NPDES Compliance Inspection Manual

Chapter 4

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CHAPTER 4 – FACILITY SITE REVIEW—WASTEWATER TREATMENT PLANTS

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A. OBJECTIVES

The objectives of a facility site review are to:

- Assess the physical conditions of the facility's current treatment processes and operations.
- Evaluate the permittee's operation and maintenance activities that impact plant performance.
- Check the completeness and accuracy of the permittee's performance/compliance records.
- Determine whether the treatment units are achieving the required treatment efficiencies.

To accomplish this, a National Pollutant Discharge Elimination System (NPDES) inspector should conduct a physical inspection of the facility (i.e., site survey), interview various levels of management and staff, and review facility records.

The information in this chapter is based on a comprehensive inspection at a Publicly Owned Treatment Works (POTW). The information is applicable to Wastewater Treatment Plants (WWTPs). This chapter includes an example of a Facility Site Review Checklist at the end of this chapter.

B. PHYSICAL INSPECTION OF THE FACILITY

This section pertains to inspections of WWTPs. To conduct a proper NPDES inspection the inspector must fully understand the wastewater treatment processes used at the facility and how each process fits into the overall treatment scheme. A General Wastewater Treatment Plant Flow Diagram is included at the end of this chapter (

Exhibit 4-1).

The inspector should conduct an examination of process treatment units, sampling and flow monitoring equipment, outfalls, and the receiving stream, particularly focusing on areas of the permittee's premises where pollutants are generated, pumped, conveyed, treated, stored, or disposed of. As the inspector becomes more knowledgeable about the facility being inspected, they should focus on areas that are likely to impact permit compliance and evaluate overall performance of the treatment facility. Inspectors should not enter confined spaces during the inspection of the facility unless they are properly training for confined space entry procedures.

During the inspection, the inspector should pay attention to the operational factors listed below and carefully document all the observations.:

- Influent characteristics, including:
  - Appearance (color, odor, etc.)
  - Combined sewer loads

  - Infiltration/inflow
  - Industrial contributions
  - Diurnal/seasonal loading variations

- Process control and settings
- Unit operations including supply of treatment chemicals
- Equipment design and current operating conditions
- Maintenance and operation staff
- Safety controls and equipment
- Effluent characteristics, including:
  - Appearance of discharge
  - Receiving stream appearance including any staining, deposits, or eutrophication
  - Evidence of toxicity of the discharge
- Other conditions particular to the plant

The inspector should evaluate the facility in terms of solids management, looking for evidence of excessive solids levels in clarifiers and sludge thickeners, insufficient solids wasting capabilities, the need for temporary sludge holding tanks, dewatering systems such as belt presses out of service, and sludge drying beds with excessive amounts of sludge. The Environmental Protection Agency's (EPA's) *Field Manual for Performance Evaluation and Trouble Shooting at Municipal Wastewater Facilities* (EPA, 1978) is a good reference for operational characteristics of plants. Additional resources for inspectors to learn more about wastewater treatment processes and facilities are provided at the end of this chapter in Section D, “References.”

The physical inspection, along with staff interviews and record reviews (discussed in subsequent sections of this chapter), may lead the inspector to determine:

- Whether a major facility design problem requires an engineering solution.
- Whether problems can be solved through proper operation and maintenance of the treatment facilities.
- Whether periodic equipment malfunctions at the facility indicate the need for equipment overhaul or replacement.

When conducting the inspection, the inspector should be aware of and look for physical conditions that indicate past, existing, or potential problems. Conditions to look for in the plant (generally and in specific processes) are listed in the following subsections. The presence of these conditions will give the inspector an idea of the types of problems present, the parts of the treatment process causing the problems, and the potential solution to existing problems.

GENERAL CONDITIONS IN OVERALL PLANT

General Indicators

- Suspected poor water quality of the effluent discharge.
- Excessive scum buildup; grease, foam, or floating sludge in clarifiers; high sludge blanket levels in the secondary clarifiers, or excessively high solids inventories in the aeration basins (unusually high mixed liquor suspended solids (MLSS).
- Sludge washout occurrences, or any other ineffective or inadequate sludge wasting capabilities.
- Hydraulic overload caused by storms, discharges of cooling water, or undersized facility or process.
- Noxious odors in wet wells and grit chambers and around aerobic and anaerobic biological units, scum removal devices, and sludge handling and treatment facilities.
- Evidence of severe corrosion at the treatment plant and in the collection system.
- Discoloration of the ground or a strong chemical smell may indicate past spills at the plant; further investigation of spills may be warranted.
- Vital treatment units out of service for repairs. Determine when the units went out of service, the type of failure, and when they will be put back in service.
- Excessive noise from process or treatment equipment.
- Any unusual equipment intended to correct operation problems (e.g., special pumps, floating aerators in diffused air systems, chemical feeders, temporary construction or structures, or any improvised system).
- Ruptures in chemical feed lines.

Flow Indicators

- Surging of influent lines, overflow weirs, and other structures.
- Hydraulically overloaded process or equipment.
- Flow through bypass channels.
- Overflows at alternative discharge points, channels, or other areas.
- Excessive septage dumping by septic tank pumpers.
- Flow from unknown source or origin.
- Open-ended pipes that appear to originate in a process or storage area and periodically discharge to the ground or to surface water. Although these pipes have been disconnected from a closed system or otherwise removed from service, they can still be connected to a discharge source.
- Flow charts indicating acute Infiltration and Inflow (I/I) problems following rain events.

Unusual Waste Indicators

- Collected screenings, slurries, sludges, waste piles, or byproducts of treatment. Their disposal, including runoff of any water, must be such that none enters navigable waters or their tributaries.
- Improper or lack of recycling of filtrates and supernatants from sludge dewatering and treatment.
- Improper storage of chemicals and hazardous substances with attention to the proper diking of chemicals and hazardous substances and segregation of incompatible chemicals. Generally, spill containment should be such that the dike could contain the contents of the largest tank.
- Spills or mishandling of chemicals.

WASTEWATER COLLECTION SYSTEM

Piping/Transport

- Degrading quality of piping material. Most commonly used materials are ductile iron, concrete, or polyvinyl chloride (PVC).

