any person may apply to the Regional Administrator in the Region where the discharge occurs for approval of an alternative test procedure.

(b) When the discharge for which an alternative test procedure is proposed occurs within a State having a permit program approved pursuant to section 402 of the Act, the applicant shall submit his application to the Regional Administrator through the Director of the State agency having responsibility for issuance of NPDES permits within such State.

(c) Unless and until printed application forms are made available, an application for an alternate test procedure may be made by letter in triplicate. Any application for an alternate test procedure under this paragraph (c) shall:

(1) Provide the name and address of the responsible person or firm making the discharge (if not the applicant) and the applicable ID number of the existing or pending permit, issuing agency, and type of permit for which the alternate test procedure is requested, and the discharge serial number.

[1] Polyethylene (P) or glass (G). For microbiology, plastic sample containers must be made of sterilizable materials (polypropylene or other autoclavable plastic).

[2] Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

[3] When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details. The term ''analyze immediately'' usually means within 15 minutes or less of sample collection.

[5] Should only be used in the presence of residual chlorine.

[6] Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

[7] Samples should be filtered immediately on-site before adding preservative for dissolved metals.

[8] Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[9] Sample receiving no pH adjustment must be analyzed within seven days of sampling.

[10] The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

[11] When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6–9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 12, 13 (re the analysis of benzidine).

[12] If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.

[13] Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

[14] For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7–10 with NaOH within 24 hours of sampling.

[15] The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

[16] Sufficient ice should be placed with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, it is necessary to immediately measure the temperature of the samples and confirm that the 4C temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature can not be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature.

[38 FR 28758, Oct. 16, 1973, as amended at 41 FR 52781, Dec. 1, 1976; 49 FR 43251, 43258, 43259, Oct. 26, 1984; 50 FR 691, 692, 695, Jan. 4, 1985; 51 FR 23693, June 30, 1986; 52 FR 33543, Sept. 3, 1987; 55 FR 24534, June 15, 1990; 55 FR 33440, Aug. 15, 1990; 56 FR 50759, Oct. 8, 1991; 57 FR 41833, Sept. 11, 1992; 58 FR 4505, Jan. 31, 1994; 60 FR 17160, Apr. 4, 1995; 60 FR 39588, 39590, Aug. 2, 1995; 60 FR 44672, Aug. 28, 1995; 60 FR 53542, 53543, Oct. 16, 1995; 62 FR 48403, 48404, Sept. 15, 1997; 63 FR 50423, Sept. 21, 1998; 64 FR 4978, Feb. 2, 1999; 64 FR 10392, Mar. 4, 1999; 64 FR 26327, May 14, 1999; 64 FR 30433, 30434, June 8, 1999; 64 FR 73423, Dec. 30, 1999]

§ 136.4 Application for alternate test procedures.

(a) Any person may apply to the Regional Administrator in the Region where the discharge occurs for approval of an alternative test procedure.

(b) When the discharge for which an alternative test procedure is proposed occurs within a State having a permit program approved pursuant to section 402 of the Act, the applicant shall submit his application to the Regional Administrator through the Director of the State agency having responsibility for issuance of NPDES permits within such State.

(c) Unless and until printed application forms are made available, an application for an alternate test procedure may be made by letter in triplicate. Any application for an alternate test procedure under this paragraph (c) shall:

(1) Provide the name and address of the responsible person or firm making the discharge (if not the applicant) and the applicable ID number of the existing or pending permit, issuing agency, and type of permit for which the alternate test procedure is requested, and the discharge serial number.

(2) Identify the pollutant or parameter for which approval of an alternate testing procedure is being requested.

(3) Provide justification for using testing procedures other than those specified in Table I.

(4) Provide a detailed description of the proposed alternate test procedure, together with references to published studies of the applicability of the alternate test procedure to the effluents in question.

(d) An application for approval of an alternate test procedure for nationwide use may be made by letter in triplicate to the Director, Analytical Methods Staff, Office of Science and Technology (4303), Office of Water, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460. Any application for an alternate test procedure under this paragraph (d) shall:

(1) Provide the name and address of the responsible person or firm making the application.

(2) Identify the pollutant(s) or parameter(s) for which nationwide approval of an alternate testing procedure is being requested.

(3) Provide a detailed description of the proposed alternate procedure, together with references to published or other studies confirming the general applicability of the alternate test procedure to the pollutant(s) or parameter(s) in waste water discharges from representative and specified industrial or other categories.

(4) Provide comparability data for the performance of the proposed alternate test procedure compared to the performance of the approved test procedures.

[38 FR 28760, Oct. 16, 1973, as amended at 41 FR 52785, Dec. 1, 1976; 62 FR 30763, June 5, 1997]

§ 136.5 Approval of alternate test procedures.

(a) The Regional Administrator of the region in which the discharge will occur has final responsibility for approval of any alternate test procedure proposed by the responsible person or firm making the discharge.

(b) Within thirty days of receipt of an application, the Director will forward such application proposed by the responsible person or firm making the discharge, together with his recommendations, to the Regional Administrator. Where the Director recommends rejection of the application for scientific and technical reasons which he provides, the Regional Administrator shall deny the application, and shall forward a copy of the rejected application and his decision to the Director of the State Permit Program and to the Director of the Analytical Methods Staff, Washington, DC.

(c) Before approving any application for an alternate test procedure proposed by the responsible person or firm making the discharge, the Regional Administrator shall forward a copy of the application to the Director of the Analytical Methods Staff, Washington, DC.

(d) Within ninety days of receipt by the Regional Administrator of an application for an alternate test procedure, proposed by the responsible person or firm making the discharge, the Regional Administrator shall notify the applicant and the appropriate State agency of approval or rejection, or shall specify the additional information which is required to determine whether to approve the proposed test procedure. Prior to the expiration of such ninety day period, a recommendation providing the scientific and other technical basis for acceptance or rejection will be forwarded to the Regional Administrator by the Director of the Analytical Methods Staff, Washington, DC. A copy of all approval and rejection notifications will be forwarded to the Director, Analytical Methods Staff, Washington, DC, for the purposes of national coordination.

(e) *Approval for nationwide use.* (1) Within sixty days of the receipt by the Director of the Analytical Methods Staff, Washington, DC, of an application for an alternate test procedure for nationwide use, the Director of the Analytical Methods Staff shall notify the applicant in writing whether the application is complete. If the application is incomplete, the applicant shall be informed of the information necessary to make the application complete.

(2) Within ninety days of the receipt of a complete package, the Analytical Methods Staff shall perform any analysis necessary to determine whether

APPENDIX 8
PREVENTIVE MAINTENANCE / LUBRICATION SCHEDULE*

WWTP PROCESS	FREQUENCY	MAINTENANCE	ESTIMATED MANHOURS	ESTIMATED ANNUAL MH
Mechanical Screen Wash Press Vortex Grit Removal/Classifier	Daily	· Check screenings container, exchange, empty and/or add lime to reduce odors.	15 mins	91.25 hrs
		· Inspect for proper operation of mechanical screen, wash press, and grit removal.	10 mins	60.83 hrs
	Weekly	· Spray off deposits and clogged material on the lamellae and lamellae fixings.	15 mins	13 hrs
		· Lubricate self aligning roller bearing for wash press.	0.5 hrs	26 hrs
		· Inspect solenoid valves/wash water pump are working properly.	10 mins	8.67 hrs
		· Inspect oil lubricated ball bearings weekly if so equipped.	0.5 hrs	26 hrs
		· Wash through deposited grit in front of the screen.	15 mins	13 hrs
	Monthly	· Spray off the complete machine including inside the covers.	0.5 hrs	6 hrs
		· Inspect water collecting trough for sediments.	1 hrs	12 hrs
		· Inspect press for clogged dewatering holes.	15 mins	3 hrs
		· Check oil seals on main bearings for leakage.	10 mins	2 hrs
		· Inspect oil level in gearboxes. Replace if contaminated with water.	15 mins	3 hrs
		· Inspect for water feed leakage.	10 mins	2 hrs
		· Wash collecting trough in press if not done automatically.	15 mins	3 hrs
	Semi-Annually	· Lubricate grit pump bearings.	1 hrs	2 hrs
		· Inspect for worn guide bars on screen.	10 mins	0.33 hrs
		· Inspect for worn screw conveyor.	15 mins	0.5 hrs
		· Inspect for worn paddles.	1 hrs	2 hrs
		· Inspect for worn compactor screw.	2 hrs	4 hrs
		· Inspect compacting flight.	0.5 hrs	1 hrs
	Annually	· Thoroughly clean the machine.	1 hrs	1 hrs
		· Tightening Torque eccentric screws on mechanical screen.	2 hrs	2 hrs
		· Check grit pump impeller wear.	8 hrs	8 hrs
		· Lubricate flange bearing on mechanical screen.	2 hrs	2 hrs
	10,000 hours, or according to the gear or oil manufacturer.	· Change drive motor gear oil. (See Manufacturer's O&M manual)	3 hrs	3 hrs
			TOTAL	296 hrs
Influent Pump Station	Daily	· Inspect general condition of pump temperature, noises, vibration, leaks, etc.	10 mins	60.83 hrs
		· Inspect pump performance (gauges, speed, and flow)	10 mins	60.83 hrs
	Weekly	· Inspect seal lubrication.	10 mins	8.67 hrs
		· Inspect bearing lubrication.	1 hrs	52.00 hrs
		· Record suction/discharge gauge readings for both pumps (if equipped).	10 mins	8.67 hrs
		· Record elapsed time meter readings.	10 mins	8.67 hrs
		· Check air flow indicator to ensure proper bubbler system air flow.	5 mins	4.33 hrs
		· Monitor station during at least one pump down cycle to check for proper pump and control operations along with leaks.	15 mins	13.00 hrs
		· Test back-up air pump.	5 mins	4.33 hrs
	Monthly	· Inspect V-Belts.	10 mins	120 hrs
		· Exercise plug valves.	15 mins	180 hrs
		· Make sure check valves open and close properly.	15 mins	180 hrs
		· Inspect ARV plunger rod.	10 mins	120 hrs

WWTP PROCESS	FREQUENCY	MAINTENANCE	ESTIMATED MANHOURS	ESTIMATED ANNUAL MH
Influent Pump Station (cont'd)	Semi-Annually	· Clean ARV plunger rod.	2 hrs	4 hrs
		· Clean air pump filter (if equipped).	1 hrs	2 hrs
		· Inspect front and rear impeller clearance.	10 mins	20 hrs
	Annually	· Grease bearings and seals.	2 hrs	2 hrs
		· Thoroughly inspect check valves.	3 hrs	3 hrs
		· Clean PRV.	3 hrs	3 hrs
		· Inspect pump and driver alignment.	10 mins	0.17 hrs
		· Inspect shaft deflection.	10 mins	0.17 hrs
		· Inspect bearings and bearing housing.	0.5 hrs	0.50 hrs
		· Test alarms for proper operation.	15 mins	0.25 hrs
		· Inspect piping.	10 mins	0.17 hrs
			TOTAL	857 hrs
Kruger Double Ditch	Daily or based on operational time.	· Check control panel lights.	10 mins	60.83 hrs
		· Grease rotor supporting bearing **every 3 days**.	1 hrs	365 hrs
		· Lubricate winches before each use.	10 mins	0.67 hrs
		· Check all screws and bolts after 200 hours, then every 6 months.	4 hrs	16 hrs
		· Perform first oil change in the rotor gear box after 500 hours and then after every 4,000 hours or after 1 year at the latest.	4 hrs	16 hrs
		· Clean and inspect motor every 500 hours or every 3 months.	1 hrs	4 hrs
	Weekly	· Check for change in vibration, abnormal noise, or loss of capacity on all aerators.	10 mins	8.67 hrs
		· Inspect lifting cables. Replace worn cables.	10 mins	8.67 hrs
		· Every two weeks rotate shafts on any stored mechanical equipment.	0.5 hrs	13 hrs
	Quarterly	· Check motor bearing temperature.	2 hrs	8 hrs
		· Inspect all painted surfaces and refinish if necessary.	0.5 - 8 hrs	32 hrs
		· Check mixer propeller for wear.	2 hrs	8 hrs
		· Clean ventilation openings and outside of electrical motors.	1 hrs	4 hrs
	Semi-Annually	· Grease multi-turn actuator output drive for effluent weir.	1 hrs	2 hrs
		· Grease gearbox lower thrust bearing for actuator on effluent weir.	1 hrs	2 hrs
		· Grease spindle on actuator for effluent weir.	1 hrs	2 hrs
		· Lubricate telescoping valve stems.	2 hrs	4 hrs
		· Lubricate all moving parts on the effluent weir.	1 hrs	2 hrs
	Annually	· Check amperage on all electrical equipment.	3 hrs	3 hrs
		· Lubricate motor bearings.	3 hrs	3 hrs
		· Dismount anti-friction bearings for cleaning and refill w/grease. Ensure that the bearing cage is packed about 1/3 with grease.	5 hrs	5 hrs
		· Thoroughly clean the gear box unit.	2 hrs	2 hrs
		· Use a "Megger" to ensure the integrity of motor winding insulation.	1 hrs	1 hrs
		· Change mixer motor oil in prechamber and gearbox chamber.	6 hrs	6 hrs
		· Check oil level in sealing chamber of mixer motor.	2 hrs	2 hrs
		· Check rotor shaft surface treatment.	0.5 hrs	0.5 hrs
		· Remove and inspect telescoping valve thrust nuts.	3 hrs	3 hrs
		· Inspect hand wheel gear operator on manual valves for lubricant quantity, quality, and consistency.	1 hrs	1 hrs
	After the first year, then every 2 - 3 years thereafter.	· Visually inspect equipment, torque all bolts and anchor bolts.	2 hrs	2 hrs
		· Perform a preventive maintenance check and adjustment on all actuators.	2 hrs	2 hrs
		· Inspect all supports, bolt holes and welds for wear, cracks, looseness, or misalignment.	2 hrs	2 hrs
			TOTAL	589 hrs

WWTP PROCESS	FREQUENCY	MAINTENANCE	ESTIMATED MANHOURS	ESTIMATED ANNUAL MH
Effluent Filters	Daily or based on operational time.	· Flush backwash system per manufacturers instructions as needed to clean clogged nozzles.	4 hrs	16 hrs
		· Clean filter elements with high pressure cleaner as necessary when backwash cycle becomes excessive.	1-4 hrs	16 hrs
		· Clean filter elements with hydrochloric acid solution if mineral deposits cause clogging problems.	1-4 hrs	16 hrs
		· Clean filter elements with sodium hydroxide solution if fats or oils cause clogging problems.	1-4 hrs	16 hrs
		· Every 300 hours, grease motor bearings.	1 hrs	4 hrs
		· Every 3,000 hours, inspect working brake air gap, lining, switch elements, pressure plate, carrier/gearing, and pressure rings.	1.5 hrs	3 hrs
		· Every 10,000 hours, inspect motor ball bearings, oil seal, and cooling passages.	2 hrs	4 hrs
		· Repair anticorrosion surfaces as necessary.	1-2 hrs	2 hrs
		· Grease backstop.	2 hrs	4 hrs
	Weekly	· Check backwash nozzle operation.	15 mins	13 hrs
		· Clean level sensor.	0.5 hrs	26 hrs
	Bi-Weekly	· Grease support wheel and center shaft bearings.	2 hrs	52 hrs
		· Perform visual inspection of filter panels for obvious wear or failure.	15 mins	6.5 hrs
	Monthly	· Check electrical connections and clean motor and drive controller.	0.5 hrs	6 hrs
		· Grease drive chain.	1 hrs	12 hrs
	Semi-Annually	· Conduct disc and drum seals inspection	30 mins	1 hrs
		· Check all bearings for excessive wear.	1 hrs	2 hrs
		· Check and adjust chain tension.	1 hrs	2 hrs
		· Exercise mud valves.	0.5 hrs	1 hrs
		· Check gearbox oil level.	1.5 hrs	3 hrs
	Annually	· Perform detailed visual inspection of all filter panels for tears or fractures.	1 hrs	1 hrs
	Bi-Annually	· Change all rinse nozzles.	16 hrs	32 hrs
		· Change mineral oil in gear drive.	6 hrs	12 hrs
	Every 5 years	· Grease anti-friction bearings in gear drive.	6 hrs	6 hrs
		· Change synthetic oil in gear drive.	6 hrs	6 hrs
			TOTAL	263 hrs
UV Disinfection Chamber	Daily	· Check UV lamps and NPW pumps for correct operation and intensity.	15 mins	91.25 hrs
	Monthly	· Check quartz sleeves.	0.5 hrs	6 hrs
	Semi-Annually	· Exercise mud valves.	0.5 hrs	1 hrs
			TOTAL	98.25 hrs
Aerobic Digesters	Daily or based on operational time.	· Check and retighten belts one week after installation.	2 hrs	2 hrs
		· Every 500 hours or 2 months, inspect and clean motor. Clean accumulations of dirt, oil, grease or water. Check all electrical connections.	1 hrs	4 hrs
		· Every 1,500 hours, change timing gear oil on all positive displacement. blowers. If using Aeon PD Synthetic Lubricant change oil every 4,500 hours.	3 hrs	6 hrs
		· Observe water surface to determine if there is any change in surface pattern that would indicate a change in conditions of the diffusion equipment.	15 mins	4 hrs
	Weekly	· Check belt tension on all belted machines.	0.5-2 hrs	104 hrs
		· Check for change in vibration, abnormal noise, or loss of capacity on all pumps and blowers.	0.5 hrs	26 hrs
		· Check blower oil level in gearbox and bearing reservoirs.	0.5 hrs	26 hrs
		· Grease drive end bearings.	1 hrs	52 hrs

WWTP PROCESS	FREQUENCY	MAINTENANCE	ESTIMATED MANHOURS	ESTIMATED ANNUAL MH
	Every 2 Months	· Drain condensate from discharge silencer on all blowers.	0.5 hrs	3 hrs
		· Check blower relief valve for setting on all blowers.	15 mins	1.5 hrs
		· Exercise/grease valves.	1 hrs	6 hrs
	Quarterly	· Clean or replace air filter on the blower (This is the maximum maintenance interval. Conditions may require more frequent changing).	1 hrs	4 hrs
	Semi-Annually	· Check pumps, blowers, valves, etc. Electrical performance, i.e., current and power requirements (amps & watts). (or every 2,000 operational hours)	3 hrs	6 hrs
		· Check for proper alignment on all belt driven or coupled equipment. Correct as necessary.	2 hrs	4 hrs
	Annually	· Use a "Megger" to ensure the integrity of motor winding insulation.	1 hrs	1 hrs
		· Grease motor bearings.	2 hrs	2 hrs
			TOTAL	448 hrs
Sludge Dewatering Facilities	Before each use	· Check fuel, engine oil, coolant, oil seals, shaft bearing lubrication, PRV's, drain valves, and return valves.	15 mins	13 hrs
	250 Hours	· Check belts, oil lines, air lines, tire pressure, impeller clearance, air filter, fuel filter, and ejector.	1 hrs	8 hrs
		· Check V-belt tension.	0.5 hrs	4 hrs
		· Lubricate clutch shaft.	15 mins	2 hrs
		· Change engine oil and filter.	1 hrs	8 hrs
	Annually	· Clean vent tubes.	0.5 hrs	0.5 hrs
		· Replace fuel filter.	1 hrs	1 hrs
		· Perform general engine tune-up.	4 hrs	4 hrs
			TOTAL	40.5 hrs
Nonpotable Water System	Weekly	· Inspect pressure of system, pressure switch and pumps.	1 hrs	52 hrs
	Annually or every 4000 hours	· Change lubricating oil in submersible pumps. Grease bearings if applicable.	4 hrs	4 hrs
		· Visually inspect lifting chain and electric cables.	0.5 hrs	0.5 hrs
	Every 3-5 years	· General pump overhaul.	8 hrs	8 hrs
			TOTAL	64.5 hrs
Chemical Feed System	Daily	· Check visual performance.	0.5 hrs	182.5 hrs
		· Check for water leaks around chlorination, lime, and polymer equipment.	15 mins	91.25 hrs
	Monthly	· Inspect lubrication in gearboxes.	1 hrs	12 hrs
	Semi-Annually	· Lubricate gearboxes.	3 hrs	6 hrs
	Annually	· Check wearing surfaces for condition and clearance.	15 mins	0.25 hrs
		· Inspect/calibrate feeding equipment.	1 hrs	1 hrs
		· Replace flexible connectors.	2 hrs	2 hrs
	As Needed	· Maintain all grease seals on movable parts.	1 hrs	6 hrs
		· Replace tubing and connectors; repair/replace valves.	2 hrs	4 hrs
		· Clean rotameter tube, floats, or any valve seats that become contaminated with impurities.	3 hrs	6 hrs
			TOTAL	440 hrs
Backup Generator	Daily or based on operational time.	· Walk-around inspection.	5 mins	30.42 hrs
		· Check oil, coolant, air cleaner, starter lubricator, and air tank (drain water)	1 hrs	12 hrs
		· Every 50 hours, clean air precleaner and check air cleaner.	2 hrs	24 hrs
		· Every 250 hours, check valve lash, magnetic pickup. Change oil and check fluids.	4 hrs	12 hrs
		· Every 250 hours, replace fuel filter and drain water and sediment from fuel tank.	4 hrs	12 hrs
		· Every 250 hours, Check belts, hoses, fan drive bearing, and batteries.	1 hrs	3 hrs
	Monthly	· Exercise generator.	1 hrs	12 hrs
			TOTAL	105.42 hrs

WWTP PROCESS	FREQUENCY	MAINTENANCE	ESTIMATED MANHOURS	ESTIMATED ANNUAL MH
Buildings, Tanks, and Grounds	Daily	· Check visual performance.	10 mins	60.83 hrs
	Weekly	· Clean weirs and baffles.	1 hrs	26 hrs
		· Flush channels	1 hrs	6 hrs
		· Mow lawns.	2 hrs	36 hrs
		· Maintain floors.	0.5 hrs	6 hrs
	Monthly	· Clean windows.	1 hrs	12 hrs
	Quarterly	· Clean roof drains.	2 hrs	8 hrs
	Annually	· Drain and flush tanks.	8 hrs	8 hrs
	As Needed	· Trim shrubbery.	1 hrs	2 hrs
		· Maintain concrete floors.	1 hrs	12 hrs
		· Clean sump pits.	3 hrs	6 hrs
			TOTAL	182.83 hrs

* This information is not meant to take the place of manufacturers' literature. Appendix 8 should be used in conjunction with manufacturers' literature to provide proper maintenance to the Rutledge Creek WWTP. Revise information as necessary to include additional or absent equipment or processes. Equipment O&M manuals and literature can be found in the laboratory control building.

ISO Viscosity grade	Viscosity, SUS at 100 F	76 Lubricants Santa Ana, CA www.76Lubricants.com	Advanced Lubrication Specialties Bensalem, PA	Alithicon Lubricants Albany, GA	Almac Brothers Tewksbury, MA
General purpose lubricants					
32	**135–165**	Unax 32	Advantage R&O 32	6510 Para/Syn Turbine	Taurus R&O 32
46	**194–236**	Unax 46	Advantage R&O 46	6518 Para/Syn Turbine	Taurus R&O 46
68	**284–346**	Unax 68	Advantage R&O 68	6520 Para/Syn Turbine	Taurus R&O 68
150	**630–770**	Unax 150	Advantage R&O 150	6540 Para/Syn Turbine	Taurus R&O 150
220	**900–1100**	Unax 220	Advantage R&O 220	6550 Para/Syn Turbine	Taurus R&O 220
460	**1935–2365**	Unax 460	Advantage R&O 460	6570 Para/Syn Turbine	Taurus R&O 460
Antiwear hydraulic oil					
32	**135–165**	Unax AW 32	Advantage AW 32	6510 Para/Syn Turbine	Taurus AW 32
46	**194–236**	Unax AW 46	Advantage AW 46	6518 Para/Syn Turbine	Taurus AW 46
68	**284–346**	Unax AW 68	Advantage AW 68	6520 Para/Syn Turbine	Taurus AW 68
Spindle oil					
2	**29–35**	—	—	200 Para/Syn Spindle	—
10	**54–66**	—	Advantage Spindle 10	1000 Para/Syn Spindle	—
22	**95–115**	Turbine 22	Advantage Spindle 22	2200 Para/Syn Spindle	Taurus 22 Spindle
Way oil					
32	**135–165**	Way HD 32	Advantage Waylube HD 32	WL 32 Para/Syn Way	Taurus 32 Way
68	**284–346**	Way HD 68	Advantage Waylube HD 68	WL 68 Para/Syn Way	Taurus 68 Way
220	**900–1100**	Way HD 220	Advantage Waylube HD 220	WL 220 Para/Syn Way	Taurus 220 Way
Extreme pressure gear oil					
68	**283–347**	Extra Duty Gear EP 2	Advantage EP Gear 68	680 Para/Syn Gear	Taurus Indugear 68
150	**630–770**	Extra Duty Gear EP 4	Advantage EP Gear 150	690 Para/Syn Gear	Taurus Indugear 150
320	**135–1650**	Extra Duty Gear EP 6	Advantage EP Gear 320	614 Para/Syn Gear	Taurus Indugear 320
Worm gear oil					
460	**1935–2365**	Steaval B	Advantage Worm Gear 460	—	Taurus Cylinder 460
Cling type gear shield (open gears)					
—	**—**	Gearshield	Advantage Open Gear	—	—
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Unoba EP	Multi-Vantage EP 2	6602 Para/Syn Bearing	—
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Unoba Moly XD	Multi-Vantage EP 2	—	—

American Agip Hainesport, NJ	American Industrial Research East Rutherford, NJ	The American Lubricants Co. Dayton, OH	American Lubricants, Inc. Buffalo, NY	Amrep Lancaster, TX	Amsoil Superior, WI
General purpose lubricants					
Turbine R&O 32	Rexlube 55	Moly Ind 32	R&O Hyd 32	Superfilm Hyd 32	RCH
Turbine R&O 46	Rexlube SOH	Moly Ind 46	R&O Hyd 46	Superfilm Hyd 46	RCI
Turbine R&O 68	Rexlube 20, 25	Moly Ind 68	R&O Hyd 68	Superfilm Hyd 68	RCJ
Turbine R&O 150	Rexlube 40, 45	Moly Ind 150	R&O Hyd 150	Superfilm Hyd 150	RCL
Turbine R&O 220	Rexlube 95	Moly Ind 220	R&O Hyd 220	Ind Gear 220	RCM
Turbine R&O 460	Rexlube 145	—	R&O Hyd 460	Ind Gear 460	RCO
Antiwear hydraulic oil					
Hyd AW 32; Hyd AW 32 (ZF)	Rexlube 55	Moly Hyd 32	AW Hyd 32	Superfilm Hyd 32	AWH
Hyd AW 46; Hyd AW 46 (ZF)	—	Moly Hyd 46	AW Hyd 46	Superfilm Hyd 46	AWI
Hyd AW 68; Hyd AW 68 (ZF)	—	Moly Hyd 68	AW Hyd 68	Superfilm Hyd 68	AWJ
Spindle oil					
Spindle 2	—	—	Spindle 2	—	—
Spindle 10	Rexlube SOL	—	Spindle 10	—	NTE
Spindle 22	—	Moly Ind 22	Spindle 22	Superfilm Spindle 22	RCG
Way oil					
Way 32	—	Moly Special Way 32	Waylube 32	—	—
Way 68	—	Moly Special Way 68	Waylube 68	—	WLJ
Way 220	—	Moly Special Way 220	Waylube 220	—	WLM
Extreme pressure gear oil					
Ind Gear EP 68	Rexlube 20	Moly Ultra-Tec Gear 80	EP Gear 68	Highload Gear	SGJ
Ind Gear EP 150	Rexlube 90, 98	Moly Ultra-Tec Gear 80W90	EP Gear 150	Highload Gear	SGL
Ind Gear EP 320	Rexlube 115 85W140	Moly Ultra-Tec Gear 85W140	EP Gear 320	Highload Gear	SGN
Worm gear oil					
Cylinder 460	Rexlube 140, 148	Alubco Worm Gear 460	Worm Gear 460	Ind Gear 460	RCO
Cling type gear shield (open gears)					
—	Rexlube OGH, OGXH	Gear Stix; Bison Open Gear Guard	Open Gear	Open Gear and Fifth Wheel	OGC
General purpose extreme pressure lithium based grease					
Lith EP 2	Rexlube 2	Superior Deluxe 2	EP Lith 2	Lith Complex EP	GLC
Molybedenum disulfide extreme pressure grease					
Moly Lith EP 2	Rexlube EP 2	Moly Deluxe 2	EP Moly Lith 2	Moly	GHD

ISO Viscosity grade	Viscosity, SUS at 100 F	Baum's Castorine Rome, NY	Benz Oil Milwaukee, WI	Bostik Middleton, MA	B-P Oil Cleveland, OH	C&C Oil Kennesaw, GA
General purpose lubricants						
32	**135–165**	Tena-Film 150 TH	Hy Circ R&O 32	—	Turbinol T 32	Precision R&O 32
46	**194–236**	Tena-Film 300 LTH	Hy Circ R&O 46	—	Turbinol T 36	Precision R&O 46
68	**284–346**	Tena-Film 300 MTH	Hy Circ R&O 68	—	Turbinol T 68	Precision R&O 68
150	**630–770**	Tena-Film 400 TH	Hy Circ R&O 150	—	Turbinol T 150	Precision R&O 150
220	**900–1100**	Tena-Film 500 TH	Hy Circ R&O 220	—	Turbinol T 220	Precision R&O 220
460	**1935–2365**	Tena-Film 2500 TH	Circ R&O 460	—	Turbinol T 460	Precision R&O 460
Antiwear hydraulic oil						
32	**135–165**	Tena-Film 150 TH	Petraulic 32	—	Energol HLP-HD 32	Precision AW 32
46	**194–236**	Tena-Film 300 LTH	Petraulic 46	—	Energol HLP-HD 46	Precision AW 46
68	**284–346**	Tena-Film 300 MTH	Petraulic 68	—	Energol HLP-HD 68	Precision AW 68
Spindle oil						
2	**29–35**	—	UCF 1	—	—	—
10	**54–66**	Tena-Film 75 TH	Petraspeed 10	—	—	—
22	**95–115**	Tena-Film 100 TH	Petraspeed 22	—	Energol HLP-HD 22	—
Way oil						
32	**135–165**	Tena-Film EP 150 ST	Waylube 32	—	—	C-way 32
68	**284–346**	Tena-Film EP 300 ST	Waylube 68	—	Energol SW 68-C	C-way 68
220	**900–1100**	Tena-Film EP 1000 ST	Waylube 220	—	Energol SW 220-C	C-way 220
Extreme pressure gear oil						
68	**283–347**	Tena-Film EP 300	Gearol 68	—	Energear EP 68	Complex EP 68
150	**630–770**	Tena-Film EP 700	Gearol 150	—	Energear EP 150	Complex EP 150
320	**135–1650**	Tena-Film EP 1400	Gearol 320	—	Energear EP 320	Complex EP 320
Worm gear oil						
460	**1935–2365**	Cylinder Compound 180	Gearol 7 Comp	—	Energrear WG 460	—
Cling type gear shield (open gears)						
—	**—**	Tena-Film Moly Compound 08470	—	—	—	Crescent Open Gear Compound 0
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	Tena-Film EP 2	Multi Service EP 2	Lith EP	Energrease LS-EP 2	Crescent Lithicom Red EP 2
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	Tena-Film Moly Compound 0 23	Moly Alumaplex EP 2	—	Energrease Moly EP 2	Crescent H/T Moly EP 2

Castrol Industrial N. America Downers Grove, IL	Century Lubricants Kansas City, KS	Certified Laboratories Ft. Worth, TX	Chempet Oak Brook, IL	Chemsearch Irving, TX	Chemtool Crystal Lake, IL www.chemtool.com
					General purpose lubricants
Hyspin R&O 32	Renolin R&O 32	Multoil 5W20; HOC 32	R&O 150	Soludize 5W20	Hydro 15
Hyspin R&O 46	Renolin R&O 46	Multoil 5W20; HOC 46	R&O 200	Soludize 5W20	Hydro 25
Hyspin R&O 68	Renolin R&O 68	Multoil 5W20; HOC 68	R&O 300	Soludize 5W20	Hydro 3
Hyspin R&O 150	Renolin R&O 150	Multoil 10W40; HOC 150	R&O 650	Soludize 10W40	Hydro 7
Hyspin R&O 220	Renolin R&O 220	Multoil 10W40; HOC 220	R&O 1000	Soludize 10W40	Gear 990
Hyspin R&O 460	Renolin R&O 460	—	R&O 2100	—	Gear 2250
					Antiwear hydraulic oil
Hyspin AW 32	Renolin AW 32	HOC 32; Hi Top	AW Hyd 150	Enerlex; MM Hyd Fluid 32	Hydro AW 15
Hyspin AW 46	Renolin AW 46	HOC 46; Hi Top	AW Hyd 200	Enerlex; MM Hyd Fluid 46	Hydro AW 225
Hyspin AW 68	Renolin AW 68	HOC 68; Hi Top	AW Hyd 300	Enerlex; MM Hyd Fluid 68	Hydro AW 315
					Spindle oil
—	—	—	Spindle 40	—	Spindle 20
Hyspin Spindle 10	Spindle 15	SOC 10	Spindle 60	MM Spindle	Spindle 60
Hyspin Spindle 22	Spindle 22	Multoil 5W20	Spindle 180	—	Spindle 100
					Way oil
Magna BD 32	RDO 32	—	S/L Way 150	—	Waylube 15
Magna BD 68	RDO 68	WOC 68	S/L Way 300	MM WLN 68	Waylube 3
Magna CF 220	RDO 220	WOC 220	S/L Way 1000	MM Way	Waylube 9
					Extreme pressure gear oil
Alpha EP 68	Hulbest EP	Certop 80W90	Gear 300	Gearco 80W90	EP Gear 315
Alpha EP 150	Hulbest EP	Certop 80W90	Gear 700	Gearco 80W90	EP Gear 750
Alpha EP 320	Hulbest EP	Certop 85W140	Gear 1500	Gearco 85W140	EP Gear 1500
					Worm gear oil
Alpha Worm Gear 460	Garwal 460	Certop 85W140	Worm Gear 2150	Gearco 85W140	—
					Cling type gear shield (open gears)
—	Centak 11	Hi Gear Plus; Lube Trac Plus	Gear Shield 2100	Gex Plus Aerosol; MM Spray Open Gear	Open Gear 1000
					General purpose extreme pressure lithium based grease
EP 2	Hullith EP 2	Lithiplex; CCL24; CCL12	Lith EP 2	Lube Plus	Chemlith EP 2A
					Molybedenum disulfide extreme pressure grease
Molydee	Molycent	Premalube; CCL24	Moly DEP2	Maxilube	Chemlith MY 2B

ISO Viscosity grade	Viscosity, SUS at 100 F	Chesterton Groveland, MA www.chesterton.com	Chevron Products Richmond, CA	Citgo Petroleum Tulsa, OK www.citgo.com	Clark Oil and Chemical Cleveland, OH
General purpose lubricants					
32	**135–165**	651 Detergent	Turbine GST 32	Pacemaker 32	Cochem 238 4
46	**194–236**	—	Turbine GST 46	Pacemaker 46	Cochem 238 5
68	**284–346**	—	Turbine GST 68	Pacemaker 68	Cochem 238 7
150	**630–770**	—	Machine AW 150	Pacemaker 150	Cochem 238 9
220	**900–1100**	—	Machine AW 220	Pacemaker 220	Cochem 238 10
460	**1935–2365**	—	Ind EP 460	Pacemaker 460	Cochem 238 11
Antiwear hydraulic oil					
32	**135–165**	—	Hyd AW 32	AW Hyd 32	Cochem 237 4
46	**194–236**	—	Hyd AW 46	AW Hyd 46	Cochem 237 5
68	**284–346**	—	Hyd AW 68	AW Hyd 68	Cochem 237 7
Spindle oil					
2	**29–35**	—	—	—	Cochem 237 0
10	**54–66**	—	Hyd AW 10	—	Cochem 237 1
22	**95–115**	601 Chain, Pin, & Bushing	Hyd AW 22	Pacemaker 19	Cochem 237 2
Way oil					
32	**135–165**	—	—	SlideRite 32	Cochem 233 1
68	**284–346**	—	Way Vistac 68	SlideRite 68	Cochem 233 3
220	**900–1100**	—	Way Vistac 220	SlideRite 220	Cochem 233 10
Extreme pressure gear oil					
68	**283–347**	—	Gear Compound EP 68	Citgear Ind EP 68	Cochem 264 2
150	**630–770**	—	Gear Compound EP 150	Citgear Ind EP 150	Cochem 264 4
320	**135–1650**	—	Gear Compound EP 320	Citgear Ind EP 320	Cochem 264 6
Worm gear oil					
460	**1935–2365**	—	Cylinder W 460	Cylinder 400 5	Cochem 1439
Cling type gear shield (open gears)					
—	**—**	715 Sprayflex; 715 Sprayflex Gold	Open Gear	Citgear (OGL A)	Cochem 1412
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	615 High Temp; 613 Moly	Dura-Lith EP NLGI 2	Premium Lith EP 2	Cochem 387 2
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	613 Moly	Moly EP NLGI 2	Lithoplex MP 2	Cochem 387 4

	CLC Lubricants Geneva, IL www.clclubricants.com	Comet Supply Washington, IL	Conoco Houston, TX	CPI Engineering Services Midland, MI www.cpieng.com
General purpose lubricants				
	HO 149	Galaxy R&O 32	Hydroclear Multipurpose R&O 32	CP 9001 32
	HO 199	Galaxy R&O 46	Hydroclear Multipurpose R&O 46	CP 9001 46
	HO 299	Galaxy R&O 68	Hydroclear Multipurpose R&O 68	CP 9001 68
	HO 699	Galaxy R&O 150	Hydroclear Multipurpose R&O 150	CP 9001 150
	HO 1059	Galaxy R&O 220	Hydroclear Multipurpose R&O 220	CP 9001 220
	HO 2200	Galaxy R&O 460	Hydroclear Multipurpose R&O 460	—
Antiwear hydraulic oil				
	HVI 32 AW	Saturn AW 32	Hydroclear AW Hyd Furo 32	CP 9000 32
	HVI 46 AW	Saturn AW 46	Hydroclear AW Hyd Furo 46	CP 9000 46
	HVI 68 AW	Saturn AW 68	Hydroclear AW Hyd Furo 68	CP 9000 68
Spindle oil				
	SP 35	Spindle 2	—	—
	SP 60	Spindle 10	—	—
	SP 100	Spindle 22	Hydroclear Spindle 15	—
Way oil				
	WL 32	Waylube 32	—	—
	WL 68 CM	Waylube 68	Hydroclear Premium Way 68	—
	WL 220	Waylube 220	Hydroclear Premium Way 220	—
Extreme pressure gear oil				
	IGO 300	Gearlube EP 68	Hydroclear EP Gear 68	CP 9020 68
	IGO 700	Gearlube EP 150	Hydroclear EP Gear 150	CP 9020 150
	IGO 1500	Gearlube EP 320	Hydroclear EP Gear 320	CP 9020 320
Worm gear oil				
	2200 Worm Gear	Cylinder 460	Inca 460	—
Cling type gear shield (open gears)				
	Lubrimax Gear Shield MM	—	Centak 11; 11W	—
General purpose extreme pressure lithium based grease				
	Lubrimax LSEP 2	Lith EP 2	Super Sta 2	—
Molybedenum disulfide extreme pressure grease				
	Lubrimax ML 2	Molylith EP 2	Super M EP 2	—