Pumping Station

- Dangerously high wet well levels at the pump station.
- Malfunctioning alarm system to notify of low-high wet well levels, pump failure, and power failure.
- Inadequate pumping capacity when wet well levels are high.
- Inoperable pumps.

PRELIMINARY TREATMENT AT THE HEADWORKS

Screening

- Spacing of screening bars outside the range of 0.25 to 2.0 inches
- Surcharge conditions in the influent sewer lines
- Excessive screen clogging
- Excessive buildup of debris against screen
- Oil and grease buildup
- Excessive scouring velocities through the screen during cleaning
- Improper disposal of screened material
- Excessive odors
- Pass through of grease and debris that shows up in the final effluent

Shredding/Grinding

- Blockage in sludge pumps or lines
- Bypass of shredding/grinding equipment
- Equipment removed or inoperable

Grit Removal

- Velocity-controlled grit removal processes with wastewater velocity exceeding or significantly less than 1 foot per second.
- Grit chamber clogged or subject to odors.
- Clogging in pipes and sedimentation basin sludge hoppers.
- Less than typical grit accumulation in subsequent processes.
- Inoperable air diffusers leading to excessive organic content of grit.
- Wear of grit removal/handling equipment.
- Excessive odors in grit removal area.

Influent Pumping

- Inadequate pumping capacity during periods of high influent flow
- Inoperable pumps

Flow Equalization

- Equalization tank never empty
- Excessive odors
- Inoperable aerators, if aerated
- Ability to bypass directly to surface water

PRIMARY CLARIFIER

General Indicators

- Excessive gas bubbles or grease on surface
- Black and odorous wastewater
- Poor removal of suspended solids in primary clarifier
- Excessive buildup of solids in center well of circular clarifier
- Unlevel discharge weirs
- Fouling of overflow weirs
- Evidence of short circuiting
- Ineffective scum rake
- Scum overflow or lack of adequate scum disposal, full scum pit
- Excessive floating sludge and/or scum (high sludge blanket level)
- Excessive sludge on bottom, inadequate sludge removal
- Noisy sludge scraper drive
- Broken sludge scraper equipment
- Poor maintenance of sludge pumps (leaking) or pump gallery

SECONDARY BIOLOGICAL TREATMENT UNITS

Trickling Filter/Activated Biofilters

- Filter ponding (indicating clogged media)
- Dried or collapsed media
- Leak at center column of filter's distribution arms
- Uneven distribution of flow on filter surface
- Uneven or discolored growth
- Excessive growth of biomass
- Excessive sloughing of growth
- Odor
- Clogging of trickling filter's distribution arm orifices
- Restricted rotation of distribution arms
- Filter flies, worms, or snails
- Ice buildup on trickling filter media or distribution arms
- Inappropriate recirculation rates of filter or secondary effluent

Rotating Biological Contactors

- Odor
- Development of white biomass on rotating biological contactor (RBC) media
- Excessive sloughing of growth
- Excessive breakage of rotating disks or shafts in RBC units
- Shaft, bearing, drive gear, or motor failure
- Solids accumulation in RBC units

Activated Sludge Tanks

- Excessive breakage of paddles on brush aerators.
- Shaft, bearing, drive gear, or motor failure on disk or brush aerators.
- Dead spots in aeration tanks.
- Use of floating aerators in basins designed with bottom air diffusers.
- Failure of surface aerators.
- Inoperative air compressors.
- Air rising unevenly.
- Excessive air leaks in compressed air piping.
- Dark mixed liquor in aeration tank (grey or black).
- Dark foam or bad odor on aeration tanks.
- Stable dark tan foam on aeration tanks that sprays cannot break up.
- Thick billows of white, sudsy foam on aeration tank.

- Low Dissolved Oxygen (DO, < 1.0 mg/l) in aeration tank (except in areas used for denitrification).
- Inadequate return activated sludge rates.
- Solids-related measurements outside of expected range (e.g., MLSS and/or Mixed Liquor Volatile Suspended Solids (MLVSS) concentration, Food to Mass ratio (F:M), sludge age, or mean cell residence time).

Stabilization Ponds/Lagoons

- Trees growing on the bank or within the root zone distance from the bank
- Erosion of stabilization pond bank or dike
- Excessive foliage or animal burrows in pond bank or dike
- Excessive weeds in stabilization ponds
- Foaming and spray in aerated lagoon
- Dead fish or aquatic organisms
- Buildup of solids around influent pipe
- Excessive scum on surface

SECONDARY CLARIFIER

General Indicators

- Excessive gas bubbles on surface.
- Fouling of overflow weirs.
- Unlevel overflow weirs.
- Evidence of short circuiting.
- Excessive buildup of solids in center well of circular clarifier.
- Deflocculation in clarifier.
- Pin floc in overflow.
- Ineffective scum rake.
- Floating sludge on surface; rising sludge or bulking sludge.
- Billowing sludge.
- Excessively high sludge blanket.
- Clogged sludge withdrawal ports on secondary clarifier for either sludge wasting or sludge return.
- Unequal sludge blanket levels in parallel units.
- Inappropriate return and wasting rates.
- Poor maintenance of sludge pumps (leaking) or pump gallery.

ADVANCED PHYSICAL TREATMENT UNITS

Filtration

- Filter surface clogging

- Short filter run
- Air displacement of gravel media
- Formation of mud balls in filter media
- Air binding of filter media
- Loss of filter media during backwashing
- Recycled filter backwash water exceeding 5 percent
- Effluent TSS and BOD levels exceeding 10 mg/L
- Excessive effluent turbidity

Microscreening

- Erratic rotation of microscreen drums
- Plugging
- Drive system noisy or overheating
- Backwash exceeding 5 percent of flow treated

Activated Carbon Adsorption

- Excessive biological growth resulting in strong odor
- pH above 9.0 standard units (S.U.)
- Plugged carbon pores
- Presence of carbon dust in effluent
- Excessive carbon regeneration

Nitrification

- Hydraulic overload
- Inadequate pH control/chemical addition
- Low DO (<2 mg/L) in the aeration basin
- Pin floc in final effluent
- Sludge rising because of gasification in secondary clarifier

Denitrification

- Air temperature below 15°C
- pH below 6.0 S.U. or above 8.0 S.U.
- Excessive methanol or other chemical additions
- Septic sludge conditions.