ISO Viscosity grade	Viscosity, SUS at 100 F	Darmex Roslyn Hts, NY	Dodge Oil (W.S.) Maywood, CA	Dryden Oil Baltimore, MD www.drydenoil.com	DuBois Chemicals Cincinnati, OH www.DuBoisChemicals.com
General purpose lubricants					
32	**135–165**	10	Deolube 150 S	Paradene 32 R&O	Polygard 32
46	**194–236**	1050	Deolube 225 S	Paradene 46 R&O	Polygard 46
68	**284–346**	1050	Deolube 300 S	Paradene 68 R&O	Polygard 68
150	**630–770**	50	Deolube 750 S	Paradene 150 R&O	Polygard EP 150
220	**900–1100**	9140	Deolube 1000 S	Paradene 220 R&O	Polygard EP 220
460	**1935–2365**	250	Deolube 2000 S	Paradene 460 R&O	Polygard EP 460
Antiwear hydraulic oil					
32	**135–165**	Hyd 100	Deolube 150 AW	Paradene 32 AW	Polygard 32
46	**194–236**	Hyd 100/200	Deolube 225 AW	Paradene 46 AW	Polygard 46
68	**284–346**	Hyd 100/200	Deolube 300 AW	Paradene 68 AW	Polygard 68
Spindle oil					
2	**29–35**	SPO L	—	—	—
10	**54–66**	SPO M	Deolube 60 S	Spindle 10	—
22	**95–115**	SPO H	Deolube 90 S	Spindle 22	—
Way oil					
32	**135–165**	10 W	Saf Way 150	Way 32	Polygard 32
68	**284–346**	30 W	Saf Way P 47	Way 68	Polygard 68
220	**900–1100**	220 W	Saf Way P 50	Way 220	Polygard EP 220
Extreme pressure gear oil					
68	**283–347**	GBO 1050 XL	Deolube Industragear 80	EP Gear 68	Polygard EP 68
150	**630–770**	75/90 XL	Deolube Industragear 85	EP Gear 150	Polygard EP 150
320	**135–1650**	140 XL	Deolube Industragear 90	EP Gear 320	Polygard EP 320
Worm gear oil					
460	**1935–2365**	140 EP	Wet Steam Cylinder 7 C	Worm Gear 460	Folder EP 460
Cling type gear shield (open gears)					
—	**—**	421	Quickset Open Gear	Open Gear 800	OGG H
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	123	EP Lith 2	HD Lith EP 2	CLG 2
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	MG 2	Moly EP Lith 2	Contractor Special	OGG H

ISO Viscosity grade	Viscosity, SUS at 100 F	Dylon Industries Cleveland, OH	Enterprise Oil Chicago, IL	Eppert Oil Detroit, MI	Exxon USA Houston, TX www.exxon.com	Fina Oil and Chemical Dallas, TX
General purpose lubricants						
32	**135–165**	—	Durafilm R&O 32	Eppco Machine 32	Teresstic GT 32	Eolan R&O 32
46	**194–236**	—	Durafilm R&O 46	Eppco Machine 46	Teresstic 46	Eolan R&O 46
68	**284–346**	—	Durafilm R&O 68	Eppco Machine 68	Teresstic 68	Eolan R&O 68
150	**630–770**	—	Durafilm R&O 150	Eppco Machine 150	Teresstic 150	Eolan R&O 150
220	**900–1100**	—	Durafilm R&O 220	Eppco Machine 220	Teresstic 220	Eolan R&O 220
460	**1935–2365**	—	Durafilm R&O 460	Eppco Machine 460	Teresstic 460	Eolan R&O 460
Antiwear hydraulic oil						
32	**135–165**	—	Durafilm AW 32	Universal GP Hyd 32	Nuto H 32	Hydran 32
46	**194–236**	—	Durafilm AW 46	Universal GP Hyd 46	Nuto H 46	Hydran 46
68	**284–346**	—	Durafilm AW 68	Universal GP Hyd 68	Nuto H 68	Hydran 68
Spindle oil						
2	**29–35**	—	Durafilm Spindle 2	Eppco Spindle 2	—	—
10	**54–66**	—	Durafilm Spindle 10	Eppco Spindle 10	Spinesstic 10	Textile 210
22	**95–115**	—	Durafilm Spindle 22	Eppco Spindle 22	Spinesstic 22	Textile 263
Way oil						
32	**135–165**	—	Durafilm Way 32	Eppco EP Extak Way 32	Febis K 32	Artac Way 32
68	**284–346**	—	Durafilm Way 68	Eppco EP Extak Way 68	Febis K 68	Artac Way 68
220	**900–1100**	—	Durafilm Way 220	Eppco EP Extak Way 220	Febis K 220	Artac Way 220
Extreme pressure gear oil						
68	**283–347**	—	Durafilm EP Compound 68	Eppco Premium Gear 68	Spartan EP 68	Pontonic N 68
150	**630–770**	LB 447; LB 447/150	Durafilm EP Compound 150	Eppco Premium Gear 150	Spartan EP 150	Pontonic N 150
320	**135–1650**	LB-447/320	Durafilm EP Compound 320	Eppco Premium Gear 320	Spartan EP 320	Pontonic N 320
Worm gear oil						
460	**1935–2365**	LB-447/480	Durafilm Cylinder 460	Eppco Premium Gear 460	Cylesstic TK 460	Cylan Cylinder
Cling type gear shield (open gears)						
—	**—**	LB 377	—	Open Gear Compound 1133	Dynagear, Surett N, Surett Fluid	Marson Open Gear
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	GR F13	Premium Lith EP 2	Eppco EP Lith 2	Unirex EP 2, Ronex MP	Marson Liplex 2
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	GR F13	Premium Moly Lith EP 2	Eppco Molyplex EP 2	Ronex Extra-Duty Moly	Marson Liplex Moly 2

ISO Viscosity grade	Viscosity, SUS at 100 F	Fiske Brothers Refining Toledo, OH www.lubriplate.com	Fluoramics Mahwah, NJ www.Tufoil.com	Fuchs Lubricants Harvey, IL	Gard Kansas City, KS
General purpose lubricants					
32	**135–165**	HO 0	Gun-Coat	Renolin AW 32	HydraGard R&O 32
46	**194–236**	HO 1	Lubit 8	Renolin AW 46	HydraGard R&O 46
68	**284–346**	HO 2	—	Renolin AW 68	HydraGard R&O 68
150	**630–770**	SPO 244	—	Renolin AW 150	HydraGard R&O 150
220	**900–1100**	SPO 255	—	Renolin AW 220	HydraGard R&O 220
460	**1935–2365**	SPO 277	—	Renolin AW 460	HydraGard R&O 460
Antiwear hydraulic oil					
32	**135–165**	HO 0	—	Renolin AW 32	HydraGard AW 32
46	**194–236**	HO 1	—	Renolin AW 46	HydraGard AW 46
68	**284–346**	HO 2	—	Renolin AW 68	HydraGard AW 68
Spindle oil					
2	**29–35**	—	—	—	—
10	**54–66**	No. 0	—	Renolin SP 10	SpinGard 10
22	**95–115**	No.1	—	Renolin SP 22	SpinGard 22
Way oil					
32	**135–165**	HO 0	—	Renolin WL 32	Gardway 32
68	**284–346**	SPO 222	—	Renolin WL 68	Gardway 68
220	**900–1100**	SPO 255	—	Renolin WL 220	Gardway 220
Extreme pressure gear oil					
68	**283–347**	APG 80	—	Renolin EP 68	GardGear EP 68
150	**630–770**	APG 90	—	Renolin EP 150	GardGear EP 150
320	**135–1650**	APG 80W140	—	Renolin EP 320	GardGear EP 320
Worm gear oil					
460	**1935–2365**	SPO 277	—	Renolin CS 460	GardGear WGL 460
Cling type gear shield (open gears)					
—	**—**	Gear Shield Extra Heavy	—	Centak 11	—
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	1552	—	Hullith EP 2	Disc Brake WB
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	3000	—	Molycent 2	Moly Lith EP 2

ISO Viscosity grade	Viscosity, SUS at 100 F	GoldenWest Lubricants S. El Monte, CA www.goldenWestLubricants.com	Huskey Specialty Lubricants Norco, CA	Hydrotex Dallas, TX www.hydrotexlube.com	I.D. Carson City, NV
General purpose lubricants					
32	**135–165**	Premium R&O 32	HLO 10	Hydiamond Fluid 6kp 32	R&O 150
46	**194–236**	Premium R&O 46	HLO 5W20	Hydiamond Fluid 6kp 46	R&O 225
68	**284–346**	Premium R&O 68	HLO 20	Hydiamond Fluid 6kp 68	R&O 300
150	**630–770**	Premium R&O 150	HLO 40	Hydiamond Fluid 6kp 150	R&O 700
220	**900–1100**	Premium R&O 220	HLO 50	Non EP Ind 220	R&O 1000
460	**1935–2365**	Premium R&O 460	HLO 70	Non EP Ind 460	R&O 2100
Antiwear hydraulic oil					
32	**135–165**	Premium AW Hyd 32	HLO 10	Hydiamond Fluid 6kz 32	AW 150
46	**194–236**	Premium AW Hyd 46	HLO 5W20	Hydiamond Fluid 6kz 46	AW 225
68	**284–346**	Premium AW Hyd 68	HLO 20	Hydiamond Fluid 6kz 68	AW 300
Spindle oil					
2	**29–35**	Premium Spindle 2	—	Super White Textile	Spindle 30
10	**54–66**	Premium Spindle 10	Spindle 10	Hydiamond Fluid 15kp 15	Spindle 60
22	**95–115**	Premium Spindle 22	Spindle 22	Hydiamond Fluid 15kp 22	Spindle 100
Way oil					
32	**135–165**	Premium Waylube 32	—	—	Way 1
68	**284–346**	Premium Waylube 68	—	Ind Way 68	Way 2
220	**900–1100**	Premium Waylube 220	—	Ind Way 220	Way 4
Extreme pressure gear oil					
68	**283–347**	Ind Gear 68	Gear 80	930 Ind Gear	EP Gear 300
150	**630–770**	Ind Gear 150	Gear 85	930S Ind Gear	EP Gear 700
320	**135–1650**	Ind Gear 320	Gear 90	932 Ind Gear	EP Gear 1500
Worm gear oil					
460	**1935–2365**	Worm Gear 460	Gear 140	933 Ind Gear	—
Cling type gear shield (open gears)					
—	**—**	Premium Open Gear 35	Open Gear	934, 940, 941 HD Ind Gear	—
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Multi-Purpose EP Lith 2	Coolplex	Acculube or MTP Ultra	—
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Multi-Purpose EP Moly 2	Molyplex	Super Shield	—

ISO Viscosity grade	Viscosity, SUS at 100 F	Illinois Oil Products Rock Island, IL	Industrial Oils Unlimited Tulsa, OK	Industrial Oils Unlimited AR Little Rock, AR	Jet-Lube Houston, TX	Jonell Oil Irwindale, CA
General purpose lubricants						
32	**135–165**	Supreme Ind 32	R&O Hyd 32	HPP R&O 32	—	Jo-Lube 1521
46	**194–236**	Supreme Ind 46	R&O Hyd 46	HPP R&O 46	—	Jo-Lube 1523
68	**284–346**	Supreme Ind 68	R&O Hyd 68	HPP R&O 68	—	Jo-Lube 1522
150	**630–770**	Supreme Ind 150	R&O Hyd 150	HPP R&O 150	—	Jo-Lube 1527
220	**900–1100**	Supreme Ind 220	R&O Hyd 220	HPP R&O 220	—	Jo-Lube 1525
460	**1935–2365**	Supreme Ind 460	R&O Hyd 460	HPP R&O 460	—	Jo-Lube 1528
Antiwear hydraulic oil						
32	**135–165**	Supreme AW 32	AW Hyd 32	HPP Premium 32 AW Hyd	—	Jo-Lube 1511
46	**194–236**	Supreme AW 46	AW Hyd 46	HPP Premium 46 AW Hyd	—	Jo-Lube 1512
68	**284–346**	Supreme AW 68	AW Hyd 68	HPP Premium 68 AW Hyd	—	Jo-Lube 1513
Spindle oil						
2	**29–35**	Supreme Spindle 2	Spindle 30	Spindle 22	—	—
10	**54–66**	Supreme Spindle 10	Spindle 60	Spindle 60	—	Jo-Lube 1509
22	**95–115**	Supreme Spindle 22	Spindle 100	Spindle 100	—	Jo-Lube 1510
Way oil						
32	**135–165**	—	Waylube 32	Premium Waylube 32	—	Jo-Lube 1501
68	**284–346**	—	Waylube 68	Premium Waylube 68	—	Jo-Lube 1502
220	**900–1100**	—	Waylube 220	Premium Waylube 220	—	Jo-Lube 1504
Extreme pressure gear oil						
68	**283–347**	Supreme EP Gear 68	AGMA EP 2	HPP EP 68 Gear	—	Jo-Lube 1590 20
150	**630–770**	Supreme EP Gear 150	AGMA EP 4	HPP EP 150 Gear	—	Jo-Lube 1590 30
320	**135–1650**	Supreme EP Gear 320	AGMA EP 6	HPP EP 320 Gear	—	Jo-Lube 1590 140
Worm gear oil						
460	**1935–2365**	—	AGMA EP 7	Super Worm Gear 460	—	Jo-Lube 1595
Cling type gear shield (open gears)						
—	**—**	—	—	—	Gear-Guard	—
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	Supreme HD Lith	Superfilm	Superfilm High Temp	CB 2	Jo-Lube 1588 EP 2
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	Supreme HD 3% Moly	Moly Hi-Temp	Superfilm HMA 2	202	Jo-Lube 1587 Moly EP 2

ISO Viscosity grade	Viscosity, SUS at 100 F	Kaeser Compressors Fredericksburg, VA	Kano Laboratories Nashville, TN www.kanolabs.com	Kendall Motor Oil Bradford, PA	Kent Oil Co. Lakeland, FL	Kernite Irving, TX
General purpose lubricants						
32	**135–165**	FG 320 Compressor	—	4 Seasons AW 32	Moly Special Duty 10	Lubricomp
46	**194–236**	FG 460, M 460 Compressor	—	4 Seasons AW 46	Moly Special Duty 15	Lubricomp
68	**284–346**	FG 680 Compressor	—	4 Seasons AW 68	Moly Special Duty 20	Lubricomp
150	**630–770**	FG 150, M 150 Compressor	—	4 Seasons AW 150	Moly Special Duty 40	M/M HO 150
220	**900–1100**	—	—	—	Moly Special Duty 50	M/M HO 220
460	**1935–2365**	FG 460 Compressor	—	—	Moly Special Duty 70	—
Antiwear hydraulic oil						
32	**135–165**	—	—	4 Seasons AW 32	Moly Hydro-Servoil 303	Hydro-Gard; MM Hyd 32
46	**194–236**	—	—	4 Seasons AW 46	Moly Hydro-Servoil 304	Hydro-Gard; MM Hyd 46
68	**284–346**	—	—	4 Seasons AW 68	Moly Hydro-Servoil 305	Hydro-Gard; MM Hyd 68
Spindle oil						
2	**29–35**	—	—	—	Moly Spindle - Extra Light	—
10	**54–66**	—	—	—	Moly Spindle - Light	M/M Spindle
22	**95–115**	—	—	Hyken Glacial Blu	Moly Spindle - Medium	—
Way oil						
32	**135–165**	—	—	—	Moly Way 10	—
68	**284–346**	—	—	—	Moly Way 20	Waylube
220	**900–1100**	—	—	—	Moly Way 50	M/M Way
Extreme pressure gear oil						
68	**283–347**	—	—	—	Moly Super Gear 89	Top Blend 80W90
150	**630–770**	—	—	NS MP 80W90; SHP 75W90	Moly Super Gear 90	Top Blend 80W90
320	**135–1650**	—	—	NS MP 85W140	Moly Super Gear 123	Top Blend 85W140
Worm gear oil						
460	**1935–2365**	—	—	Kendco 155 Comp	Moly Worm Gear 460	Top Blend 85W140
Cling type gear shield (open gears)						
—	**—**	—	—	SR 12X	Moly Open Gear Spray - Regular	M/M Sprayable Open Gear
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	—	—	L426/L427	7 Plus Poly Moly 2	Lubra K
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	—	Molyfilm	L424/L428	7 Plus Poly Moly 2	Summit

ISO Viscosity grade	Viscosity, SUS at 100 F	Klüber Lubrication N. America Londonderry, NH www.kluber.com	Leahy-Wolf Franklin Park, IL	Lube-Tech/Rollins Golden Valley, MN	LubeCon Systems White Cloud, MI
General purpose lubricants					
32	**135–165**	Crucolan 32	Gold Seal Hydrol 32	R&O Hyd 150	—
46	**194–236**	Crucolan 46	Gold Seal Hydrol 46	R&O Hyd 215	—
68	**284–346**	Crucolan 68	Gold Seal Hydrol 68	R&O Hyd 315	—
150	**630–770**	Crucolan 150	Gold Seal Hydrol 150	R&O Hyd 700	—
220	**900–1100**	Crucolan 220	Gold Seal Hydrol 220	R&O Hyd 1000	—
460	**1935–2365**	Crucolan 460	Gold Seal Hydrol 460	—	—
Antiwear hydraulic oil					
32	**135–165**	Lamora HLP 32	Hydrol Master 32	AW Hyd 150	—
46	**194–236**	Lamora HLP 46	Hydrol Master 46	AW Hyd 215	—
68	**284–346**	Lamora HLP 68	Hydrol Master 68	AW Hyd 315	—
Spindle oil					
2	**29–35**	—	Lubemaster MA R&O 2	Spindle 000	—
10	**54–66**	Crucolan 10	Lubemaster MA R&O 10	Spindle 00	—
22	**95–115**	Crucolan 22	Lubemaster MA R&O 22	Spindle 0	—
Way oil					
32	**135–165**	—	Tac Master EP 32	Waylube 32	Way 32
68	**284–346**	Lamora D 68	Tac Master EP 68	Waylube 68	Way 68
220	**900–1100**	Lamora D 220	Tac Master EP 220	Waylube 220	Way 220
Extreme pressure gear oil					
68	**283–347**	Lamora 68	Ind EP 2	Ace EP 2 Gear	Turmogearoil Omser 68
150	**630–770**	Lamora 150	Ind EP 4	Ace EP 4 Gear	Turmogearoil Omser 150
320	**135–1650**	Lamora 320	Ind EP 6	Ace EP 6 Gear	Series 90/140
Worm gear oil					
460	**1935–2365**	Unimoly 460	Lubemaster 103 2	—	Turmogearoil Omser 460
Cling type gear shield (open gears)					
—	**—**	Grafloscon C SGO Ultra	Metallic Gear Cote	—	Series JIM
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Centoplex EP 2	Cling Master 2	Multi-Lith MP EP 2	Turmogrease LI 802 EP
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Staburags N 12 MF	Moly Master 2	Moly-Lith EP 2	HDMP 2

ISO Viscosity grade	Viscosity, SUS at 100 F	LuBest Div. of Momar Atlanta, GA www.momar.com	Lubra Systems Dallas, TX www.lubrasystems.com	Lubrication Engineers Fort Worth, TX	LubriSource Florence, SC
General purpose lubricants					
32	**135–165**	Turbine 32	IGM 5W20; Hymaster 32	Monolec Turbine; 6801 Multilec	R&O Hyd 32
46	**194–236**	Turbine 46	IGM 5W20; Hymaster 46	Monolec Turbine; 6802 Multilec	R&O Hyd 46
68	**284–346**	Turbine 68	IGM 5W20; Hymaster 68	Monolec Turbine; 6803 Multilec	R&O Hyd 68
150	**630–770**	Turbine 150	IGM 10W40; Hymaster 150	Monolec Turbine; 6805 Multilec	R&O Hyd 150
220	**900–1100**	Turbine 220	IGM 10W40; Hymaster 220	Monolec Turbine; 6806 Multilec	R&O Hyd 220
460	**1935–2365**	—	—	—	R&O Hyd 460
Antiwear hydraulic oil					
32	**135–165**	AW Hyd 32	Hymaster 10W30; Hymaster 32	6520 Monolec Hyd	AW Hyd 32
46	**194–236**	AW Hyd 46	Hymaster 10W30; Hymaster 46	6110 Monolec Hyd	AW Hyd 46
68	**284–346**	AW Hyd 68	Hymaster 10W30; Hymaster 68	6120 Monolec Hyd	AW Hyd 68
Spindle oil					
2	**29–35**	—	—	—	—
10	**54–66**	Spindle 15	SPL 10	—	—
22	**95–115**	Spindle 22	Hymaster 5W20	—	Spindle & Loom 32
Way oil					
32	**135–165**	Slideway 32	—	6301 Monolec Rock Drill	Skim & Save Way 32
68	**284–346**	Slideway 68	WAL 68	—	Skim & Save Way 68
220	**900–1100**	Slideway 220	WAL 220	6315 Monolec Way	Skim & Save Way 220
Extreme pressure gear oil					
68	**283–347**	Ind Gear EP 2	Geartech 80W90	300 Monolec Ind	Premium EP Gear 68
150	**630–770**	Ind Gear EP 4	Geartech 80W90	604 Almasol Vari-Purpose Gear	Premium EP Gear 80W90
320	**135–1650**	Ind Gear EP 6	Geartech 85W140	605 Almasol Vari-Purpose Gear	Premium EP Gear 85W140
Worm gear oil					
460	**1935–2365**	Worm Gear 460	Geartech 85W140	608 Almasol Vari-Purpose Gear	Worm Gear 460
Cling type gear shield (open gears)					
—	**—**	Titan 444	Geartech Open Gear; OGL Plus; AOG Plus	5180/9000 Pyroshield	—
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Titan 555	Lubraplex; MML; Lithilube	3752 Almagard Vari-Purpose	—
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Titan 777	PCL; MML	—	Non Melt EP Moly

ISO Viscosity grade	Viscosity, SUS at 100 F	Lyondell Lubricants Houston, TX	Macro Specialty Industries Napoleon, OH	Madol Lubricants Reidsville, NC	Mantek Dallas, TX www.mantek.com	McCollister Council Bluffs, IA
General purpose lubricants						
32	**135–165**	Duro 32	—	210	M/M MP 5W20	3043 32
46	**194–236**	Duro 46	—	220	M/M MP 5W20	3044 46
68	**284–346**	Duro 68	—	230	M/M MP 5W20	3045 68
150	**630–770**	Duro 150	—	240	—	3047 150
220	**900–1100**	Duro 220	—	250	—	3048 220
460	**1935–2365**	Rubilene 460	—	260	—	—
Antiwear hydraulic oil						
32	**135–165**	Duro AW 32	—	332	Hydrex; M/M Hyd Fluid 32	3043 Ind Hyd 32
46	**194–236**	Duro AW 46	—	346	Hydrex; M/M Hyd Fluid 46	3044 Ind Hyd 46
68	**284–346**	Duro AW 68	—	368	Hydrex; M/M Hyd Fluid 68	3045 Ind Hyd 68
Spindle oil						
2	**29–35**	—	—	402	—	—
10	**54–66**	Diamond 7	—	406	M/M Spindle	4760 Spindle 60
22	**95–115**	Diamond 20	—	410	—	4761 Spindle 100
Way oil						
32	**135–165**	Truslide 32	—	532	—	4353 Ind Way 32
68	**284–346**	Truslide 68	—	568	M/M MWL 68	4355 Ind Way 68
220	**900–1100**	Truslide 220	—	590	M/M Way	4358 Ind Way 220
Extreme pressure gear oil						
68	**283–347**	Pennant NL 68	—	5423	Manco MP Gear 80W90	4376 Ind Gear 68
150	**630–770**	Pennant NL 150	—	5475	Manco MP Gear 80W90	4370 Ind Gear 100
320	**135–1650**	Pennant NL 320	—	5477	Manco MP Gear 85W140	4373 Ind Gear 320
Worm gear oil						
460	**1935–2365**	Modoc 175	—	5280	Manco MP Gear 85W140	4364 Ind Gear 460
Cling type gear shield (open gears)						
—	**—**	Jet Lube TM	—	5104; 5496	Top Gear Plus; GG 10 Plus	—
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	Litholine HEP 2	LRG 500	—	—	2339
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	EP Moly D	—	—	Elite	2280 Moly-Lith 2

ISO Viscosity grade	Viscosity, SUS at 100 F	McGean-Rohco Cleveland, OH	Metalworking Lubricants Pontiac, MI	Mid-Town Petroleum Bridgeview, IL	Minuteman Lubricants Cabot, PA	Mobil Oil Fairfax, VA www.mobil.com
General purpose lubricants						
32	**135–165**	McEase GL 150	Lubemet 32	Super R&O 32	Turbine R&O 32	DTE Light
46	**194–236**	McEase GL 215	Lubemet 46	Super R&O 46	Turbine R&O 46	DTE Medium
68	**284–346**	McEase Compressor	Lubemet 68	Super R&O 68	Turbine R&O 68	DTE Heavy Medium
150	**630–770**	McEase GL 700	Lubemet 150	Super R&O 150	Turbine R&O 150	DTE Extra Heavy
220	**900–1100**	McEase 1000	Lubemet 220	Super R&O 220	Turbine R&O 220	DTE BB
460	**1935–2365**	—	Lubemet 460	Super R&O 460	Turbine R&O 460	DTE HH
Antiwear hydraulic oil						
32	**135–165**	McEase 32	Lubemet 32 AW	Super AW Hyd 32	Hyd AW 32; Hyd AW 32 (ZF)	DTE 24; Hyd 32
46	**194–236**	McEase 46	Lubemet 46 AW	Super AW Hyd 46	Hyd AW 46; Hyd AW 46 (ZF)	DTE 25; Hyd 46
68	**284–346**	McEase 68	Lubemet 68 AW	Super AW Hyd 68	Hyd AW 68; Hyd AW 68 (ZF)	DTE 26; Hyd 68
Spindle oil						
2	**29–35**	—	Lubemet Spindle 2	Super Spindle 2	Spindle 2	Velocite 3
10	**54–66**	McEase Spindle 60	Lubemet Spindle 10	Super Spindle 10	Spindle 10	Velocite 6
22	**95–115**	McEase Spindle 100	Lubemet Spindle 22	Super Spindle 22	Spindle 22	Velocite 10
Way oil						
32	**135–165**	—	Lubemet Wayslide 32	Super Waylube 32	Way 32	Vactra 1
68	**284–346**	McEase Waylube 47	Lubemet Wayslide 68	Super Waylube 68	Way 68	Vactra 2
220	**900–1100**	McEase Waylube 50	Lubemet Wayslide 220	Super Waylube 220	Way 220	Vactra 4
Extreme pressure gear oil						
68	**283–347**	McEase Gear 315	Metgear 68	Super NL Gear Compound 68	Ind Gear EP 68	Mobilgear 626
150	**630–770**	McEase Gear 629	Metgear 150	Super NL Gear Compound 150	Ind Gear EP 150	Mobilgear 629
320	**135–1650**	McEase Gear 80W140	Metgear 320	Super NL Gear Compound 320	Ind Gear EP 320	Mobilgear 632
Worm gear oil						
460	**1935–2365**	—	Metgear 460	Super Cylinder 460	Cylinder 460	600 W Cyl
Cling type gear shield (open gears)						
—	**—**	McEase Base 6000	Metkling Gear	—	—	Mobiltac 375 NC
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	McEase MLC 4	Lubemet 2	Super Lith Complex	Lith EP 2	Mobilith AW 2
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	—	Metlith 2	Super Moly D	Moly Lith EP 2	Mobilgrease Special

ISO Viscosity grade	Viscosity, SUS at 100 F	New Technology Lubricants Winfield, IL	Niagara Lubricant Buffalo, NY	Noco Energy Lisbon, NY	Norton Petroleum Newark, DE
General purpose lubricants					
32	**135–165**	Contempo ML 32	Niavis R&O 32	Turbine T 32	Premium R&O 32
46	**194–236**	Contempo ML 46	Niavis R&O 46	Turbine T 46	Premium R&O 46
68	**284–346**	Contempo ML 68	Niavis R&O 68	Turbine T 68	Premium R&O 68
150	**630–770**	Contempo ML 100	Niavis R&O 150	Turbine T 150	Premium R&O 150
220	**900–1100**	Contempo ML 220	Niavis R&O 220	Turbine T 220	Premium R&O 220
460	**1935–2365**	Contempo ML 460	Niavis R&O 460	Turbine T 460	Premium R&O 460
Antiwear hydraulic oil					
32	**135–165**	Contempo AW Plus 1	Niavis R&O AW 32	AW 32	Premium AW 32
46	**194–236**	Contempo AW Plus 2	Niavis R&O AW 46	AW 46	Premium AW 46
68	**284–346**	Contempo AW Plus 3	Niavis R&O AW 68	AW 68	Premium AW 68
Spindle oil					
2	**29–35**	—	Spindle 2	Spinlube 5	Enduro R&O 2
10	**54–66**	—	Spindle 10	Spinlube 10	Enduro R&O 10
22	**95–115**	—	Spindle 22	Spinlube 22	Enduro 22
Way oil					
32	**135–165**	—	Waylube 32	Waylube 32	Norway 32
68	**284–346**	—	Waylube 68	Waylube 68, 350	Norway 68
220	**900–1100**	—	Waylube 220	Waylube 220, 950	Norway 220
Extreme pressure gear oil					
68	**283–347**	Contempo EP 68	Aragain EP 68	Norgear EP 68	Premium Gear 68
150	**630–770**	Contempo EP 150	Aragain EP 150	Norgear EP 150	Premium Gear 150
320	**135–1650**	Contempo EP 320	Aragain EP 320	Norgear EP 320	Premium Gear 320
Worm gear oil					
460	**1935–2365**	Contempo Premium 460	Aragain EP 460	—	Champion 600 W
Cling type gear shield (open gears)					
—	**—**	—	Open Gear Shield	—	Gear Shield
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	—	EP Lith 2	Lith EP 2	Norlith 2
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	—	Moly Lith 2	Molylith EP 2	—

ISO Viscosity grade	Viscosity, SUS at 100 F	Oils Unlimited Tulsa, OK	Orelube Plainview, NY	Pacer Lubricants Houston, TX www.pacerlubricants.com	Pennzoil Products Houston, TX
General purpose lubricants					
32	**135–165**	Superfilm R&O 32	Circona AW 32	Thermal T 32	Pennzbell R&O 32
46	**194–236**	Superfilm R&O 46	Circona AW 46	Thermal T 46	Pennzbell R&O 46
68	**284–346**	Superfilm R&O 68	Circona AW 68	Thermal T 68	Pennzbell R&O 68
150	**630–770**	Superfilm R&O 150	Circona AW 150	Thermal T 150	Pennzbell R&O 150
220	**900–1100**	Superfilm R&O 220	Circona AW 220	Thermal T 220	Pennzbell R&O 220
460	**1935–2365**	Superfilm R&O 460	Circona AW 460	Power N 460	Pennzbell R&O 460
Antiwear hydraulic oil					
32	**135–165**	Superfilm A/W Hyd 32	HA 1	Turino V 32	Pennzbell AW 32
46	**194–236**	Superfilm A/W Hyd 46	HA 2	Turino V 46	Pennzbell AW 46
68	**284–346**	Superfilm A/W Hyd 68	HA 3	Turino V 68	Pennzbell AW 68
Spindle oil					
2	**29–35**	Spindle 2	Spindle Extra Light	—	Pennzspin 3
10	**54–66**	Spindle 10	Spindle Light	Spindle 70	Pennzspin 10
22	**95–115**	Spindle 22	Spindle Medium	Spindle 100	Pennzspin AW 22
Way oil					
32	**135–165**	Superfilm Waylube 32	Waylight	Tru-Slide 150	Tableways 32
68	**284–346**	Superfilm Waylube 68	Way 68	Tru-Slide 300	Tableways 68
220	**900–1100**	Superfilm Waylube 220	Way 220	Tru-Slide 1000	Tableways 220
Extreme pressure gear oil					
68	**283–347**	Super EP 68	GL 68	Goltex AGMA EP 2	Super Maxol EP 68
150	**630–770**	Super EP 150	G 75/80	Goltex AGMA EP 4	Super Maxol EP 150
320	**135–1650**	Super EP 320	K 90/140	Goltex AGMA EP 6	Super Maxol EP 320
Worm gear oil					
460	**1935–2365**	Super Worm Gear 460	G 90/140	Golden G AGMA EP 7	Cylinder 8
Cling type gear shield (open gears)					
—	**—**	Open Gear Superfilm	G 1650	—	Pennztac Fluids
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Superfilm Hi-Temp 2	LC 116	Synfilm 4X EP 2	Pennlith EP 712; Prem Lith Complex 2
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Superfilm HMA 2	Neptune 7	Synfilm Super Moly EP 2	Prem Lith Complex 2 w/Moly; TTM 302

ISO Viscosity grade	Viscosity, SUS at 100 F	Perkins Products Bedford Park, IL	Petro-Canada Mississauga, ON www.htlubricants.com	Phillips 66 Bartlesville, OK www.phillips66.com	Premium Lubricants Vicksburg, MS
General purpose lubricants					
32	**135–165**	Perlube R&O 32	Premium R&O 32	Magnus 32	500 32
46	**194–236**	Perlube R&O 46	Premium R&O 46	Magnus 46	500 46
68	**284–346**	Perlube R&O 68	Premium R&O 68	Magnus 68	500 68
150	**630–770**	Perlube R&O 150	Premium R&O 150	Magnus 150	500 150
220	**900–1100**	Perlube R&O 220	Premium R&O 220	Magnus 220	500 220
460	**1935–2365**	Perlube R&O 460	—	All Mineral 460	500 460
Antiwear hydraulic oil					
32	**135–165**	Perlube AW 32	Premium AW 32	Magnus A 32	525 32
46	**194–236**	Perlube AW 46	Premium AW 46	Magnus A 46	525 46
68	**284–346**	Perlube AW 68	Premium AW 68	Magnus A 68	525 68
Spindle oil					
2	**29–35**	—	—	—	—
10	**54–66**	Perlube S 10	Premium R&O 10	—	—
22	**95–115**	Perlube S 22	Premium R&O 22	Magnus 22	—
Way oil					
32	**135–165**	Perlube WL 32	—	—	—
68	**284–346**	Perlube WL 68	Accuflo DM 68	Rock Drill 68	—
220	**900–1100**	Perlube WL 220	Accuflo DM 220	Way 220	—
Extreme pressure gear oil					
68	**283–347**	Perlube EP 68	Ultima EP 68	All Purpose Philgear 68	401 68
150	**630–770**	Perlube EP 150	Ultima EP 150	All Purpose Philgear 150	401 150
320	**135–1650**	Perlube EP 320	Ultima EP 320	All Purpose Philgear 320	401 320
Worm gear oil					
460	**1935–2365**	Perlube 460F	Senate 460	Hector 460	450
Cling type gear shield (open gears)					
—	**—**	Perlube 6X	Vulcan	Philstik	458
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Perlube AP 2	Multipurpose EP 2	High Temp EP	—
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Perlube MC 2	Multiflex Moly EP 2	Philube MW	—

ISO Viscosity grade	Viscosity, SUS at 100 F	Premium Oil Rockford, IL	Rock Valley Oil & Chemical Rockford, IL	Royal Purple Humble, TX	Safety-Kleen Oil Recovery Countryside, IL	Schaeffer Mfg. St. Louis, MO
General purpose lubricants						
32	**135–165**	Superior 32	Trojan 32	—	America's Choice R&O 32	112 Micron Moly HTC 32
46	**194–236**	Superior 46	Trojan 46	—	America's Choice R&O 46	112 Micron Moly HTC 46
68	**284–346**	Superior 68	Trojan 68	—	America's Choice R&O 68	112 Micron Moly HTC 68
150	**630–770**	Superior 150	Trojan 150	—	America's Choice R&O 150	112 Micron Moly HTC 150
220	**900–1100**	Superior 220	Trojan 220	—	America's Choice R&O 220	112 Micron Moly HTC 220
460	**1935–2365**	—	Trojan 460	—	America's Choice R&O 460	—
Antiwear hydraulic oil						
32	**135–165**	Superior AW 32	Trojan 32 AW	RP Syndraulic 32	America's Choice AW 32	112 Micron Moly HTC 32
46	**194–236**	Superior AW 46	Trojan 46 AW	RP Syndraulic 46	America's Choice AW 46	112 Micron Moly HTC 46
68	**284–346**	Superior AW 68	Trojan 68 AW	RP Syndraulic 68	America's Choice AW 68	112 Micron Moly HTC 68
Spindle oil						
2	**29–35**	—	Rockspin 2	—	—	—
10	**54–66**	Tru Spin 60	Rockspin 10	RP Needle 10	America's Choice R&O 10	—
22	**95–115**	Superior 22	Rockspin 22	RP Needle 22	America's Choice R&O 22	112 Micron Moly HTC 22
Way oil						
32	**135–165**	Waylube 32	Rockway 32 S	—	America's Choice Way 32	160 Moly Slide & Way 32; 203 Moly EP Ind 32
68	**284–346**	Waylube 68	Rockway 68-S	—	America's Choice Way 68	160 Moly Slide & Way 68; 203 Moly EP Ind 68
220	**900–1100**	Waylube 220	Rockway 220 S		America's Choice Way 220	160 Moly Slide & Way 220; 203 Moly EP Ind 220
Extreme pressure gear oil						
68	**283–347**	Gearep 68	EP Gear S 68	—	America's Choice EP 68	203A Moly EP Ind 68
150	**630–770**	Gearep 150	EP Gear S 150	RP Synergy 150	America's Choice EP 150	209 Moly Universal Gear 150; 209A Moly Universal Gear 150
320	**135–1650**	Gearep 320	EP Gear S 320	RP Synergy 320	America's Choice EP 320	209 Moly Universal Gear 320; 209A Moly Universal Gear 320
Worm gear oil						
460	**1935–2365**	Steam Cylinder 460	Cylinder 460	RP Synergy 460	—	209 Moly Universal Gear 460; 209A Moly Universal Gear 460
Cling type gear shield (open gears)						
—	**—**	—	—	—	—	200S Silver Streak Special
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	—	Lith EP 2	—	—	221 Moly Ultra 800 EP; 238 Moly Ultra Supreme
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	—	Lith EP 2 w/Moly	—	—	221 Moly Ultra 800 EP; 238 Moly Ultra Supreme

ISO Viscosity grade	Viscosity, SUS at 100 F	Seeco-Eastern Edenton, NC	Sentinel Lubricants Miami, FL	Shell Oil Houston, TX www.shell-lubricants.com	Silogram Lubricants Staten Island, NY
General purpose lubricants					
32	**135–165**	Hydravis 32	SMPO 10	Turbo T 32	MP 157
46	**194–236**	Hydravis 46	SMPO 20	Turbo T 46	MP 207
68	**284–346**	Hydravis 68	SMPO 30	Turbo T 68	MP 307
150	**630–770**	Hydravis 150	SMPO 50	Morlina 150	MP 707
220	**900–1100**	Hydravis 220	SMPO 90	Morlina 220	MP 907
460	**1935–2365**	Hydravis 460	SMPO 140	Morlina 460	MP 1507
Antiwear hydraulic oil					
32	**135–165**	32 AW	SH 10	Tellus 32	TIP 100 15 7; AW 150
46	**194–236**	46 AW	SH 10/20	Tellus 46	TIP 100 20 7; AW 200
68	**284–346**	68 AW	SH 20	Tellus 68	TIP 100 30 7; AW 300
Spindle oil					
2	**29–35**	—	Spin L	—	LVS 35
10	**54–66**	Spindoil 10	Spin LM	Spindle 10	LVS 60
22	**95–115**	Spindoil 22	Spin M	Spindle 22	LVS 100
Way oil					
32	**135–165**	—	S 10	Tonna V 32	MP 157
68	**284–346**	Waylube 68	S 20	Tonna V 68	MP 307
220	**900–1100**	Waylube 220	S 50	Tonna V 220	MP 907
Extreme pressure gear oil					
68	**283–347**	Ind EP 68	S 75/80	Omala 68	MP 307
150	**630–770**	Ind EP 150	S 80/90	Omala 150	EP 90
320	**135–1650**	Ind EP 320	S 90/140	Omala 320	EP140
Worm gear oil					
460	**1935–2365**	—	S 140	Valvata J 460	MP 1507
Cling type gear shield (open gears)					
—	**—**	—	SLOG	Malleus GL 95	R&G 25
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Multi-Purpose EP 2	SL 123 R	Alvania EP 2	MP 2
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Moly Complex	SLM 2	Retinax CMX	M4