Ammonia Stripping

- Excessive hydraulic loading rate
- Tower packing coated with calcium carbonate
- pH below 10.8 S.U.
- Inadequate tower packing depth

- Air temperature below 65°F (18 °C)

DISINFECTION

Chlorination

- Sludge buildup in contact chamber
- Gas bubbles
- Inadequate retention time (typically 30 minutes at peak flow conditions)
- Floating scum and/or solids
- Evidence of short circuiting (poor tank baffling)
- Inadequate ventilation of chlorine feeding room and storage area
- High temperatures in chlorination rooms
- Improper operation of automatic feed or feedback control
- Excessive foaming downstream
- Evidence of toxicity downstream (dead fish, other dead organisms)
- Improper chlorine feed, storage, and reserve supply
- Leak detection equipment is tied into the plant alarm system
- Self-Contained Breathing Apparatus (SCBA) available on-site
- Proper training in use of SCBA
- Lack emergency SOP and/or RMP (Risk Management Plan)
- No chlorine repair kit available

Dechlorination

- Improper storage of sulfur dioxide cylinders.
- Inadequate ventilation of sulfur dioxide feeding room.
- Automatic sulfur dioxide feed or feedback control not operating properly.
- Depressed DO after dechlorination.
- Improper storage and mixture of sodium metabisulfite containers.
- Reduced efficiency of activated carbon dechlorination units because of organic and inorganic compound interference.
- No SCBAs available on-site.
- Improper training in use of SCBA.
- No emergency SOP and/or RMP.

Ultraviolet (UV)

- Quartz sleeves not kept clean
- Bulbs are not all operational
- Effluent has high turbidity
- Fecal coliform tests show inadequate bacterial kill

SLUDGE HANDLING

General Indicators

- The facility does not waste sludge.
- Inadequate sludge removal from clarifiers or thickeners.
- Poor dewatering characteristics of thermal treated sludge.
- Thickened sludge too thin.
- Fouling of overflow weirs on gravity thickeners.
- Air flotation skimmer blade binding on beaching plate.
- Unordinary down time of sludge treatment units.
- Sludge disposal inadequate to keep treatment system in balance - storing excess sludge inventory within other treatment units such as activated sludge basin, or clarifiers due to inadequate sludge wasting capabilities.
- Mass balance inappropriate (ratio of sludge wasted should be 0.65-0.85 lbs. of sludge per lb. of Biochemical Oxygen Demand (BOD) removed).
- Sludge decant or return flows high in solids.
- Odors.
- Improper loading rates.
- Lack of adequate process control (unit removal efficiencies, DO, sludge age, F:M ratio, etc.).

Sludge Anaerobic Digestion

- Inoperative mechanical or gas mixers
- Inoperative sludge heater or low temperature
- Inadequate gas production
- Unexpected gas composition
- Floating cover of digester tilting
- Inoperative gas burner
- Supernatant emitting a sour odor from either primary or secondary digester
- Excessive suspended solids in supernatant
- Supernatant recycle overloading the Wastewater Treatment Plant (WWTP)
- pH problems

Sludge Aerobic Digestion

- Excessive foaming in tank
- Objectionable odor in aerobically digested sludge
- Insufficient dissolved oxygen in digester
- Digester overloaded
- Clogging of diffusers in digester
- Mechanical aerator failure in digester

- Inadequate supernatant removal from sludge lagoons
- Solids accumulation in tank

Sludge Dewatering

- Drying beds
  - Poor sludge distribution on drying beds
  - Vegetation in drying beds (unless reed design)
  - Dry sludge remaining in drying beds (storage)
  - Inadequate drying time on drying beds
  - Some unused drying beds
  - Dry sludge stacked around drying beds where runoff may enter navigable waters
  - Filtrate from sludge drying beds returned to front of plant
  - Inadequate sludge wasting capabilities as indicated by all beds being full, and high solids inventory within the treatment units

- Centrifuge
  - Excessive solids in fluid phase of sample after centrifugation
  - Inadequate dryness of centrifugal sludge cake
  - Excessive vibration or other mechanical problems

- Filter press
  - High level of solids in filtrate from filter presses or vacuum filters
  - Thin filter cake caused by poor dewatering
  - Vacuum filter cloth binding
  - Low vacuum on filter
  - Improperly cleaned vacuum filter media
  - Sludge buildup on belts and/or rollers of filter press
  - Excessive moisture in belt filter press sludge cake
  - Difficult cake discharge from filter presses
  - Filter cake sticks to solids-conveying equipment of filter press
  - Frequent media binding of plate filter press
  - Sludge blowing out of filter press
  - Insufficient run time of sludge dewatering equipment

Sludge Stabilization

- Lagoon
  - Objectionable odor from sludge lagoon
  - Damage to dikes around sludge drying lagoons
  - Unlined sludge lagoons

  - Sludge lagoons full, overflowing sludge back to plant or to natural drainage
  - Deep rooted vegetation on dikes or berms

- Composting
  - Piles that give off foul odor
  - Inoperable blower
  - Temperature does not reach 122–140°F (50–60°C)
  - Uncontrolled stormwater runoff

- Heat drying/pelletizing
  - Excess moisture in sludge feed
  - Insufficient air flow or drying temperature achieved
  - Inadequate drying of final product (excess moisture in final product)
  - Excess odors associated with treatment area
  - Excess odors associated with treated product

- Alkaline stabilization
  - Insufficient amount of lime (or other alkaline additive) used to ensure pH is raised sufficiently.
  - Inadequate mixing provided to ensure good contact of lime (or other alkaline additive) with sludge solids.
  - pH problems.
  - Excess odors associated with treatment area.
  - Excess odors associated with treated product.
  - Excessive lime dust around treatment equipment.