ISO Viscosity grade	Viscosity, SUS at 100 F	Southwestern Petroleum Fort Worth, TX www.swepcousa.com	Specialty Products Jersey City, NJ	Sunbelt Lubricants Tampa, FL	Sunoco Lubricants Philadelphia, PA www.sunlubes.com
General purpose lubricants					
32	**135–165**	708 32 Ind/Turbine	Hydralube 8	Briteray 32	Sunvis 932
46	**194–236**	708 46 Ind/Turbine	Hydralube 10	Briteray 46	Sunvis 946
68	**284–346**	708 Ind/Turbine	Hydralube 20	Briteray 68	Sunvis 968
150	**630–770**	708 150 Ind/Turbine	Hydralube 30	Briteray 150	Sunvis 9150
220	**900–1100**	708 220 Ind/Turbine	Hydralube 40	Briteray 220	Sunvis 9220
460	**1935–2365**	—	Hydralube 50	Briteray 460	Sunvis 9460
Antiwear hydraulic oil					
32	**135–165**	704 32 AW Hyd	—	Sunray AW 32	Sunvis 832
46	**194–236**	704 46 AW Hyd	—	Sunray AW 46	Sunvis 846
68	**284–346**	704 68 AW Hyd	—	Sunray AW 68	Sunvis 868
Spindle oil					
2	**29–35**	—	Spindle 81	Spinray 3	—
10	**54–66**	—	Spindle 82	Spinray 10	—
22	**95–115**	—	Spindle 83	Spinray 22	Sunvis 922
Way oil					
32	**135–165**	708 32 Ind/Turbine	—	Wayex D 32	Lubeway 1706
68	**284–346**	708 68 Ind/Turbine	Way 28	Wayex D 68	Waylube 1180
220	**900–1100**	708 220 Ind/Turbine	Way 58	Wayex D 220	Waylube 1190
Extreme pressure gear oil					
68	**283–347**	—	Gear EP 20	Progear 68	Sunep 68
150	**630–770**	201 150 Gear	Gear EP 80	Progear 150	Sunep 150
320	**135–1650**	201 320 Gear	Gear EP 90W140	Progear 320	Sunep 320
Worm gear oil					
460	**1935–2365**	201 460 Gear	—	Sunsil 460	Gear 7C
Cling type gear shield (open gears)					
—	**—**	604 Outside Gear	—	—	Sunep T OGL 11
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	601 Moly Wheel Bearing	All Purpose EP	—	Ultra Prestige EP 2
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	101 Moly EP 2	Black Magic 2	—	Contractor's - Summer

ISO Viscosity grade	Viscosity, SUS at 100 F	Superior Lubricants N. Tonawanda, NY www.superiorlubricants.com	Sure Lubricants Elk Grove Village, IL	Texaco Lubricants Houston, TX www.texaco.com/tlc	Texas Refinery Corp. Fort Worth, TX
General purpose lubricants					
32	**135–165**	13 32 Turbine R&O 32	Ind R&O 320	Regal R&O 32	Special Universal 10
46	**194–236**	13 46 Turbine R&O 46	Ind R&O 460	Regal R&O 46	Special Universal 46
68	**284–346**	13 68 Turbine R&O 68	Ind R&O 680	Regal R&O 68	Special Universal 20
150	**630–770**	13 150 Turbine R&O 150	Ind R&O 1500	Regal R&O 150	Special Universal 40
220	**900–1100**	13 220 Turbine R&O 220	Ind R&O 2200	Regal R&O 220	Special Universal 50
460	**1935–2365**	13 460 Turbine R&O 460	Ind R&O 4600	Regal R&O 460	—
Antiwear hydraulic oil					
32	**135–165**	14 32 Hyd R&O 32	Hydradyne AW 320	Rando HD 32	Hyd 10
46	**194–236**	14 46 Hyd R&O 46	Hydradyne AW 460	Rando HD 46	Hyd 46
68	**284–346**	14 68 Hyd R&O 68	Hydradyne AW 680	Rando HD 68	Hyd 20
Spindle oil					
2	**29–35**	Super Spin 2	Triton 20	—	—
10	**54–66**	Super Spin 10	Triton 100	Spindura 10	—
22	**95–115**	Super Spin 22	Triton 220	Spindura 22	Special Universal 5
Way oil					
32	**135–165**	8 32 Slide Away 32	Transway 320	Hydra-way 32	Rock Drill 10
68	**284–346**	8 68 Slide Away 68	Transway 680	Way 68	Rock Drill 20
220	**900–1100**	8 220 Slide Away 220	Transway 2200	Way 220	Rock Drill 50
Extreme pressure gear oil					
68	**283–347**	9 68 HD EP Gear 68	Transgear EP 200	Meropa 68	790 Sure Universal 80
150	**630–770**	9 150 HD EP Gear 150	Transgear EP 400	Meropa 150	790 Sure Universal 80W90
320	**135–1650**	9 320 HD EP Gear 320	Transgear EP 600	Meropa 320	790 Sure Universal 85W140
Worm gear oil					
460	**1935–2365**	Steam Cylinder 167	Cylinder 4600	Vanguard 460	—
Cling type gear shield (open gears)					
—	**—**	—	Transtac Fluids	Crater 2X	Takilube
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Lith EP 2	Translith EP 2	Multifak EP 2	Lithplex
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Moly Lith EP 2	Translith EP 2 M	Molytex EP 2	Moly 880

ISO Viscosity grade	Viscosity, SUS at 100 F	TexPenn Oil Toms River, NJ	Thermal-Lube Pointe-Claire, PQ www.thermal-lube.com	Tower Oil & Technology Chicago, IL	Tri-State Industrial Lubricants Skokie, IL	Tribology/ Tech Lube Yaphank, NY
General purpose lubricants						
32	**135–165**	Ind 32	XL 7360/032	Hydroil CC	Hydro Flo 15	ATO 32, 32FG
46	**194–236**	Ind 46	XL 7360/046	Hydroil D	Hydro Flo 2	ATO 46
68	**284–346**	Ind 68	XL 7360/068	Hydroil EE	Hydro Flo 3	ATO 68
150	**630–770**	Ind 150	XL 7360/150	Hydroil F	Hydro Flo 65	ATO 150
220	**900–1100**	Ind 220	XL 7360/220	Hydroil G	Hydro Flo 1000	ATO 220
460	**1935–2365**	Ind 460	XL 7360/460	Express Gear J	Hydro Flo 2200	T85/190
Antiwear hydraulic oil						
32	**135–165**	AW Ind 32	XL 7325/032	Hydroil AW 3	Hydro Flo AW 15	T Hyd 32
46	**194–236**	AW Ind 46	XL 7325/046	Hydroil AW 4	Hydro Flo AW 2	T Hyd 46
68	**284–346**	AW Ind 68	XL 7325/068	Hydroil AW 5	Hydro Flo AW 3	T Hyd 68
Spindle oil						
2	**29–35**	Spindle 2	—	Durol AA	Spindle 30	T SO 2
10	**54–66**	Spindle 10	—	Durol A	Spindle 60	T SO 10
22	**95–115**	Spindle 22	—	Durol B	Spindle 100	T SO 22
Way oil						
32	**135–165**	Way 32	—	Way 15	Stalube 15	T 10/50
68	**284–346**	Way 68	—	Way 68	Stalube 3	T 30/90
220	**900–1100**	Way 220	—	Way 95	Stalube 9	T 75/90 Clear
Extreme pressure gear oil						
68	**283–347**	EP Gear 68	XL 0835/068	Durol EP 90	Gearmate 3	T 100
150	**630–770**	EP Gear 150	XL 0835/150	Express Gear F	Gearmate 65	T 75/90
320	**135–1650**	EP Gear 320	XL 0835/320	Express Gear GH	Gearmate 1600	T 85W140
Worm gear oil						
460	**1935–2365**	Worm Gear 460	XL 7316/460	Express Gear J	Cylinder 460	T 460
Cling type gear shield (open gears)						
—	**—**	Open Gear Heavy	XL 0063/003	Kotall HD	Gearmate EP 1600	T 333
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	NU Blue Complex	—	Grezall RL 2	GL 85	T 777
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	Royal Moly	XLO EP 2/002	Grezall ME 1	GL 88	Tri-Moly 2

ISO Viscosity grade	Viscosity, SUS at 100 F	U.S. Industrial Lubricants Cincinnati, OH	U.S. Oil Combined Locks, WI	Ultrachem New Castle, DE	Universal Lubricants Wichita, KS www.universallubes.com
General purpose lubricants					
32	**135–165**	Power-Flo 32 R&O	R&O Turbine 32	Chemlube 624	—
46	**194–236**	Power-Flo 46 R&O	R&O Turbine 46	Chemlube 625	—
68	**284–346**	Power-Flo 68 R&O	R&O Turbine 68	Chemlube 626	—
150	**630–770**	Power-Flo 150 R&O	R&O Turbine 150	Chemlube 629	—
220	**900–1100**	Power-Flo 220 R&O	R&O Turbine 220	Chemlube 630	—
460	**1935–2365**	Power-Flo 460 R&O	R&O Turbine 460	Chemlube 634	—
Antiwear hydraulic oil					
32	**135–165**	Power-Flo 32 AW	150 Hyd	Chemlube 624	Universal Hydra 32
46	**194–236**	Power-Flo 46 AW	200 Hyd	Chemlube 625	Universal Hydra 46
68	**284–346**	Power-Flo 68 AW	300 Hyd	Chemlube 626	Universal Hydra 68
Spindle oil					
2	**29–35**	2 Spindle	32 Spindle	—	—
10	**54–66**	10 Spindle	60 Spindle	Chemlube 10	—
22	**95–115**	22 Spindle	100 Spindle	Chemlube 22	Universal Hydra 22
Way oil					
32	**135–165**	32 Way	150 Waylube	—	—
68	**284–346**	68 Way	300 Waylube	—	Universal Mizar 402
220	**900–1100**	220 Way	1000 Waylube	—	Universal Mizar 445
Extreme pressure gear oil					
68	**283–347**	68 EP	AGMA EP 2	Omnigear 68	Dyna-Plex ZIL Sirius 602
150	**630–770**	EP 150	AGMA EP 4	Omnigear 150	Dyna-Plex ZIL Sirius 645
320	**135–1650**	320 EP	AGMA EP 6	Omnigear 320	Dyna-Plex ZIL Sirius 606
Worm gear oil					
460	**1935–2365**	340 WGO	AGMA 7 Comp	Chemlube 250	Dyna-Plex ZIL Sirius 608
Cling type gear shield (open gears)					
—	**—**	800 Open Gear Compound	—	—	—
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Everstay 100	Lith EP 2	—	Dyna-Plex ZIL Ultra Blue 2
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Everstay Moly XD 2	Lith EP 2 w/Moly	—	Dyna-Plex ZIL 500 + w/Moly

ISO Viscosity grade	Viscosity, SUS at 100 F	Valvoline Co. Ashland, KY	Viking Chemical Rockford, IL	Wallover Oil East Liverpool, OH	David Weber Oil Carlstadt, NJ	West Penn Oil Warren, PA www.westpenn.com
General purpose lubricants						
32	**135–165**	R&O 32	Admiral 32	Turbine & Hyd 32	32 R&O	Emblem R&O 150
46	**194–236**	R&O 46	Admiral 46	Turbine & Hyd 46	46 R&O	Emblem R&O 200
68	**284–346**	R&O 68	Admiral 68	Turbine & Hyd 68	68 R&O	Emblem R&O 300
150	**630–770**	R&O 150	Admiral 150	Turbine & Hyd 150	150 R&O	Emblem R&O 600
220	**900–1100**	R&O 220	Admiral 220	Turbine & Hyd 1200	220 R&O	Emblem R&O 900
460	**1935–2365**	—	Admiral 460	Turbine & Hyd 2300	460 R&O	Emblem Mineral Gear 140
Antiwear hydraulic oil						
32	**135–165**	AW 32	Admiral AW 32	AW 32	32 Premium AW Hyd	Emblem AW 160
46	**194–236**	AW 46	Admiral AW 46	AW 46	46 Premium AW Hyd	Emblem AW 200
68	**284–346**	AW 68	Admiral AW 68	AW 68	68 Premium AW Hyd	Emblem AW 300
Spindle oil						
2	**29–35**	—	Spinrite 40	Spindle 2	—	Emblem EK 510
10	**54–66**	Spindle 10	Spinrite 60	Spindle 10	10 Spindle	Emblem R&O 55
22	**95–115**	Spindle 22	Spinrite 100	Spindle 22	22 Spindle	Emblem R&O 100
Way oil						
32	**135–165**	Waylube 32	Sliderite 150	Way 1	32 Way	Emblem Powerway 150
68	**284–346**	Waylube 68	Sliderite 310	Way 2	68 Way	Emblem Powerway 300
220	**900–1100**	Waylube 220	Sliderite 1000	Way 4	220 Way	Emblem Powerway 900
Extreme pressure gear oil						
68	**283–347**	AGMA EP 68	Luberite EP 68	HEP 68	AGMA EP 2 Gear	Emblem APG 80
150	**630–770**	AGMA EP 150	Luberite EP 150	HEP 150	AGMA EP 4 Gear	Emblem APG 90
320	**135–1650**	AGMA EP 320	Luberite EP 320	HEP 320	AGMA EP 6 Gear	—
Worm gear oil						
460	**1935–2365**	Light Cylinder	Cylinder 460	Woco Worm Gear	AGMA 7 Compound	Emblem Mineral Gear 140
Cling type gear shield (open gears)						
—	**—**	—	—	Woco Open Gear	Moly Open Gear Shield	—
General purpose extreme pressure lithium based grease						
—	**NLGI 2**	Multi-Purpose General All Fleet Crimson	—	Woco EP 2 Lith	Poly Lith EP 2	Emolube 302 EP
Molybdenum disulfide extreme pressure grease						
—	**NLGI 2**	Multi-Purpose Ford All Fleet Palladium	—	Woco 2 Moly Lith	Molylitho 2	Emolube 292

ISO Viscosity grade	Viscosity, SUS at 100 F	Whitmore Mfg. Rockwall, TX	Wolverine Oil & Supply Detroit, MI	Worldwide Lubricants Wheeling, IL	O.F. Zurn Philadelphia, PA
General purpose lubricants					
32	**135–165**	Turbine 32	A 1 R&O Hyd 150	Moly Hyd 150	Zurnpreem 15A
46	**194–236**	Turbine 46	A 1 R&O Hyd 200	Moly Hyd 225	Zurnpreem 21A
68	**284–346**	Turbine 68	A 1 R&O Hyd 300	Moly Hyd 315	Zurnpreem 30A
150	**630–770**	Turbine 150	A 1 R&O Hyd 700	Moly Hyd 700	Zurnpreem 70A
220	**900–1100**	Turbine 220	A 1 R&O Hyd 1000	Moly Hyd 1000	Zurnpreem 95A
460	**1935–2365**	Turbine 460	A 1 R&O Hyd 2100	Moly Hyd 2300	Zurnpreem 140A
Antiwear hydraulic oil					
32	**135–165**	Hyd 32	A 1 AW Hyd 150	Moly Hyd AW 150	Zurnpreem 15A
46	**194–236**	Hyd 46	A 1 AW Hyd 200	Moly Hyd AW 225	Zurnpreem 21A
68	**284–346**	Hyd 68	A 1 AW Hyd 300	Moly Hyd AW 315	Zurnpreem 30A
Spindle oil					
2	**29–35**	—	A 1 Spindle 30	3 Moly Spindle	Zurnpreem 3A
10	**54–66**	—	A 1 Spindle 60	60 Moly Spindle	Zurnpreem 6A
22	**95–115**	—	A 1 Spindle 100	1 Moly Spindle	Zurnpreem 10A
Way oil					
32	**135–165**	—	A 1 Way 150	Moly Way 15	HW 15; Waylube 1
68	**284–346**	Way 68	A 1 Way 300	Moly Way 3	Waylube 80
220	**900–1100**	Way 220	A 1 Way 1000	Moly Way 9	Waylube 90
Extreme pressure gear oil					
68	**283–347**	Paragon 68	A 1 Bearing & Gear 300	Moly-Gear 325	EP 35
150	**630–770**	Paragon 150	A 1 Bearing & Gear 700	Moly-Gear 700	EP 70
320	**135–1650**	Paragon 320	A 1 Bearing & Gear 1500	Moly-Gear 1600	EP 120
Worm gear oil					
460	**1935–2365**	—	A 1 Worm Gear 2100	Moly-Gear EP 2000	Gear 150
Cling type gear shield (open gears)					
—	**—**	Envirolube	A 1 Open Gear	Moly Open Gear EP 1000	Open Gear
General purpose extreme pressure lithium based grease					
—	**NLGI 2**	Omnilith 500	A 1 Lith 2	2 WL	MD EP 2
Molybdenum disulfide extreme pressure grease					
—	**NLGI 2**	Omnilith 500M	A 1 Moly 2	2 ML	MD 2 Moly

ISO viscosity grade	Viscosity, SUS at 100 F	Akzo Nobel Dobbs Ferry, NY	Alithicon Lubricants Div., Southeast Oil & Grease Co., Inc. Albany, GA www.alithicon.com	American Agip Co., Inc. Cabot, PA	American Lubricants, Inc. Buffalo, NY
Gear & bearing circulation oil					
32	135-165	—	6510 Turbine (1,3)	Syncirc 32 (1)	Syn Circulating 32 (1)
46	194-236	—	6515 Turbine (1,3)	Syncirc 46 (1)	Syn Circulating 46 (1)
68	284-346	—	6520 Turbine (1,3)	Syncirc 68 (1)	Syn Circulating 68 (1)
100	420-520	—	6530 Turbine (1,3)	Syncirc 100 (1)	Syn Circulating 100 (1)
150	630-770	—	6540 Turbine (1,3)	Syncirc 150 (1)	Syn Circulating 150 (1)
220	900-1100	—	6550 Turbine (1,3)	Syncirc 220 (1)	Syn Circulating 220 (1)
320	1350-1650	—	6560 Turbine (1,3)	Syncirc 320 (1)	Syn Circulating 320 (1)
460	1935-2365	—	6570 Turbine (1,3)	Syncirc 460 (1)	Syn Circulating 460 (1)
Extreme pressure gear oil					
100	420-520	—	SGO 100 Enclosed Gear (1,3)	Syngear EP 100 (1)	Syn EP Gear 100 (1)
150	630-770	—	SGO 150 Enclosed Gear (1,3)	Syngear EP 150 (1)	Syn EP Gear 150 (1)
220	900-1100	—	SGO 220 Enclosed Gear (1,3)	Syngear EP 220 (1)	Syn EP Gear 220 (1)
320	1350-1650	—	SGO 320 Enclosed Gear (1,3)	Syngear EP 320 (1)	Syn EP Gear 320 (1)
460	1935-2365	—	SGO 460 Enclosed Gear (1,3)	—	Syn EP Gear 460 (1)
High pressure (antiwear) hydraulic oil					
32	135-165	—	6510 Turbine (1,3)	Syn Hyd AW 32 (1)	Syn HP AW Hyd 32 (1)
46	194-236	—	6515 Turbine (1,3)	Syn Hyd AW 46 (1)	Syn HP AW Hyd 46 (1)
68	284-346	—	6520 Turbine (1,3)	Syn Hyd AW 68 (1)	Syn HP AW Hyd 68 (1)
100	420-520	—	6530 Turbine (1,3)	—	Syn HP AW Hyd 100 (1)
Fire-resistant hydraulic fluid					
Synthetic		Fyrquel (6)	—	PE 200 Phosphate Ester (6)	—
Water glycol		—	—	FC 200 Water Glycol	Syn WG FR Fluid (5)
Compressor lubricant					
32	135-165	—	SCL 32 Comp (1,3)	Syn Comp 32 (3)	Syn Comp 32 (1)
46	194-236	—	SCL 46 Comp (1,3)	Syn Comp 46 (3)	Syn Comp 46 (1)
68	284-346	—	SCL 68 Comp (1,3)	Syn Comp 68 (3)	Syn Comp 68 (1)
100	420-520	—	SCL 100 Comp (1,3)	Syn Comp 100 (3)	Syn Comp 100 (1)
150	630-770	—	SCL 150 Comp (1,3)	Syn Comp 150 (3)	Syn Comp 150 (1)
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	—	9992-TL Bearing (1,3)	—	MP EP Syn Grease #2 (1)
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	M-888 Bearing (1,3)	—	MP EP Syn Grease #2 w/moly (1)
Multipurpose high temperature grease (without moly)					
150	NLGI 2	—	9992-TL Bearing (1,3)	—	MP EP High Temp Grease #2 (1)