- Incineration
  - Objectionable odors associated with treatment area
  - Evidence of excessive ash around unit
  - Visible smoke or dust exhaust from unit
  - Noncompliance with air permit parameters
  - Spilling or leaking sludge from dewatered sludge transfer equipment

- Sludge disposal
  - Sludge constituents not analyzed before disposal
  - Sludge not transported in appropriate and approved vehicle
  - Surface runoff of sludge at land application site
  - Liquid sludge (i.e., less than 10 percent solids) applied to landfill site
  - Sludge fails paint filter test
  - Inadequate coverage of sludge in subsurface plow injection system

- Objectionable odors generated at land application site
- Slow drying of soil-sludge mixture in subsurface injection system
- Sludge pooling at land application sites
- Breeding flies, vectors, and/or odors at landfill site
- Inadequate burial of sludge at landfill site
- Excessive erosion at sludge sites
- Sludge disposed of in unpermitted sites
- Disposal not in accordance with federal, state, or local regulations
- Sludge lagoons full and overflowing
- Inadequate runoff control at landfill or land application sites

POLISHING PONDS OR TANKS

- Objectionable odor, excessive foam, floating solids, or oil sheens in polishing ponds or tanks.
- Solids or scum accumulations in tank or at side of pond.
- Evidence of bypassed polishing ponds or tanks.

PLANT EFFLUENT

- Excessive suspended solids, turbidity, foam, grease, scum, color, and other macroscopic particulate matter present.
- Potential toxicity (dead fish, dead plants at discharge).
- Stained sediments in receiving waters.
- Sludge in the receiving water, anaerobic sediments, and blood worms.
- Low dissolved oxygen content.
- Eutrophication.

FLOW MEASUREMENT

- Improper placement of flow measurement device.
- Flow totalizer not calibrated.
- Buildup of solids in flume or weir.
- Broken or cracked flume or weir.
- Improperly functioning magnetic flowmeter.
- Clogged or broken stilling wells.
- Weir plate edge corroded or damaged; i.e., not sharp edged (< 1/8"), or not level.
- System not capable of measuring maximum flow.
- Sizing of system adequate to handle flow range.
- Flow measurement error greater than ± 10 percent.
- Flow measurement that includes all wastewater discharged and does not include wastestreams that are recirculated back to the treatment plant.

CHEMICAL TREATMENT UNITS

- Evidence of heavy corrosion
- No portion-measuring device at feed unit
- pH measuring not evident at pH adjustment tank
- Chemicals left open when they should be closed
- Chemicals outdated
- Chemical containers stored improperly or hazardously
- Inappropriately stored, moved, or handled chemical tank cars (trucks or train)
- Spilled dry chemicals on floor between storage area and feed units
- Improperly disposed of empty chemical containers
- Large containers handled improperly, container transfer equipment not maintained
- No appropriate sized berms or dikes at liquid chemical feed units
- Inadequate supply of chemicals
- Chemical dust covering feed unit area or, storage and transfer areas
- Use of an inappropriate coagulant
- Improperly stored or handled glass carboys (acid storage)

STANDBY POWER AND ALARMS

- Emergency generator with no automatic switch-over.
- Generator not regularly checked and exercised.
- No separate electrical substation feed line.
- Portable generators with quick connects.
- Portion of plant operated by the standby power.
- Treatment units and headworks equipped with alarms to notify operations staff of unit failure or loss of power.
- System for Supervisory Control and Data Available (SCADA):
  - Only large facilities tend to have this equipment.
  - SCADA to monitor and operate lift station in the collection system.

GENERAL HOUSEKEEPING

- Facility control panel in disrepair or not in use
- Wastewater pipelines not clearly distinguished from product pipelines
- Spills or leaks in dry areas not remediated in a timely manner

PRODUCTION CHANGES

- For a POTW, change in service area.
- For a POTW, increase or decrease in intake flows from industrial, commercial, or domestic sectors.

- For an IU, change in production volume.
- For an IU, large alteration of processes (inputs, temperature, etc.).

C. PERMIT COMPLIANCE AND OPERATION AND MAINTENANCE EVALUATION

In addition to the physical inspection of the plant, inspectors should also evaluate the operation and maintenance of the plant equipment and the facility's compliance with their permit requirements. When the physical inspection findings indicate that specific practices of the facility contribute to or cause problems, the inspector should detail the problems and use that information to evaluate the operation and maintenance procedures.

Inspectors should interview various staff to provide a better idea of what is happening on-site. If conflicting information is received during staff interviews, make sure to clarify this information before leaving the site. If the staff does not clearly answer a question, rephrase the question and ask it later during the inspection. The inspector should interview facility staff to:

- Gather background information.
- Determine normal operation and maintenance procedures.
- Evaluate knowledge and ability.
- Determine the number of operation, maintenance, laboratory, and other essential staff.

The inspector should also review the following records as needed:

- Operator logs
- Operations and maintenance records
- Operations and maintenance manual
- Sampling and laboratory records
- Monitoring reports

COMPLIANCE EVALUATION

The inspector should bring to the inspection a few submitted Discharge Monitoring Reports (DMRs) to compare with the monitoring reports kept on-site. To evaluate compliance with permit requirements, the inspector should:

- Compare monitoring report data to the permit requirements and verify that all non-compliance has been reported, monitoring requirements have been met, and analysis is in accordance with permit requirements.
- Compare the laboratory data to reported data to ensure transcription errors have not occurred and ensure all data on the DMR is accurate.
- Evaluate laboratory analytical procedures and methods to ensure the accuracy of the effluent discharge data.
- Randomly check calculations to evaluate accuracy of reported data.

OPERATION EVALUATION

Operating factors affecting plant performance range from qualitative factors such as the skills and aptitudes of operators (e.g., process knowledge and general aptitude), to physical deficiencies in laboratory equipment or a lack of flexibility in process equipment. The evaluation of operation functions must focus on wastewater treatment, sludge treatment/disposal, and laboratory analysis. The evaluation should be based on the following topics:

- Policies and procedures
- Organization
- Staffing and training
- Planning
- Management controls

Although each of the preceding evaluation topics should be covered in the review of operation functions, the four areas discussed in the following paragraphs should particularly concern the inspector:

Policies and Procedures

Written operating procedures and standard reference texts enable the operator to achieve efficient plant operation. The operations manual prepared for the facility is the most important reference that an inspector should review when evaluating plant policies and procedures. Other reference materials relating to operations that should be available to the operator include manufacturers' literature, publications by professional organizations (e.g., the Water Environment Federation), and EPA publications.