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

2000 Plant Engineering Magazine's Exclusive Synthetic Lubricants Guide

ISO viscosity grade	Viscosity, SUS at 100 F	Amsoil, Inc. Superior, WI www.amsoil.com	Anderol Co. East Hanover, NJ www.anderol.com	Baum's Castorine Co., Inc. Rome, NY	Behnke Lubricants, Inc. Menomonee Falls, WI	Benz Oil Milwaukee, WI	Castrol Industrial N.A. Downers Grove, IL www.castrolindustrialna.com
Gear & bearing circulation oil							
32	**135-165**	RCH (1)	4032 (1), 6032 (1)	Tena-Film 150-TH	JAX Ind Gear 32 (1)	Syn-Tech 32 (1)	—
46	**194-236**	RCI (1)	4046 (1), 6046 (1)	Tena-Film 300-LTH	JAX Ind Gear 46 (1)	Syn-Tech 46 (1)	—
68	**284-346**	RCJ (1)	4068S (1), 6068 (1)	Tena-Film 300-MTH	JAX Ind Gear 68 (1)	Syn-Tech 68 (1)	—
100	**420-520**	RCK (1)	4100 (1), 6100 (1)	Tena-Film 300-HTH	JAX Ind Gear 100 (1)	Syn-Tech 100 (1)	—
150	**630-770**	RCL (1)	4150 (1), 6150 (1)	Tena-Film 400-TH	JAX Ind Gear 150 (1)	Syn-Tech 150 (1)	Tribol 800-150 (5)
220	**900-1100**	RCM (1)	4220 (1), 6220 (1)	Tena-Film 500-TH	JAX Ind Gear 220 (1)	Syn-Tech 220 (1)	Tribol 800-220 (5)
320	**1350-1650**	RCN (1)	4320 (1), 6320 (1)	Tena-Film 600-TH	JAX Ind Gear 320 (1)	Syn-Tech 320 (1)	Tribol 800-320 (5)
460	**1935-2365**	RCO (1)	4460 (1), 6460(1)	Tena-Film 2500-TH	JAX Ind Gear 460 (1)	Syn-Tech 460 (1)	Tribol 800-460 (5)
Extreme pressure gear oil							
100	**420-520**	SGK (1)	5004 (1)	Tena-Film EP 500	JAX Synax EP 100 (1)	—	—
150	**630-770**	SGL (1)	—	Tena-Film EP 700	JAX Synax EP 150 (1)	—	Tribol 800-150 (5)
220	**900-1100**	SGM (1)	5005 (1)	Tena-Film EP 1000	JAX Synax EP 220 (1)	—	Tribol 800-220 (5)
320	**1350-1650**	SGN (1)	—	Tena-Film EP 1400	JAX Synax EP 320 (1)	—	Tribol 800-320 (5)
460	**1935-2365**	SGO (1)	5006 (1)	Tena-Film 2500-ST	JAX Synax EP 460 (1)	—	Tribol 800-460 (5)
High pressure (antiwear) hydraulic oil							
32	**135-165**	AWH (1)	—	Tena-Film 150-TH	JAX Enviro-Guard 32 (3)	—	—
46	**194-236**	AWI (1)	—	Tena-Film 300-LTH	JAX Enviro-Guard 46 (3)	—	Tribol 1444-46 (4)
68	**284-346**	AWJ (1)	—	Tena-Film 300-MTH	JAX Enviro-Guard 68 (3)	—	Tribol 1444-68 (4)
100	**420-520**	AWK (1)	—	Tena-Film 300-HTH	JAX Enviro-Guard 100 (3)	—	—
Fire-resistant hydraulic fluid							
Synthetic		—	—	—	JAX Pyro-Guard Plus (5)	Ultra Guard 552 (4)	Tribol 1444-46/68 (4)
Water glycol		—	—	—	—	Petraulic Sur-Safe (5)	Hydrasafe 200 (5)
Compressor lubricant							
32	**135-165**	PCH (1), DCH (3)	495 (3), 3032 (1), S32	Technilube Syn Comp 46 AW	JAX Syncomp 32 D (3), FG (1), P (1)	Syncom 32 (1)	Tribol 890 Light (3)
46	**194-236**	PCI (1), DCI (3)	496 (3), 3046 (1), S46	Technilube Syn Comp 46 AW	JAX Syncomp 46 D (3), FG (1), P (1)	Syncom 46 (1)	—
68	**284-346**	PCJ (1), DCJ (3)	497 (3), 3068 (1), S68	—	JAX Syncomp 68 D (3),FG (1), P (1)	Syncom 68 (1)	Tribol 890 Medium (3)
100	**420-520**	PCK (1), DCK (3)	500 (3), 3100 (1), S100	—	JAX Syncomp 100 D (3), FG (1), P (1)	Syncom 100 (1)	Tribol 890 Heavy (3)
150	**630-770**	PCM (1), DCM (3)	750 (3), 3150 (1), S150	—	JAX Syncomp-FG 150 (1)	—	—
Multipurpose extreme pressure grease (without moly)							
150/220	**NLGI 2**	GLC (1), GRG (1)	786 (2)	Tena-Film Superplex EP-2	JAX Millennium Grease (1)	—	—
Multipurpose molybdenum disulfide extreme pressure grease							
150/220	**NLGI 2**	GHD (1)	—	Tena-Film Moly Compound 0-23	—	—	—
Multipurpose high temperature grease (without moly)							
150	**NLGI 2**	GVC (1)	700 (4)	Tena-Film 2500-2ST	JAX Magna-Plate 1200 (4)	—	—

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	C&C Oil Co. Kennesaw, GA www.ccoil.com	Chemtool, Inc. Crystal Lake, IL www.chemtool.com	Chevron Products Co. Houston, TX www.chevron.com	CITGO Petroleum Corp. Tulsa, OK www.citgo.com
Gear & bearing circulation oil					
32	135-165	Duration R&O 32 (1)	CT Gear 32 (1)	—	—
46	194-236	Duration R&O 46 (1)	CT Gear 46 (1)	—	—
68	284-346	Duration R&O 68 (1)	CT Gear 68 (1)	—	Citgear HT 68 (1)
100	420-520	Duration R&O 100 (1)	CT Gear 100 (1)	—	Citgear HT 100 (1)
150	630-770	Duration R&O 150 (1)	CT Gear 150 (1)	—	Citgear HT 150 (1)
220	900-1100	Duration R&O 220 (1)	CT Gear 220 (1)	—	Citgear HT 220 (1)
320	1350-1650	Duration R&O 320 (1)	CT Gear 320 (1)	—	Citgear HT 320 (1)
460	1935-2365	Duration R&O 460 (1)	CT Gear 460 (1)	—	Citgear HT 460 (1)
Extreme pressure gear oil					
100	420-520	Duration EP 100 (1)	CT EP 100 (1)	—	—
150	630-770	Duration EP 150 (1)	CT EP 150 (1)	Tegra Gear 150 (1)	Citgear EP 150 (1)
220	900-1100	Duration EP 220 (1)	CT EP 220 (1)	Tegra Gear 220 (1)	Citgear EP 220 (1)
320	1350-1650	Duration EP 320 (1)	CT EP 320 (1)	Tegra Gear 320 (1)	Citgear EP 320 (1)
460	1935-2365	Duration EP 460 (1)	CT EP 460 (1)	Tegra Gear 460 (1)	Citgear EP 460 (1)
High pressure (antiwear) hydraulic oil					
32	135-165	Duration AW 32 (1)	CT AW 32 (1)	—	—
46	194-236	Duration AW 46 (1)	CT AW 46 (1)	—	—
68	284-346	Duration AW 68 (1)	CT AW 68 (1)	—	—
100	420-520	Duration AW 100 (1)	CT AW 100 (1)	—	—
Fire-resistant hydraulic fluid					
Synthetic		—	Chemtolubric (4)	—	—
Water glycol		—	Lubricast 902 LPC (5)	—	Glycol FR 40 XD (5), Glycol FR 5046 HP (5)
Compressor lubricant					
32	135-165	Duration DSCF 32 (1)	CT Comp 32 (1)	Tegra Comp 32 (1), Syntholube 32 (3)	Compressorgard DE 32 (3)
46	194-236	Duration DSCF 46 (1)	CT Comp 46 (1)	—	Compressorgard PAO 46 (1)
68	284-346	Duration DSCF 68 (1)	CT Comp 68 (1)	Tegra Comp 68 (1), Syntholube 68 (3)	Compressorgard DE 68 (3), PAO 68 (1)
100	420-520	Duration DSCF 100 (1)	CT Comp 100 (1)	Tegra Comp 100 (1), Syntholube 100 (3)	Compressorgard DE 100 (3), PAO 100 (1)
150	630-770	Duration DSCF 150 (1)	CT Comp 150 (1)	Tegra Comp 150 (1), Syntholube 150 (3)	Compressorgard DE 125 (3), PAO 150 (1)
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	Crescent Lithicom Syn EP (1)	Chemlith EP-2-A	Ulti-Plex Syn Grease EP (1)	—
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	Chemlith MY-2-B	—	—
Multipurpose high temperature grease (without moly)					
150	NLGI 2	Crescent Lithicom Syn EP (1)	Duralube EP-2 (vis 165-180)	Ulti-Plex Syn Grease EP (1)	—

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	CPI Engineering Services, Inc. Midland, MI www. cpieng.com	Darmex Corp. Roslyn Hts., NY www. darmex.com	David Weber Oil Co. Carlstadt, NJ www. weberoil.com	Dow Corning Corp. Midland, MI www. dowcorning.com	DuBois Chemicals Cincinnati, OH	Dylon Industries, Inc. Cleveland, OH
Gear & bearing circulation oil							
32	**135-165**	4601-32 (1)	GBO 10 (1)	Syngear 32 (1)	—	Summa Rotar (3)	—
46	**194-236**	4601-46 (1)	GBO 1050 (1)	Syngear 46 (1)	—	—	—
68	**284-346**	4601-68 (1)	GBO 1050 (1)	Syngear 68 (1)	—	Summa 20 (3)	—
100	**420-520**	4601-100 (1)	75/90 (1)	Syngear 100 (1)	—	Summa Recip (4)	—
150	**630-770**	4601-150 (1)	75/90 (1)	Syngear 150 (1)	—	Prima 1000 (5)	SL-150
220	**900-1100**	4601-220 (1)	90 (1)	Syngear 220 (1)	—	Prima 2000 (5)	SL-220
320	**1350-1650**	4601-320 (1)	9140 (1)	Syngear 320 (1)	—	—	SL-320
460	**1935-2365**	4601-460 (1)	140 (1)	Syngear 460 (1)	—	Prima 3000 (5)	SL-460
Extreme pressure gear oil							
100	**420-520**	4617-100-F (1)	75/90 EP (1,3)	Syngear 100 EP (1)	—	—	—
150	**630-770**	4617-150-F (1)	75/90 EP (1,3)	Syngear 150 EP (1)	—	Prima 1000 (5)	ML-150
220	**900-1100**	4617-220-F (1)	90 (1,3)	Syngear 220 EP (1)	—	Prima 2000 (5)	ML-220
320	**1350-1650**	4617-320-F (1)	9140 EP (1,3)	Syngear 320 EP (1)	—	—	ML-320
460	**1935-2365**	4617-460-F (1)	140 EP (1,3)	Syngear 460 EP (1)	—	Prima 3000 (5)	ML-460
High pressure (antiwear) hydraulic oil							
32	**135-165**	4608-32-F (1)	Hyd 100 (1)	—	—	Ultragard 100 (1)	—
46	**194-236**	4608-46-F (1)	Hyd 100/200 (1)	—	—	—	—
68	**284-346**	4608-68-F (1)	Hyd 100/200 (1)	—	—	Ultragard 300 (1)	—
100	**420-520**	4608-100-F (1)	Hyd 200 (1)	—	—	—	—
Fire-resistant hydraulic fluid							
Synthetic		1550-46 (5)	—	—	—	—	—
Water glycol		1550-46 (5)	—	—	—	—	—
Compressor lubricant							
32	**135-165**	4601-32 (1)	ACO 10 (1,3)	32 Syn-Comp (3)	—	Summa Rotar (3)	—
46	**194-236**	4601-46 (1)	ACO 1040 (1,3)	—	—	—	—
68	**284-346**	4601-68 (1)	ACO 1040 (1,3)	68 Syn-Comp (3)	—	Summa 20 (3)	—
100	**420-520**	4601-100 (1)	ACO 30 (1,3)	100 Syn-Comp (3)	—	Summa Recip (4)	—
150	**630-770**	4601-150 (1)	ACO 40 (1,3)	—	—	—	—
Multipurpose extreme pressure grease (without moly)							
150/220	**NLGI 2**	GRS-460-F (1)	123 (1)	—	Molykote G-4500 (1)	—	GR-500
Multipurpose molybdenum disulfide extreme pressure grease							
150/220	**NLGI 2**	GRS-453 (1)	123M (1)	—	Molykote G-4700 (1)	—	GR-F13
Multipurpose high temperature grease (without moly)							
150	**NLGI 2**	GRS-421 (4)	707 (4)	—	—	HTG-Plus (4)	GR-650

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Exxon Fairfax, Va	Fina Oil & Chemical Co. Dallas, TX	Halocarbon Products Corp. River Edge, NJ www.halocarbon.com	Hatco Corp. Fords, NJ www. hatcocorporation.com
Gear & bearing circulation oil					
32	135-165	Teresstic SHP 32 (1), Synesstic 32 (3)	Synolan 1000 Oil 32 (1)	27 Oil	—
46	194-236	Teresstic SHP 46 (1)	Synolan 1000 Oil 46 (1)	—	—
68	284-346	Teresstic SHP 68 (1), Synesstic 68 (3)	Synolan 1000 Oil 68 (1)	56 Oil	—
100	420-520	Teresstic SHP 100 (1), Synesstic 100 (3)	Synolan 1000 Oil 100 (1)	95 Oil	—
150	630-770	Teresstic SHP 150 (1), Synesstic 150 (3)	—	—	—
220	900-1100	Teresstic SHP 220 (1)	Synolan 1000 Oil 220 (1)	200 Oil	—
320	1350-1650	Teresstic SHP 320 (1)	—	—	—
460	1935-2365	Teresstic SHP 460 (1)	Synolan 1000 Oil 460 (1)	400 Oil	—
Extreme pressure gear oil					
100	420-520	Spartan EP 100 (1)	—	—	—
150	630-770	Spartan EP 150 (1)	—	—	—
220	900-1100	Spartan EP 220 (1)	—	—	—
320	1350-1650	Spartan EP 320 (1)	—	—	—
460	1935-2365	Spartan EP 460 (1)	—	—	—
High pressure (antiwear) hydraulic oil					
32	135-165	Teresstic SHP 32 (1), Synesstic 32 (3)	—	27 AW Oil	—
46	194-236	Teresstic SHP 46 (1)	—	—	—
68	284-346	Teresstic SHP 68 (1), Synesstic 68 (3)	—	56 AW Oil	—
100	420-520	Teresstic SHP 100 (1), Synesstic 100 (3)	—	95 AW Oil	—
Fire-resistant hydraulic fluid					
Synthetic		Firexx HF-DU 68 (4)	—	Safetol 3.1 Oil	—
Water glycol		Firexx HF-C 46 (5)	—	—	—
Compressor lubricant					
32	135-165	Teresstic SHP 32 (1), Synesstic 32 (3)	Synolan 1000 Oil 32 (1)	27 Oil	Hatcol 2812 (3)
46	194-236	Teresstic SHP 46 (1)	Synolan 1000 Oil 46 (1)	—	—
68	284-346	Teresstic SHP 68 (1), Synesstic 68 (3), Zerice S 68 (2)	Synolan 1000 Oil 68 (1)	56 Oil	Hatcol 2862 (3)
100	420-520	Teresstic SHP 100 (1), Synesstic 100 (3), Zerice S 100 (2), Exxcolub SRS 100 (5)	Synolan 1000 Oil 100 (1)	95 Oil	Hatcol 2850 (3)
150	630-770	Teresstic SHP 150 (1), Synesstic 150 (3), Exxcolub SRS 150 (5)	—	—	—
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	Unirex SHP 220 (1)	—	25-5S Grease	—
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	—	—	—
Multipurpose high temperature grease (without moly)					
150	NLGI 2	Unirex S 2 (4)	—	—	—

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Houghton Intl., Inc. Valley Forge, PA www.houghtonintl.com	Industrial Oils Unlimited, Inc. Tulsa, OK	Jenkin-Guerin, Inc. St. Louis, MO www.jenkin-guerin.com
Gear & bearing circulation oil				
32	135-165	—	Syncomp P-32 (1)	Anchor 150 Hi-Temp Oven Chain (6)
46	194-236	—	Syncomp P-46 (1)	—
68	284-346	—	Syncomp P-68 (1)	—
100	420-520	—	Syncomp P-100 (1)	—
150	630-770	—	Syncomp P-150 (1)	—
220	900-1100	—	Syncomp P-220 (1)	—
320	1350-1650	—	Syncomp P-320 (1)	—
460	1935-2365	—	Syncomp P-460 (1)	—
Extreme pressure gear oil				
100	420-520	—	Syngear G-100 (1,3)	—
150	630-770	—	Syngear G-150 (1,3)	Anchor 2000 SAE 75/90 Gear (6)
220	900-1100	—	Syngear G-220 (1,3)	Anchor 2000 SAE 50 Trans (6)
320	1350-1650	—	Syngear G-320 (1,3)	—
460	1935-2365	—	Syngear G-460 (1,3)	—
High pressure (antiwear) hydraulic oil				
32	135-165	—	Hysyn 32 (1)	—
46	194-236	—	Hysyn 46 (1)	—
68	284-346	—	Hysyn 68 (1)	—
100	420-520	—	Hysyn 100 (1)	—
Fire-resistant hydraulic fluid				
Synthetic		Houghto-Safe 1110, 1120, 1115, 1130, 1055, 1114-LT (6); Cosmolubric HF 122, HF 130, HF 144, B 230, B 220 (4)	—	—
Water glycol		Houghto-Safe 620, 419R, 520, 320, 620TY, 419TY	—	—
Compressor lubricant				
32	135-165	—	Syncomp 32 (3)	Anchor 32-ES (6)
46	194-236	—	Syncomp 46 (3)	Anchor 46-ES (6)
68	284-346	—	Syncomp 68 (3)	Anchor 68-ES (6)
100	420-520	—	Syncomp 100 (3)	Anchor 100-ES (6)
150	630-770	—	Syncomp 150 (3)	—
Multipurpose extreme pressure grease (without moly)				
150/220	NLGI 2	—	Superfilm Synplex EP (1)	Alaska Crystal #2 Food Machinery (1)
Multipurpose molybdenum disulfide extreme pressure grease				
150/220	NLGI 2	—	—	—
Multipurpose high temperature grease (without moly)				
150	NLGI 2	Hi-Temp 2409	Superfilm Synplex EP (1)	—

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Jonell Oil Corp. Irwindale, CA	Kacey Enterprises, Inc. Winfield, IL	Kaeser Compressors, Inc. Fredericksburg, VA www.kaeser.com	Kent Oil Co., Inc. Lakeland, FL
Gear & bearing circulation oil					
32	135-165	Jo-Lube 1611 (1,4)	Contempo Premium 32 (1)	—	—
46	194-236	Jo-Lube 1612 (1,4)	Contempo Premium 46 (1)	—	—
68	284-346	Jo-Lube 1613 (1,4)	Contempo Premium 68 (1)	—	—
100	420-520	Jo-Lube 1614	Contempo Premium 100 (1)	—	—
150	630-770	Jo-Lube 1615	Contempo Premium 150 (1)	—	—
220	900-1100	Jo-Lube 1616	Contempo Premium 220 (1)	—	—
320	1350-1650	—	Contempo Premium 320 (1)	—	—
460	1935-2365	—	Contempo Premium 460 (1)	—	—
Extreme pressure gear oil					
100	420-520	—	Contempo Premium EP 100 (1)	—	—
150	630-770	—	Contempo Premium EP 150 (1)	SB 150 (1)	Syn-Nrg 89 (1,4)
220	900-1100	—	Contempo Premium EP 220 (1)	SB 220 (1)	Syn-Nrg 90 (1,4)
320	1350-1650	—	Contempo Premium EP 320 (1)	SB 320 (1)	Syn-Nrg 123 (1,4)
460	1935-2365	—	Contempo Premium EP 460 (1)	—	Syn-Nrg 140 (1,4)
High pressure (antiwear) hydraulic oil					
32	135-165	Jo-Lube 1611 (1,3;1,4)	Contempo AW Plus #1 (1)	—	—
46	194-236	Jo-Lube 1612 (1,3;1,4)	Contempo AW Plus #2 (1)	—	—
68	284-346	Jo-Lube 1613 (1,3;1,4)	Contempo AW Plus #3 (1)	—	—
100	420-520	—	—	—	—
Fire-resistant hydraulic fluid					
Synthetic		Jo-Safe 1551, 1651 (5)	—	—	Syn FR Fluid (6)
Water glycol		—	—	—	—
Compressor lubricant					
32	135-165	Jo-Lube SCO 1690 (1,4)	Contempo Poly-Ess 32 (4)	S 320 (1)	Syn-Comp 32 (1,4)
46	194-236	Jo-Lube SCO 1691 (1,4)	Contempo Poly-Ess 46 (4)	S 460 (1)	Syn-Comp 46 (1,4)
68	284-346	Jo-Lube SCO 1692 (1,4)	Contempo Poly-Ess 68 (1)	S 680 (1)	Syn-Comp 68 (1,4)
100	420-520	—	Contempo Comp Oil 100 (1)	S 100 (3)	Syn-Comp 100 (1,4)
150	630-770	—	Contempo Comp Oil 150 (1)	S 150 (3)	—
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	—	—	—	F Series (1)
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	—	—	Syn-Nrg no melt (1)
Multipurpose high temperature grease (without moly)					
150	NLGI 2	—	—	—	Ultra High Temp