Staffing and Training

Even the best engineered facility cannot perform to its potential without enough capable and qualified staff. The inspector must consider the abilities and limitations of the operating staff. Most states have some type of certification program for operators. The inspector may inquire about how many of the staff has been trained and to what degree staff is certified. Staff interviews may include the individual in charge of the overall operation, the chief operator, specific unit process operators, and laboratory staff. The inspector should ascertain the hours the facility is manned and unmanned. If the facility is regularly unmanned, the inspector should inquire about unit alarms, in the event of equipment failure or loss of power, alarm telemetry or autodialers, facility response procedures and whether there have been any unit bypasses as a result of the plant being unmanned.

Health and Safety

At all times, the facility should follow safe operating procedures. Employees must be trained in emergency shut-down, fire control, and spill response procedures, as well as in the use of safety equipment, safe sampling techniques, and safe handling of chemicals and wastes. Employees should not enter confined spaces unless properly trained and equipped. Managers must be aware of the Occupational Safety and Health Administration (OSHA) Right-to-Know

laws regarding potentially dangerous chemicals in the workplace. This law specifically requires a written hazard communication program, labeling of chemicals, and the availability of material safety data sheets to employees upon request. Safety practices specified in the NPDES permit should be verified by the inspector, however, if safety concerns unrelated to the permit are observed, the facility should be referred to OSHA to address the concern.

Management Controls

Monitoring practices are a good indicator of both the emphasis placed on operations and the operator's understanding of process controls. Factors affecting a facility's monitoring capabilities include the following:

- The sampling program
- Performance testing
- Analytical capabilities
- Recordkeeping practices

An effective process control program is essential to a treatment facility's optimal performance. In most cases, the inspector will rely on discussions with the plant superintendent and/or operators to supplement available records and the technical evaluation. The key considerations for effective process controls include the following:

- Process control data
- Process knowledge of the operators
- The basis for the control practices
- Implementation of the control practices
- Past performance
- Operator emphasis on controls
- Recordkeeping

Table 4-1 presents the basic review questions that an inspector should ask in evaluating operation functions.

Table 4-1. Operation and Maintenance Function Evaluation Questions

Policies and Procedures
• Is there a formal or informal set of policies for facility operations? • Do policies address: — Compliance with permit? — Maintaining process controls? — Quality control? — Preventive maintenance? • Is there a set of standard procedures to implement these policies? • Are the procedures written or informal?

Table 4-1. Operation and Maintenance Function Evaluation Questions

- Do the procedures consider the following areas?
  - Collection system
  - Emergency
  - Energy conservation
  - Equipment record system
  - Inventory management
  - Labor relations scheduling
  - Laboratory
  - Maintenance planning
  - Monitoring
  - Operating procedures
  - Process control
  - Pumping stations
  - Safety
  - Sludge disposal
  - Treatment chemical supply
  - Treatment process
  - Work orders
- Are the procedures followed?

Organization

- Is there an organizational plan (or chart) for operations?
- Does the plan include:
  - Delegation of responsibility and authority?
  - Job descriptions?
  - Interaction with other functions (such as maintenance)?
- Is the plan formal or informal?
- Does staff have access to and understand the plan?
- Does the facility follow the plan?
- Is the plan consistent with policies and procedures?
  - Is the plan flexible?
  - Can it handle emergency situations?
  - Does the plan clearly define lines of authority and responsibility in the following subfunctional areas?
    - Laboratory
    - Monitoring practices
    - Process control
    - Mechanical
    - Instruments
    - Electrical
    - Sludge disposal
    - Buildings and grounds
    - Collection system
    - Automotive
    - Pumping stations
    - Supplies and spare parts

Staffing

- Is there an adequate number of staff to achieve policies and procedures?
- Are staff members adequately qualified for their duties and responsibilities by demonstrating the following:
  - Certification
  - Qualifications
  - Ability

Table 4-1. Operation and Maintenance Function Evaluation Questions

- Job performance
- Understanding of treatment processes

- Is staff used effectively to support plant activities?
- Has the potential for borrowing personnel from other plants been considered?
- Are training procedures followed for:
  - Orientation of new staff?
  - Training new operators?
  - Training new supervisors?
  - Continuing training of existing staff?
  - Cross training staff between plant jobs needing more staff/support?
- Which of the following training procedures are used?
  - Formal classroom
  - Home study
  - On-the-job training
  - Participation in professional organization
- Does the training program provide specific instruction for the following operations and maintenance activities?
  - Automotive
  - Building maintenance
  - Electrical
  - Emergency procedures
  - Equipment troubleshooting
  - Handling personnel problems
  - Instrumentation
  - Inventory control
  - Laboratory procedures
  - Mechanical
  - Monitoring practices
  - Safety
  - Treatment processes
- Does management encourage staff motivation?
- Does management support its first-line supervisors?
- Is staff motivation maintained through any of the following tools?
  - Encouragement for training
  - Job recognition
  - Job security
  - Promotional opportunities
  - Salary incentives
  - Working environment

Operations

- How does the facility establish operating schedules?
- Do schedules attempt to attain optimum staff utilization?
- Are line supervisors included in manpower scheduling?
- Are staff involved in and/or informed of manpower planning?
- Is there sufficient long-term planning for staff replacement and system changes?

Table 4-1. Operation and Maintenance Function Evaluation Questions

- Are there procedures in manpower staffing for emergency situations?
- How are process control changes initiated?
- How do process control changes interact with management controls?
- How are laboratory results used in process control?
- Are there emergency plans for treatment control?
- Is there an effective energy management plan? Is the plan used?
- To what extent are operations personnel involved in the budget process?
- Do budgets adequately identify and justify the cost components of operations?
- Are future budgets based on current and anticipated operating conditions?
- Do operating and capital budget limits constrain operations?
- Can budget line items be adjusted to reflect actual operating conditions?

Maintenance

- Are maintenance activities planned? Is the planning formal or informal?
- Does the facility have sufficient management controls to affect realistic planning and scheduling? If the controls exist, are they used?
- Are operating variables exploited to simplify maintenance efforts?
- To what extent are the supply and spare part inventories planned in conjunction with maintenance activities?
- Have minimum and maximum levels been established for all inventory items?
- Does the facility have a maintenance emergency plan?
- Is the maintenance emergency plan current? Is the staff knowledgeable about emergency procedures?
- Does a plan exist for returning to the preventive maintenance mode following an emergency?
- Are preventive maintenance tasks scheduled in accordance with manufacturer's recommendations?
- Is adequate time allowed for corrective maintenance?
- Are basic maintenance practices (preventive and corrective) and frequencies reviewed for cost-effectiveness?
- Do the management controls provide sufficient information for accurate budget preparation?
- Does the maintenance department receive feedback on cost performance to facilitate future budget preparation?
- To what extent are maintenance personnel involved in the budget process?
- Do budgets adequately identify and justify the cost components of maintenance?
- Are future budgets based on current and anticipated operating and maintenance conditions?
- Do maintenance and capital budget limits constrain preventive maintenance (equipment replacement and improvements)?
- Does the maintenance department receive adequate feedback on cost performance?
- Can budget line items be adjusted to reflect actual maintenance conditions?

Management Controls

- Are current versions of the following documents maintained?
  - Operating reports
  - Work schedules

Table 4-1. Operation and Maintenance Function Evaluation Questions

- Activity reports
- Performance reports (labor, supplies, energy)
- Expenditure reports (labor, supplies, energy)
- Cost analysis reports
- Emergency and complaint calls
- Process control data, including effluent quality

- Do the reports contain sufficient information to support their intended purpose?
- Are the reports usable and accepted by the staff?
- Are the reports being completed as required?
- Are the reports consistent among themselves?
- Are the reports used directly in process control?
- Are the reports reviewed and discussed with operating staff?
- What types of summary reports are required?
- To whom are reports distributed and when?

Management Controls (Maintenance)

- Does a maintenance record system exist? Does it include the following?
  - As-built drawings
  - Shop drawings
  - Construction specifications
  - Capital and equipment inventory
  - Maintenance history (preventive and corrective)
  - Maintenance costs
  - Equipment manuals
- Does the facility keep a current base record system as part of daily maintenance practices?
- Does the facility have a work order system for scheduling maintenance? Is it explicit or implicit?
- Which of the following do work orders contain?
  - Date
  - Location
  - Work requirements
  - Assigned personnel
  - Work order number
  - Nature of problem
  - Time requirements
  - Space for reporting work performed, required parts and supplies, time required, and cost summary
  - Responsible staff member and supervisory signature requirements
- When emergency work must be performed without a work order, is one completed afterward?
- Are work orders usable and acceptable by staff as essential to the maintenance program? Are they completed?

Table 4-1. Operation and Maintenance Function Evaluation Questions

- Is work order information transferred to a maintenance record system?
- Does a catalog or index system exist for controlling items in inventory?
- Are withdrawal tickets used for obtaining supplies from inventory?
- Do the tickets contain cost information and interact well with inventory controls and the work order system?
- Is the cost and activity information from work orders aggregated to provide management reports? Is this information also used for budget preparation?
- Is the maintenance performance discussed regularly with staff?
- How is the cost of contract maintenance or the use of specialized assistance recorded?
- Are safeguards and penalties adequate to prevent maintenance cards from being returned without the work being done?
- Is the preventive maintenance record checked after an emergency equipment failure?

MAINTENANCE EVALUATION

Facility maintenance directly affects the ability of the facility to run efficiently and to comply with its NPDES permit. The two types of facility maintenance are preventive maintenance and corrective maintenance:

- Preventive maintenance:
  - Reduces facility operating costs by eliminating breakdowns and the need for corrective maintenance.
  - Improves the facility's reliability by minimizing the time equipment is out of service.
  - Increases the useful life of equipment, thus avoiding costly premature replacement.
  - Avoids possible compliance violations.
- Corrective maintenance:
  - Returns malfunctioning equipment to operation
  - Avoids or minimizes possible violations

Evaluation of the maintenance function should focus on the ability to maintain process equipment, supply of treatment chemicals, vehicles, and building and grounds. Although each of the five evaluation topics (policies and procedures, organization, staffing, planning, and management controls) should be covered for each facility inspected, the principal areas of concern in the maintenance evaluation are:

- Staffing and training
- Planning and scheduling
- Management controls, including records systems and inventory control

Only well-trained, competent plant staff can be expected to perform adequate physical inspections, repairs, and preventive maintenance. Wastewater facility maintenance is complex and requires a variety of skills. An ongoing training program is essential because many of these skills are not readily available.

Maintenance planning and scheduling are essential to effective corrective and preventive maintenance. The maintenance supervisor should prepare work schedules listing job priorities, work assignments, available personnel, and timing.

A detailed records system is the basis of any maintenance program. Records are used to establish maintenance histories on equipment, diagnose problems, and anticipate—and thereby avoid—equipment failure, making records an effective tool for preventive maintenance.

A central inventory of spare parts, equipment, and supplies should be maintained and controlled. The basis for the inventory should be the equipment manufacturer's recommendations, supplemented by specific, historical experience with maintenance problems and requirements. Inventoried supplies should be kept at levels sufficient to avoid process interruptions.

A maintenance cost control system should be an integral part of every wastewater facility. Budgets must be developed from past cost records and usually are categorized according to preventive maintenance, corrective maintenance, and projected and actual major repair requirements. Annual costs must be compared to the budget periodically to control maintenance expenditures. Evaluating costs this way serves to control expenditures and provides a baseline for future budgets.

The basic concerns that need to be addressed and evaluated during the inspector's maintenance program review are presented in Table 4-1. These questions may help identify the causes of a facility's operation and maintenance problems.

D. REFERENCES

The following is a list of resources providing more information on wastewater treatment facilities and their processes.

U.S. Environmental Protection Agency. (1973). *Maintenance Management Systems for Municipal Wastewater Facilities.* EPA 430/9-74-004.

U.S. Environmental Protection Agency. (1978). *Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities.* MO No. 16, EPA 430/9-78-001.