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Keystone Lubricants Co. Linden, NJ www.keystonelubricants.com	Kluber Lubrication North America Londonderry, NH	Leahy-Wolf Co. Franklin Park, IL
Gear & bearing circulation oil				
32	135-165	KSL 213 (3)	Constant OY 32 (1), Syntheso D 32 (5)	Synmaster G 32 (1)
46	194-236	KSL 800 (1)	Constant OY 46 (1), Syntheso D 46 (5)	Synmaster G 1 (1)
68	284-346	KSL 220 (3)	Constant OY 68 (1), Syntheso D 68 (5)	Synmaster G 2 (1)
100	420-520	KSL 219 (3)	Constant OY 100 (1), Syntheso D 100 (5)	Synmaster G 3 (1)
150	630-770	KSL 222 (3)	Constant OY 150 (1)	Synmaster G 4 (1)
220	900-1100	KSL 550 (3)	Constant OY 220 (5)	Synmaster G 5 (1)
320	1350-1650	—	—	Synmaster G 6 (1)
460	1935-2365	—	Syntheso D 460 (5)	Synmaster G 7 (1)
Extreme pressure gear oil				
100	420-520	—	Klubersynth EG 4-100 (1), GH 6-100 (5)	—
150	630-770	KSL 365 (3)	Klubersynth EG 4-150 (1), GH 6-150 (5)	Synmaster EP 4 (1)
220	900-1100	KSL 366 (3)	Klubersynth EG 4-220 (1), GH 6-220 (5)	Synmaster EP 5 (1)
320	1350-1650	—	Klubersynth EG 4-320 (1), GH 6-320 (5)	Synmaster EP 6 (1)
460	1935-2365	KSL 367 (3)	Klubersynth EG 4-460 (1), GH 6-460 (5)	Synmaster EP 7 (1)
High pressure (antiwear) hydraulic oil				
32	135-165	—	Klubersynth UH1 4-32 US (1)	Synmaster AW 32 (1)
46	194-236	—	Klubersynth UH1 4-46 US (1)	Synmaster AW 46 (1)
68	284-346	—	Klubersynth UH 1 4-68 US (1)	Synmaster AW 68 (1)
100	420-520	—	Klubersynth UH1 4-100 US (1)	Synmaster AW 100 (1)
Fire-resistant hydraulic fluid				
Synthetic		—	—	—
Water glycol		—	—	—
Compressor lubricant				
32	135-165	KSL 214 (3)	Klubersynth DH 2-32 (3), DH 4-32 (1), DH 6-32 (5)	Synmaster D 32 (3)
46	194-236	KSL 800 (1)	Klubersynth DH 4-46 (1)	Synmaster D 46 (3)
68	284-346	KSL 220 (3)	Klubersynth DH 2-68 (3), DH 4-68 (1)	Synmaster D 68 (3)
100	420-520	KSL 219 (3)	Klubersynth DH 2-100 (3), DH 4-100 (1)	Synmaster D 100 (3)
150	630-770	KSL 222 (3)	—	Synmaster D 150 (3)
Multipurpose extreme pressure grease (without moly)				
150/220	NLGI 2	—	Kluberplex BEM 34-132 (1)	—
Multipurpose molybdenum disulfide extreme pressure grease				
150/220	NLGI 2	—	—	—
Multipurpose high temperature grease (without moly)				
150	NLGI 2	—	Petamo GHY 133N (1)	—

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	The Lockrey Co., Inc. Merchantville, NJ www.liqui-moly-usa.com	Lubemaster Div., Certified Laboratories Ft. Worth, TX www.certifiedlabs.com	Lu Best Div., Momar, Inc. Atlanta, GA www.momar.com	Lubricating Specialties Co. Pico Rivera, CA
Gear & bearing circulation oil					
32	135-165	—	—	Turbine Oil 32 (1)	Synlube FM (1)
46	194-236	—	—	Turbine Oil 46 (1)	Synlube FM (1)
68	284-346	—	—	Turbine Oil 68 (1)	Synlube FM (1)
100	420-520	—	—	Turbine Oil 100 (1)	Synlube FM (1)
150	630-770	—	—	Turbine Oil 150 (1)	Synlube FM (1)
220	900-1100	—	—	Turbine Oil 220 (1)	Synlube FM (1)
320	1350-1650	—	—	—	Synlube FM (1)
460	1935-2365	—	—	—	Synlube FM (1)
Extreme pressure gear oil					
100	420-520	—	Certop SN 75W90 (1)	Gear EP 3 (1)	—
150	630-770	—	Certop SN 75W90 (1)	Gear EP 4 (1)	—
220	900-1100	—	Certop SN 75W90 (1)	Gear EP 5 (1)	—
320	1350-1650	—	Certop SN 75W140 (1)	Gear EP 6 (1)	—
460	1935-2365	—	Certop SN 75W140 (1)	Gear EP 7 (1)	—
High pressure (antiwear) hydraulic oil					
32	135-165	—	—	Hyd AW 32 (1)	—
46	194-236	—	—	Hyd AW 46 (1)	—
68	284-346	—	—	Hyd AW 68 (1)	—
100	420-520	—	—	Hyd AW 100 (1)	—
Fire-resistant hydraulic fluid					
Synthetic		—	—	—	—
Water glycol		—	Lubra Mate (5)	—	Polosafe 2000 (5)
Compressor lubricant					
32	135-165	—	Syncom 10W (4)	Comp 32 (1)	Syncom (3)
46	194-236	—	Syncom 20 (4)	Comp 46 (1)	Syncom (1)
68	284-346	—	Syncom 20 (4)	Comp 68 (1)	Syncom (3)
100	420-520	—	Syncom 30 (4)	Comp 100 (1)	Syncom (3)
150	630-770	—	—	Comp 150 (1)	Syncom (3)
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	—	Courier Special (1)	—	—
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	Liqui-Moly NV	—	—	—
Multipurpose high temperature grease (without moly)					
150	NLGI 2	—	CCL 2000 (4)	—	Hi-Temp (1)

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Lubrication Engineers, Inc. Fort Worth, TX www.le-inc.com	Lubriplate Div., Fiske Brothers Newark, NJ www.lubriplate.com	McLube Div., McGee Industries, Inc. Aston, PA www.888teammclube.com	Metalcote Crystal Lake, IL www.metalcote.com
Gear & bearing circulation oil					
32	135-165	9032 Monolec Air Comp (1)	SFGO 32 (1)	—	MC Gear 32 (1)
46	194-236	—	SFGO 46 (1)	—	MC Gear 46 (1)
68	284-346	9068 Monolec Air Comp (1)	SFGO 68 (1)	—	MC Gear 68 (1)
100	420-520	9100 Monolec Air Comp (1)	SFGO 100 (1)	—	MC Gear 100 (1)
150	630-770	9150 Monolec Air Comp (1)	SFGO 150 (1)	—	MC Gear 150 (1)
220	900-1100	9220 Monolec Ind (1)	SFGO 220 (1)	—	MC Gear 220 (1)
320	1350-1650	9320 Monolec Ind (1)	SFGO 320 (1)	—	MC Gear 320 (1)
460	1935-2365	9460 Monolec Ind (1)	SFGO 460 (1)	—	MC Gear 460 (1)
Extreme pressure gear oil					
100	420-520	—	SFGO 100 (1)	500 (5)	MC EP 100 (1)
150	630-770	—	SFGO 150 (1)	505 (5)	MC EP 150 (1)
220	900-1100	—	SFGO 220 (1)	—	MC EP 220 (1)
320	1350-1650	9320 Monolec Ind (1)	SFGO 320 (1)	—	MC EP 320 (1)
460	1935-2365	9460 Monolec Ind (1)	SFGO 460 (1)	—	MC EP 460 (1)
High pressure (antiwear) hydraulic oil					
32	135-165	—	SFGO 32 (1)	—	MC AW 32 (1)
46	194-236	—	SFGO 46 (1)	—	MC AW 46 (1)
68	284-346	—	SFGO 68 (1)	—	MC AW 68 (1)
100	420-520	—	SFGO 100 (1)	—	MC AW 100 (1)
Fire-resistant hydraulic fluid					
Synthetic		9455 FR Hyd Fluid (4)	—	—	Chemtolubric (4)
Water glycol		—	—	—	Lubricast 902 LPC (5)
Compressor lubricant					
32	135-165	9032 Monolec Air Comp (1)	SYNAC 32 (3)	—	MC Comp 32 (1)
46	194-236	—	SYNAC 46 (3)	—	MC Comp 46 (1)
68	284-346	9068 Monolec Air Comp (1)	SYNAC 68 (3)	—	MC Comp 68 (1)
100	420-520	9100 Monolec Air Comp (1)	SYNAC 100 (3)	—	MC Comp 100 (1)
150	630-770	9150 Monolec Air Comp (1)	SYNAC 150 (3)	—	MC Comp 150 (1)
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	—	—	—	MC 2044
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	—	—	MC 2127A
Multipurpose high temperature grease (without moly)					
150	NLGI 2	9901 Almasol Syntemp	—	MoS_2 1190 (1)	MC 2495

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Mobil Fairfax, VA www.mobil.com	Moroil Technologies Davidson, NC www.moroil.com	NFO Technologies Div., Century Lubriants Co. Kansas City, KS www.centurylub.com
Gear & bearing circulation oil				
32	135-165	SHC 624 (1)	SRO 32 (1,3)	—
46	194-236	—	SRO 46 (1,3)	—
68	284-346	SHC 626 (1)	SRO 68 (1,3)	—
100	420-520	SHC 627 (1)	SRO 100 (1,3)	—
150	630-770	SHC 629 (1)	SRO 150 (1,3)	—
220	900-1100	SHC 630 (1)	SRO 220 (1,3)	—
320	1350-1650	SHC 632 (1)	SRO 320 (1,3)	—
460	1935-2365	SHC 634 (1)	SRO 460 (1,3)	—
Extreme pressure gear oil				
100	420-520	—	SGL 100 (1,3)	Gear Pro 3S (4)
150	630-770	SHC 150 (1), Glygoyle 22 (5)	SGL 150 (1,3)	Gear Pro 4S (4)
220	900-1100	SHC 220 (1), Glygoyle 30 (5)	SGL 220 (1,3)	Gear Pro 5S (4)
320	1350-1650	SHC 320 (1)	SGL 320 (1,3)	Gear Pro 6S (4)
460	1935-2365	SHC 460 (1), Glygoyle HE 460 (5)	SGL 460 (1,3)	Gear Pro 7S (4)
High pressure (antiwear) hydraulic oil				
32	135-165	SHC 524 (1), EAL Envirosyn 32H (1)	AW/AL 32S (1,3)	Synshield HO-PAO 32 (1)
46	194-236	SHC 525 (1), EAL Envirosyn 46H (1)	AW/AL 46 (1,3)	Synshield HO-PAO 46 (1)
68	284-346	SHC 526 (1), EAL Envirosyn 68H (1)	AW/AL 68 (1,3)	Synshield HO-PAO 68 (1)
100	420-520	EAL Envirosyn 100H (1)	AW/AL 100 (1,3)	—
Fire-resistant hydraulic fluid				
Synthetic		Pyrogard 53 (6)	AW 46 PE	—
Water glycol		Nyvac FR 200 D (5)	AW 46 FR	—
Compressor lubricant				
32	135-165	EAL Arctic 32 (4)*, Rarus SHC 1024 (1), Gargoyle Arctic SHC 224 (1)*, Rarus 824 (3)	Syncomp 32 (1), 32PG (3), 432 (5)	Synshield PAO (1), Diester (3)
46	194-236	EAL Arctic 46 (4)*	Syncomp 46 (1), 446 (3)	Synshield PAO (1), Diester (3)
68	284-346	EAL Arctic 68 (4)*, Rarus SHC 1026 (1), Gargoyle Arctic SHC 226 (1)*, Rarus 826 (3)	Syncomp 68 (1), 68PG (3), 468 (5)	Synshield PAO (1), Diester (3)
100	420-520	EAL Arctic 100 (4)*, Rarus 827 (3)	Syncomp 100 (1), 410 (3)	Synshield PAO (1), Diester (3)
150	630-770	Rarus 829 (3), Glygoyle 22 (5)	Syncomp 150 (1), 415 (3)	Synshield PAO (1), Diester (3)
Multipurpose extreme pressure grease (without moly)				
150/220	NLGI 2	Mobilith SHC 220 (1)	SGR P2, SPG, GS19	HT 100 (4)
Multipurpose molybdenum disulfide extreme pressure grease				
150/220	NLGI 2	—	SGR P2M	HT 250/MS (4)
Multipurpose high temperature grease (without moly)				
150	NLGI 2	—	SGR P2, SPG, GS19	Chemplex 940 (1)

** Not to be used in air compressors*

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Pennzoil-Quaker State Co. The Woodlands, TX www.pennzoil.com	Perkins Products, Inc. Bedford Park, IL www.perkinsproducts.com	Petronomics Mfg. Group, Inc. Hutchinson, KS	Phillips 66 Co. Bartlesville, OK www.phillips66.com/lube
Gear & bearing circulation oil					
32	135-165	Pennzbell SHD 32 (1)	Perlube SYN-GO-32 (1)	51070 (1)	—
46	194-236	Pennzbell SHD 46 (1)	Perlube SYN-GO-46 (1)	51072 (1)	—
68	284-346	Pennzbell SHD 68 (1)	Perlube SYN-GO-68 (1)	51074 (1)	—
100	420-520	Pennzbell SHD 100 (1)	Perlube SYN-GO-100 (1)	51076 (1)	—
150	630-770	Pennzbell SHD 150 (1)	Perlube SYN-GO-150 (1)	51078 (1), 53090 (5)	—
220	900-1100	Pennzbell SHD 220 (1)	Perlube SYN-GO-220 (1)	51080 (1), 53092 (5)	—
320	1350-1650	Pennzbell SHD 320 (1)	Perlube SYN-GO-320 (1)	51082 (1), 53094 (5)	—
460	1935-2365	Pennzbell SHD 460 (1)	Perlube SYN-GO-460 (1)	51084 (1), 53096 (5)	—
Extreme pressure gear oil					
100	420-520	Super Maxol S 100 (1)	Perlube SYN-GO-100 (1)	51090 (1), 51392 (5)	—
150	630-770	Super Maxol S 150 (1)	Perlube SYN-GO-150 (1)	51092 (1), 51394 (5)	Syndustrial EP 150 (1)
220	900-1100	Super Maxol S 220 (1)	Perlube SYN-GO-220 (1)	51094 (1), 51396 (5)	Syndustrial EP 220 (1)
320	1350-1650	Super Maxol S 320 (1)	Perlube SYN-GO-320 (1)	51096 (1)	Syndustrial EP 320 (1)
460	1935-2365	Super Maxol S 460 (1)	Perlube SYN-GO-460 (1)	51098 (1), 51398 (5)	Syndustrial EP 460 (1)
High pressure (antiwear) hydraulic oil					
32	135-165	—	—	51201 (1), 51226 (1)	—
46	194-236	—	Perlube SYN-58-H (4)	51203 (1), 51228 (1)	—
68	284-346	—	Perlube SYN-68-H (4)	51205 (1), 51230 (1)	—
100	420-520	—	—	51207 (1), 51232 (1)	—
Fire-resistant hydraulic fluid					
Synthetic		Pennzsafe SL (4), FE (6)	Perlube SYN-58-H (4)	30142, 54100 (4)	—
Water glycol		Glycol FR Fluid (5)	Perlube FR-200 (5)	55250 (5), 55130 (5), 55260 (5)	—
Compressor lubricant					
32	135-165	Pennzcom PAO 32 (1)	Perlube SYN-32-AC (3)	51280 (3), 51290 (1)	Syndustrial P 32 (1), E 32 (3), Turbine 32 (1)
46	194-236	Pennzcom PAO 46 (1)	Perlube SYN-46-AC (3)	51282 (3), 51292 (1), 53052 (4)	Syndustrial P 46 (1)
68	284-346	Pennzcom PAO 68 (1)	Perlube SYN-68-AC (3)	51284 (3), 51294 (1), 53054 (4)	Syndustrial P 68 (1), E 68 (3)
100	420-520	Pennzcom PAO 100 (1)	Perlube SYN-100-AC (3)	51286 (3), 51296 (1)	Syndustrial E 100 (3)
150	630-770	Pennzcom PAO 150 (1)	Perlube SYN-150-AC (3)	51288 (3), 51298 (1)	—
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	Pennlith SHD EP 220 (1)	Perlube HP-2	00880, 00950, 00510	—
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	Perlube MC-2	00800	—
Multipurpose high temperature grease (without moly)					
150	NLGI 2	—	Perlube SYN-2	00880, 00950, 00510	—