U.S. Environmental Protection Agency. (1979). *Inspector's Guide for Evaluation of Municipal Wastewater Treatment Plants*. EPA 430/9-79-010.

U.S. Environmental Protection Agency. (1982). *Comprehensive Diagnostic Evaluation and Selected Management Issues*. EPA 430/9-82-003.

U.S. Environmental Protection Agency. (1999a). *Wastewater Technology Fact Sheet Ozone Disinfection*. EPA 832-F-99-063.

U.S. Environmental Protection Agency. (1999b). *Wastewater Technology Fact Sheet Ultraviolet Disinfection*. EPA 832-F-99-064.

U.S. Environmental Protection Agency. (2000a). *Biosolids Technology Fact Sheet Centrifuge Thickening and Dewatering*. EPA 832-F-00-053.

U.S. Environmental Protection Agency. (2000b). *Biosolids Technology Fact Sheet Belt Filter Press*. EPA 832-F-00-057.

U.S. Environmental Protection Agency. (2000c). *Decentralized Systems Technology Fact Sheet Aerobic Treatment*. EPA 832-F-00-031.

U.S. Environmental Protection Agency. (2000d). *Decentralized Systems Technology Fact Sheet Evapotranspiration*. EPA 832-F-00-033.

U.S. Environmental Protection Agency. (2000e). *Guide for Evaluating Capacity, Management, Operation, and Maintenance Programs at Wastewater Treatment Plants*. EPA 300-B-00-015.

U.S. Environmental Protection Agency. (2000f). *Wastewater Technology Fact Sheet Ammonia Stripping*. EPA 832-F-00-019.

U.S. Environmental Protection Agency. (2000g). *Wastewater Technology Fact Sheet Chemical Precipitation*. EPA 832-F-00-018.

U.S. Environmental Protection Agency. (2000h). *Wastewater Technology Fact Sheet Dechlorination*. EPA 832-F-00-022.

U.S. Environmental Protection Agency. (2000i). *Wastewater Technology Fact Sheet Force Main Sewers*. EPA 832-F-00-071.

U.S. Environmental Protection Agency. (2000j). *Wastewater Technology Fact Sheet Granular Activated Carbon Adsorption and Regeneration*. EPA 832-F-00-017.

Water Environment Federation (WEF). (1992). *Wastewater Treatment Plant Design*. MOP No. 8.
Water Pollution Control Federation (WPCF). (1990). *Operation of Wastewater Treatment Plants*. MOP No. 11.

E. FACILITY SITE REVIEW CHECKLIST

The following is an example of a checklist that may be used by inspectors at a facility site review.

A. Operation and Maintenance Evaluation			
Yes	No	N/A	1. Facility properly operates and maintains treatment units
Yes	No	N/A	2. Facility has standby power or other equivalent provision.
Yes	No	N/A	3. Adequate alarm system for power or equipment failures is available.
			4. Sludge disposal procedures are appropriate:
Yes	No	N/A	a. Disposal of sludge according to regulations
Yes	No	N/A	b. State approval for sludge disposal received.
Yes	No	N/A	5. All treatment units, other than backup units, are in service.
Yes	No	N/A	6. Facility follows procedures for facility operation and maintenance.
Yes	No	N/A	7. Sufficient sludge is disposed of to maintain treatment process equilibrium.
Yes	No	N/A	8. Organizational Plan (chart) for operation and maintenance is provided.
Yes	No	N/A	9. Plan establishes operating schedules.
Yes	No	N/A	10. Facility has written emergency plan for treatment control.
			11. Maintenance record system exists and includes:
Yes	No	N/A	a. As-built drawings
Yes	No	N/A	b. Shop drawings
Yes	No	N/A	c. Construction specifications
Yes	No	N/A	d. Maintenance history
Yes	No	N/A	e. Maintenance costs
Yes	No	N/A	f. Repair history
Yes	No	N/A	g. Records of equipment repair and timely return to service.
Yes	No	N/A	12. Adequate number of qualified operator's on-hand.
Yes	No	N/A	13. Facility has established procedures for training new operators.
Yes	No	N/A	14. Facility maintains adequate spare parts and supplies inventory.
Yes	No	N/A	15. Facility keeps instruction files for operation and maintenance of each item of major equipment.
Yes	No	N/A	16. Operation and maintenance manual is available.
Yes	No	N/A	17. Regulatory agency is notified of any bypassing. (Dates: _____)
			18.
Yes	No	N/A	a. Hydraulic overflows and/or organic overloads are experienced.
Yes	No	N/A	b. Untreated bypass discharge occurs during power failure.
Yes	No	N/A	c. Untreated overflows occurred since last inspection. Reason:
Yes	No	N/A	d. Flows were observed in overflow or bypass channels.
Yes	No	N/A	e. Checking for overflows is performed routinely.
Yes	No	N/A	f. Overflows are reported to EPA or to the appropriate state agency as specified in the permit.

B. Safety Evaluation			
Yes	No	N/A	1. Facility uses undiked/unbermed oil/chemical storage tanks.
Yes	No	N/A	2. Facility maintains up-to-date equipment repair records.
Yes	No	N/A	3. Dated tags show out-of-service equipment. a. Proper facility/unit lock-out and tag-out procedures are being followed.
Yes	No	N/A	4. Facility schedules/performs routine and preventive maintenance on time.
Yes	No	N/A	5. Facility provides personal protective clothing (e.g., safety helmets, ear protectors, goggles, gloves, rubber boots with steel toes, eyewashes in labs).
			6. Safety devices are readily available:
Yes	No	N/A	a. Fire extinguishers.
Yes	No	N/A	b. Oxygen deficiency/explosive gas indicator.
Yes	No	N/A	c. Self-contained breathing apparatus near entrance to chlorine room.
Yes	No	N/A	d. Safety harness.
Yes	No	N/A	e. First aid kits.
Yes	No	N/A	f. Ladders to enter manholes or wet-wells (fiberglass or wooden for electrical work).
Yes	No	N/A	g. Traffic control cones.
Yes	No	N/A	h. Safety buoy at activated sludge plants.
Yes	No	N/A	i. Life preservers for lagoons.
Yes	No	N/A	j. Fiberglass or wooden ladder for electrical work.
Yes	No	N/A	k. Portable crane/hoist.
Yes	No	N/A	7. Plant has general safety structures such as rails around or covers over tanks, pits, or wells.
Yes	No	N/A	8. Emergency phone numbers are listed, including EPA and state.
Yes	No	N/A	9. Plant is generally clean, free from open trash areas.
Yes	No	N/A	10. Facility has available portable hoists, for equipment removal.
Yes	No	N/A	11. All plant personnel are immunized for typhoid, tetanus, and hepatitis B.
Yes	No	N/A	12. No cross connections exist between a potable water supply and non-potable source.
Yes	No	N/A	13. Gas/explosion controls such as pressure-vacuum relief values, no smoking signs, explosimeters, and drip traps are present near anaerobic digesters, enclosed screening or degritting chambers, and sludge-piping or gas-piping structures.
Yes	No	N/A	14. Facility has enclosed and identified all electrical circuitry.
Yes	No	N/A	15. Personnel are trained in electrical work to be performed as well as safety procedures.

			16. Chlorine safety precautions are followed:
Yes	No	N/A	a. NIOSH-approved 30-minute air pack?
Yes	No	N/A	b. All standing chlorine cylinders chained in place?
Yes	No	N/A	c. All personnel trained in the use of chlorine?
Yes	No	N/A	d. Chlorine repair kit available?
Yes	No	N/A	e. Chlorine leak detector tied into plant alarm system?
Yes	No	N/A	f. Chlorine cylinders stored in adequately ventilated areas?
Yes	No	N/A	g. Ventilation fan with an outside switch?
Yes	No	N/A	h. Posted safety precautions?
Yes	No	N/A	i. Existing emergency SOP and/or RMP or SPCC?
Yes	No	N/A	17. Facility has complied with the six employer responsibilities for the Worker Right-to-Know Law (P.A. 83-240)
Yes	No	N/A	18. Emergency Action Plan on file with local fire department and appropriate emergency agency.
Yes	No	N/A	19. Laboratory safety devices (eyewash and shower, fume hood, proper labeling and storage, pipette suction bulbs) available.
Yes	No	N/A	20. Facility post warning signs (no smoking, high voltage, non-potable water, chlorine hazard, watch-your-step, and exit).

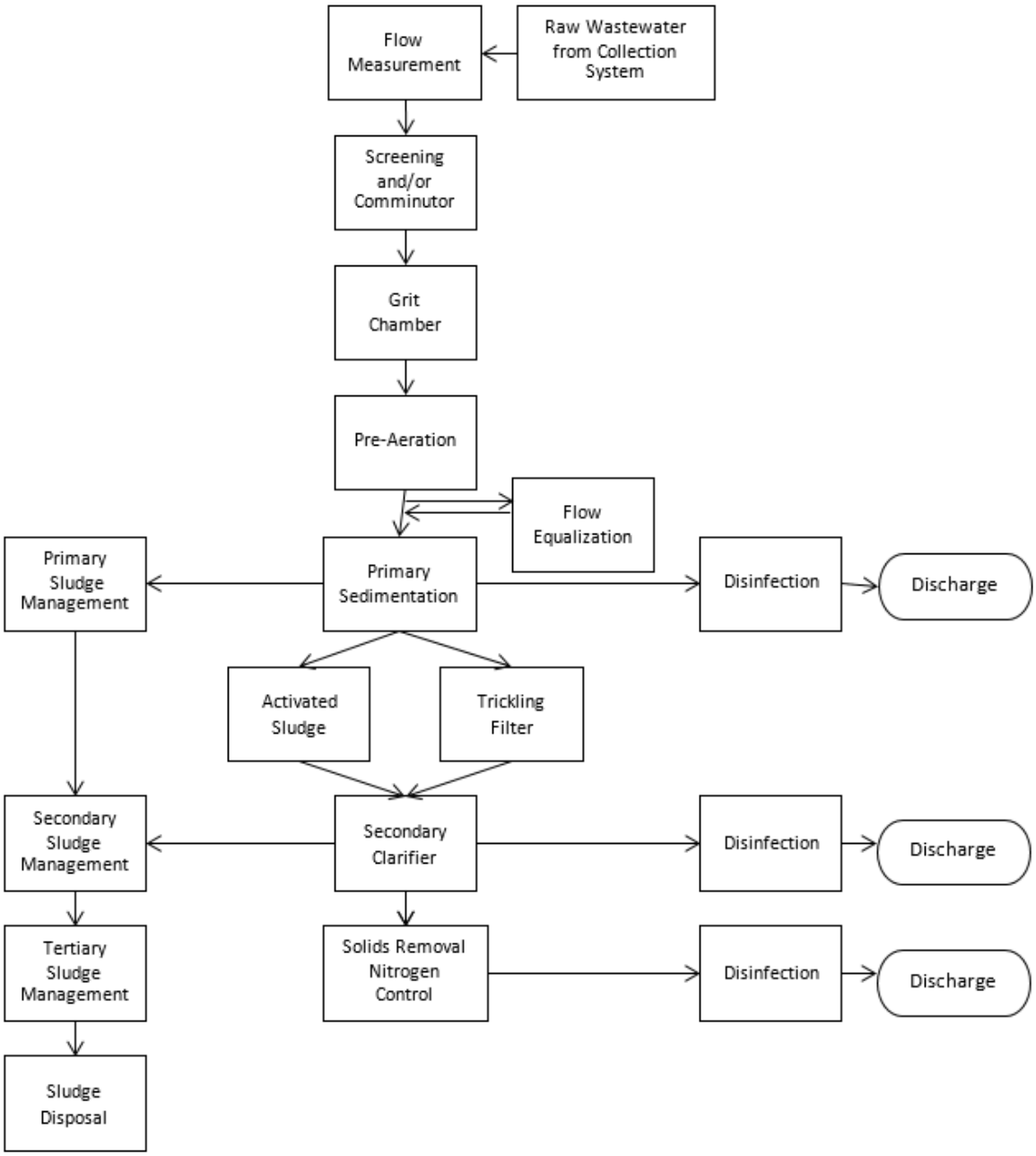

Exhibit 4-1. General Wastewater Treatment Flow Diagram