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	PICO Chemical Corp. Chicago Hts., IL www.picochemical.com	Royal Lubricants, Inc. East Hanover, NJ www.royallube.com	Royal Purple, Inc. Humble, TX www.royalpurple.com
Gear & bearing circulation oil				
32	135-165	Syn RO 32 (1,4)	Royco 5032 (1)	Synfilm GT 32 (1), Polyguard 32 (1), Polyguard FDA 32 (1)
46	194-236	Syn RO 46 (1,4)	Royco 5046 (1)	Synfilm GT 46 (1), Polyguard 46 (1), Polyguard FDA 46 (1)
68	284-346	Syn RO 68 (1,4)	Royco 5068 (1)	Synfilm GT 68 (1), Polyguard 68 (1), Polyguard FDA 68 (1)
100	420-520	Syn RO 100 (1,4)	Royco 5100 (1)	Synfilm GT 100 (1), Polyguard 100 (1), Polyguard FDA 100 (1)
150	630-770	Syn RO 150 (1,4)	Royco 5150 (1)	Synfilm GT 150 (1), Polyguard FDA 150 (1)
220	900-1100	Syn RO 220 (1,4)	Royco 5220 (1)	Synfilm GT 220 (1), Polyguard FDA 220 (1)
320	1350-1650	Syn RO 320 (1,4)	Royco 5320 (1)	Synfilm GT 320 (1), Polyguard FDA 320 (1)
460	1935-2365	Syn RO 460 (1,4)	Royco 5460 (1)	Synfilm GT 460 (1), Polyguard FDA 460 (1)
Extreme pressure gear oil				
100	420-520	Syn GO EP 100 (1,4)	—	Synergy 100 (1), Thermyl-Glyde 100 (1)
150	630-770	Syn GO EP 150 (1,4)	Royco 611 (1)	Synergy 150 (1), Thermyl-Glyde 150 (1)
220	900-1100	Syn GO EP 220 (1,4)	Royco 612 (1)	Synergy 220 (1), Thermyl-Glyde 220 (1)
320	1350-1650	Syn GO EP 320 (1,4)	Royco 613 (1)	Synergy 320 (1), Thermyl-Glyde 320 (1)
460	1935-2365	Syn GO EP 460 (1,4)	Royco 614 (1)	Synergy 460 (1), Thermyl-Glyde 460 (1), Synergy Worm Gear 460 (1), Thermal-Glyde Worm Gear 460 (1)
High pressure (antiwear) hydraulic oil				
32	135-165	Syn AW 32 (1,4)	Royco 732 (1)	Syndraulic 32 (1), Polyguard FDA 32 (1)
46	194-236	Syn AW 46 (1,4)	Royco 746 (1)	Syndraulic 46 (1), Polyguard FDA 46 (1)
68	284-346	Syn AW 68 (1,4)	Royco 768 (1)	Syndraulic 68 (1), Polyguard FDA 68 (1)
100	420-520	Syn AW 100 (1,4)	Royco 786 (1)	Syndraulic 100 (1), Polyguard FDA 100 (1)
Fire-resistant hydraulic fluid				
Synthetic		FRHH (4)	BioGuard 3000 Series (4)	Mea Hyd Fluid (1)
Water glycol		WGHF (5)	—	—
Compressor lubricant				
32	135-165	Syn AC 32 (1,4)	Royco 432 (1), 4032 (3), 832 (5)	Synfilm 32 (1), Synfilm NGL 32 (1), Parafilm 32 (1)
46	194-236	Syn AC 46 (1,4)	Royco 446 (1)	Synfilm 46 (1), Synfilm NGL 46 (1), Parafilm 46 (1)
68	284-346	Syn AC 68 (1,4)	Royco 468 (1), 4068 (3), 868 (5)	Synfilm 68 (1), Synfilm NGL 68 (1), Parafilm 68 (1)
100	420-520	Syn AC 100 (1,4)	Royco 486 (1), 4100 (3), 886 (5)	Synfilm 100 (1), Synfilm NGL 100 (1), Parafilm 100 (1)
150	630-770	Syn AC 150 (1,4)	Royco 489 (1), 4150 (3), 889 (5)	Synfilm 150 (1), Synfilm NGL 150 (1), Parafilm 150 (1)
Multipurpose extreme pressure grease (without moly)				
150/220	NLGI 2	DNA	OnGuard LC 460 (1)	Ultra Perf #2 (1), Ultra Perf FDA #2 (1)
Multipurpose molybdenum disulfide extreme pressure grease				
150/220	NLGI 2	DNA	—	—
Multipurpose high temperature grease (without moly)				
150	NLGI 2	DNA	OnGuard FG 460	Ultra Perf #2 (1), Ultra Perf FDA #2 (1)

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	RSI Co. Fairfield, NJ	Saunders Enterprises, Inc. Long Island City, NY www.magnalube.com	Schaeffer Mfg. St. Louis, MO www.schaefferoil.com	Sentinel Synthetic Lubricants Miami, FL www.sentinelsynthetic.com
Gear & bearing circulation oil					
32	135-165	Estrolene 10 (3)	—	264 Moly Pure Hyd 32 (1)	SMPO 32 (1)
46	194-236	—	—	264 Moly Pure Hyd 46 (1)	SMPO 46 (1)
68	284-346	Estrolene 20 (3)	—	264 Moly Pure Hyd 68 (1)	SMPO 68 (1)
100	420-520	Estrolene 30 (3)	—	264 Moly Pure Hyd 100 (1)	SMPO 100 (1)
150	630-770	—	—	264 Moly Pure Hyd 150 (1)	SMPO 150 (1)
220	900-1100	—	—	264 Moly Pure Hyd 220 (1)	SMPO 220 (1)
320	1350-1650	—	—	—	SMPO 320 (1)
460	1935-2365	—	—	—	SMPO 460 (1)
Extreme pressure gear oil					
100	420-520	—	—	167 Moly Pure Gear 100 (1)	S 75/90 (1)
150	630-770	—	—	167 Moly Pure Gear 150 (1)	S 80/90 (1)
220	900-1100	—	—	167 Moly Pure Gear 220 (1)	S 90 (1)
320	1350-1650	—	—	167 Moly Pure Gear 320 (1)	S 90/140 (1)
460	1935-2365	—	—	167 Moly Pure Gear 460 (1)	S 140 (1)
High pressure (antiwear) hydraulic oil					
32	135-165	Estrolene 10 (3)	—	264 Moly Pure Hyd 32 (1)	SH 10 (1)
46	194-236	—	—	264 Moly Pure Hyd 46 (1)	SH 10/20 (1)
68	284-346	Estrolene 20 (3)	—	264 Moly Pure Hyd 68 (1)	SH 20 (1)
100	420-520	Estrolene 30 (3)	—	264 Moly Pure Hyd 100 (1)	SH 30 (1)
Fire-resistant hydraulic fluid					
Synthetic		—	—	620 Syquench (4)	S FRIT 46 (4)
Water glycol		—	—	265 Glycol Torque Fluid (5)	S FRNG (5)
Compressor lubricant					
32	135-165	Estrolene 10 (3)	—	158 Moly Pure Comp 32 (1)	SCO 10S (4)
46	194-236	—	—	158 Moly Pure Comp 46 (1)	SCO 10W20S (4)
68	284-346	Estrolene 20 (3)	—	158 Moly Pure Comp 68 (1)	SCO 20S (4)
100	420-520	Estrolene 30 (3)	—	158 Moly Pure Comp 100 (1)	SCO 30S (4)
150	630-770	—	—	158 Moly Pure Comp 150 (1)	SCO 40S (4)
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	—	Magnalube-G (1)	—	SL 123R (1)
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	Magnalube-X (6)	197 Moly Pure (1)	SLM-2 (1)
Multipurpose high temperature grease (without moly)					
150	NLGI 2	—	Magnalube-G (1)	—	SL WR White (1)

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

2000 Plant Engineering Magazine's Exclusive Synthetic Lubricants Guide

ISO viscosity grade	Viscosity, SUS at 100 F	76 Lubricants Co. Santa Ana, CA www.76lubricants.com	Shell Houston, TX www.shell-lubricants.com	South Coast Products, Inc. Houston, TX www.socousa.com	Sprayon/Sherwin-Williams Industrial Columbus, OH www.sprayon.com
Gear & bearing circulation oil					
32	135-165	Triton Syn TGO 32 (1)	Omala RL 32 (1)	—	Tri-flow Food Grade
46	194-236	Triton Syn TGO 46 (1)	—	—	Tri-flow Food Grade
68	284-346	Triton Syn TGO 68 (1)	Omala RL 68 (1)	—	Tri-flow Food Grade
100	420-520	—	Omala RL 100 (1)	—	Tri-flow Food Grade
150	630-770	—	Omala RL 150 (1)	—	Tri-flow Food Grade
220	900-1100	Triton Syn TGO 220 (1)	Omala RL 220 (1)	—	Tri-flow Food Grade
320	1350-1650	—	Omala RL 320 (1)	—	—
460	1935-2365	—	Omala RL 460 (1)	—	Tri-flow Food Grade
Extreme pressure gear oil					
100	420-520	—	—	—	Tri-flow Food Grade
150	630-770	Triton Syngear 4 EP (1)	—	—	Tri-flow Food Grade
220	900-1100	Triton Syngear 5 EP (1)	Omala HD 220 (1)	—	Tri-flow Food Grade
320	1350-1650	—	Omala HD 320 (1)	—	—
460	1935-2365	Triton Syngear 7 EP (1)	Omala HD 460 (1)	—	Tri-flow Food Grade
High pressure (antiwear) hydraulic oil					
32	135-165	Triton Syn TGO 32 (1)	Tellus HD 32 (1)	—	Tri-flow Food Grade
46	194-236	Triton Syn TGO 46 (1)	Tellus HD 46 (1)	—	Tri-flow Food Grade
68	284-346	Triton Syn TGO 68 (1)	Tellus HD 68 (1)	—	Tri-flow Food Grade
100	420-520	—	—	—	Tri-flow Food Grade
Fire-resistant hydraulic fluid					
Synthetic		—	—	—	Tri-flow Food Grade
Water glycol		FR Fluid Glycol (5)	—	—	—
Compressor lubricant					
32	135-165	Triton Syn 32 (3)	Corena AS 32 (1)	—	—
46	194-236	—	Corena AS 46 (1)	—	—
68	284-346	Triton Syn 68 (3)	Corena AS 68 (1), DE 68 (3)	—	—
100	420-520	Triton Syn 100 (3)	Corena DE 100 (3), Madrela G 100 (5)	—	—
150	630-770	—	Corena DE 150 (3), Madrela G 150 (5)	—	—
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	Triton Syn EP (1)	Albida SLC 220 (1)	Desco 622 (4)	Tri-flow Food Grade
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	—	Desco Mag-EP (1)	—
Multipurpose high temperature grease (without moly)					
150	NLGI 2	—	—	Desco MPG w/PTFE (2)	Tri-flow Food Grade

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Sunoco Lubricants Philadelphia, PA www.sunocoinc.com	Synco Chemical Corp. Bohemia, NY www.super-lube.com	Texaco Houston, TX www.texaco.com/tlc	Texas Refinery Corp. Ft. Worth, TX www.texasrefinery.com
Gear & bearing circulation oil					
32	**135-165**	Challenge R&O 32 (1)	—	Pinnacle 32 (1)	—
46	**194-236**	Challenge R&O 46 (1)	Super Lube Oil (1)	Pinnacle 46 (1)	—
68	**284-346**	Challenge R&O 68 (1)	Super Lube Oil (1)	Pinnacle 68 (1)	—
100	**420-520**	—	—	Pinnacle 100 (1)	—
150	**630-770**	Challenge R&O 150 (1)	Super Lube Oil w/PTFE (1)	Pinnacle 150 (1)	—
220	**900-1100**	Challenge R&O 220 (1)	Super Lube Oil w/PTFE (1)	Pinnacle 220 (1)	—
320	**1350-1650**	Challenge R&O 320 (1)	Super Lube Oil w/PTFE (1)	Pinnacle 320 (1)	—
460	**1935-2365**	Challenge R&O 460 (1)	—	Pinnacle 460 (1)	—
Extreme pressure gear oil					
100	**420-520**	—	—	—	—
150	**630-770**	Challenge EP 150 (1)	—	Pinnacle EP 150 (1)	Syntex 2700 (1)
220	**900-1100**	Challenge EP 220 (1)	—	Pinnacle EP 220 (1)	—
320	**1350-1650**	Challenge EP 320 (1)	—	Pinnacle EP 320 (1)	Syntex 2700 (1)
460	**1935-2365**	Challenge EP 460 (1)	—	Pinnacle EP 460 (1)	—
High pressure (antiwear) hydraulic oil					
32	**135-165**	Challenge AW 32 (1)	—	Hydra 32 (4)	—
46	**194-236**	Challenge AW 46 (1)	—	Hydra 46 (4)	—
68	**284-346**	Challenge AW 68 (1)	—	—	—
100	**420-520**	—	—	—	—
Fire-resistant hydraulic fluid					
Synthetic		—	—	—	—
Water glycol		Fireresist Glycol	—	Hyd Safety Fluid	—
Compressor lubricant					
32	**135-165**	Challenge AC 32 (1), DE 32 (3)	—	Cetus PAO 32 (1), DE 32 (3), PGE 32 (5,3)	Syn Comp (3)
46	**194-236**	Challenge AC 46 (1)	—	Cetus PAO 46 (1)	—
68	**284-346**	Challenge AC 68 (1)	—	Cetus PAO 68 (1), DE 68 (3), PGE 68 (5,3)	Syn Comp (3)
100	**420-520**	Challenge AC 100 (1), DE 100 (3)	—	Cetus PAO 100 (1), DE 100 (3)	Syn Comp (3)
150	**630-770**	Challenge AC 150 (1), DE 125 (3)	—	—	—
Multipurpose extreme pressure grease (without moly)					
150/220	**NLGI 2**	Challenge 1.5 EP (1)	Super Lube Grease (1)	Starfak 2202 (1)	—
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	**NLGI 2**	Syn Moly (1)	—	—	—
Multipurpose high temperature grease (without moly)					
150	**NLGI 2**	Challenge 1.5 EP (1)	Super Lube High Temp EP (1)	Polystar 1002 (1)	—

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

ISO viscosity grade	Viscosity, SUS at 100 F	Tower Oil & Technology Co. Chicago, IL	Tribology/ Tech-Lube Yaphank, NY	TriboMaxx Corp. Omaha, NE www.dmxtechnology.com	Tri State Industrial Lubricants, Inc. Skokie, IL	Ultrachem, Inc. New Castle, DE www. ultracheminc.com
Gear & bearing circulation oil						
32	135-165	Syncom 5 (3), P 32 (1)	T 32 Clear (1)	—	Syn Gear DE 32 (1)	Chemlube 624 (1)
46	194-236	—	T 46 Clear (1)	—	Syn Gear DE 46 (1)	Chemlube 625 (1)
68	284-346	Syncom P 68 (1)	T 68 Clear (1)	—	Syn Gear DE 68 (1)	Chemlube 626 (1)
100	420-520	Syncom 8 (3)	T 10/50 (1)	—	Syn Gear DE 100 (1)	Chemlube 627 (1)
150	630-770	—	T 30/90 (1)	—	Syn Gear DE 150 (1)	Chemlube 629 (1)
220	900-1100	Syngear GH 1200 (1)	T 220 Clear (1)	—	Syn Gear DE 220 (1)	Chemlube 630 (1)
320	1350-1650	—	T 320 Clear (1)	—	Syn Gear DE 320 (1)	Chemlube 632 (1)
460	1935-2365	—	T 460 Clear (1)	—	Syn Gear DE 460 (1)	Chemlube 634 (1)
Extreme pressure gear oil						
100	420-520	—	T 100 (1)	EP Gear 100	Syn Gear DE 100 (3)	Omnigear 100 (1)
150	630-770	—	T 75/90 (1)	EP Gear 150	Syn Gear DE 150 (3)	Omnigear 150 (1)
220	900-1100	Syngear GH 1200 (1)	T 220 (1)	EP Gear 220	Syn Gear DE 220 (3)	Omnigear 220 (1)
320	1350-1650	—	T 320 (1)	EP Gear 320	Syn Gear DE 320 (3)	Omnigear 320 (1)
460	1935-2365	—	T 460 (1)	EP Gear 460	Syn Gear DE 460 (3)	Omnigear 460 (1)
High pressure (antiwear) hydraulic oil						
32	135-165	—	Hyd 32 (1)	EP Hyd 32	SY Hydro DE 32 (1)	Chemlube 624 (1)
46	194-236	—	Hyd 46 (1)	EP Hyd 46	SY Hydro DE 46 (1)	Chemlube 625 (1)
68	284-346	—	Hyd 68 (1)	EP Hyd 68	SY Hydro DE 68 (1)	Chemlube 626 (1)
100	420-520	—	Hyd 10/30 (1)	EP Hyd 100	SY Hydro DE 100 (1)	Chemlube 627 (1)
Fire-resistant hydraulic fluid						
Synthetic		—	FRH 200 (4)	—	—	—
Water glycol		FR Fluid 40 (5)	600 WS (5)	—	AFHAW	—
Compressor lubricant						
32	135-165	Syncom 5 (3), P 32 (1)	Taco 32 HT, 32 D (3)	—	Syn Com 32 (3)	Chemlube 215 (3), 221 (1), 932 (4)
46	194-236	—	Taco 46 HT, 46 D (3)	—	Syn Com 46 (3)	Chemlube 229 (3), 228 (1), 946 (4)
68	284-346	Syncom P 68 (1)	Taco 68 HT, 68 D (3)	—	Syn Com 68 (3)	Chemlube 230 (3), 268 (1)
100	420-520	Syncom 8 (3)	Taco 100 HT, 100 D (3)	—	Syn Com 100 (3)	Chemlube 501 (3), 9100 (4)
150	630-770	—	Taco 150 HT, 150 D (3)	—	Syn Com 150 (3)	Chemlube 751 (3)
Multipurpose extreme pressure grease (without moly)						
150/220	NLGI 2	—	Tri 123, T 760 (1)	TM 2035 (1)	GL Poly	Omnilube 2 (1)
Multipurpose molybdenum disulfide extreme pressure grease						
150/220	NLGI 2	—	Tri Moly (1)	—	GL 83	—
Multipurpose high temperature grease (without moly)						
150	NLGI 2	—	Black Gold, Red Gold, T-123 HT (1)	TM 2035 (1)	GL Poly	Vischem 502 (4)

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid

Plant Engineering Magazine's Exclusive Synthetic Lubricants Guide 2000

ISO viscosity grade	Viscosity, SUS at 100 F	Union Carbide Danbury, CT www.unioncarbide.com	U.S. Industrial Lubricants Cincinnati, OH	Wallover Oil Co., Inc. Strongsville, OH www.walloveroil.com	Whitmore Mfg. Co. Rockwall, TX www.whitmores.com
Gear & bearing circulation oil					
32	135-165	Uconall 32 (5)	—	WOCO SCO 32 (1)	—
46	194-236	Uconall 46 (5)	—	WOCO SCO 46 (1)	—
68	284-346	Uconall 68 (5)	—	WOCO SCO 68 (1)	Decathlon SH 68 (1)
100	420-520	—	—	WOCO SCO 100 (1)	Decathlon SH 100 (1)
150	630-770	Uconall 150 (5)	USL 150 Gear (1)	WOCO SCO 150 (1)	Decathlon SH 150 (1)
220	900-1100	Uconall 220 (5)	USL 220 Gear (1)	WOCO SCO 220 (1)	Decathlon SH 220 (1)
320	1350-1650	Uconall 320 (5)	USL 320 Gear (1)	WOCO SCO 320 (1)	Decathlon SH 320 (1)
460	1935-2365	Uconall 460 (5)	USL 460 Gear (1)	WOCO SCO 460 (1)	Decathlon SH 460 (1)
Extreme pressure gear oil					
100	420-520	—	—	—	—
150	630-770	Uconall 150 (5)	—	WOCO SGO 150 (1)	Decathlon HD 150 (1)
220	900-1100	Uconall 220 (5)	—	WOCO SGO 220 (1)	Decathlon HD 220 (1)
320	1350-1650	Uconall 320 (5)	—	WOCO SGO 320 (1)	Decathlon HD 320 (1)
460	1935-2365	Uconall 460 (5)	—	WOCO SGO 460 (1)	Decathlon HD 460 (1)
High pressure (antiwear) hydraulic oil					
32	135-165	Uconall 32 (5)	USL 32 AW (1)	WOCO SHO 32 (1)	Decathlon AW 32 (1)
46	194-236	Uconall 46 (5)	USL 46 AW (1)	WOCO SHO 46 (1)	Decathlon AW 46 (1)
68	284-346	Uconall 68 (5)	USL 68 AW (1)	WOCO SHO 68 (1)	Decathlon AW 68 (1)
100	420-520	—	USL 100 AW (1)	WOCO SHO 100 (1)	Decathlon AW 100 (1)
Fire-resistant hydraulic fluid					
Synthetic		—	—	—	—
Water glycol		Ucon Hydrolubes (5)	—	WOCOSAFE 46 WG	—
Compressor lubricant					
32	135-165	Uconall 32 (5)	Dyna-Therm 32 (1)	WOCO DEC 32 (3)	Decathlon HC 32 (1)
46	194-236	Uconall 46 (5)	Dyna-Therm 46 (1)	—	Decathlon HC 46 (1)
68	284-346	Uconall 68 (5)	Dyna-Therm 68 (1)	WOCO DEC 68 (3)	Decathlon HC 68 (1)
100	420-520	—	Dyna-Therm 100 (1)	WOCO DEC 100 (3)	Decathlon DE 100
150	630-770	Unconall 150 (5)	Dyna-Therm 150 (1)	WOCO DEC 150 (3)	Decathlon HC 150 (1)
Multipurpose extreme pressure grease (without moly)					
150/220	NLGI 2	—	Everstay Hi-Temp (1)	—	Decathlon LC 220 #2 (1)
Multipurpose molybdenum disulfide extreme pressure grease					
150/220	NLGI 2	—	—	—	Decathlon LC 460 #2 (1)
Multipurpose high temperature grease (without moly)					
150	NLGI 2	—	Everstay Hi-Temp (1)	—	Decathlon LC 220 #2 (1)

Base Stock Code Key: 1 Polyalphaolefin 2 Dialkylated Benzene 3 Dibasic Acid Ester 4 Polyol Ester 5 Polyglycol 6 Phosphate Ester 7 Silicone Fluid