# CITY OF LYNNWOOD WTP CLASS II INSPECTION

by
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## ABSTRACT

A Class II Inspection was conducted at the City of Lynnwood Wastewater Treatment Plant on June 17-19, 1991. The effluent met NPDES permit requirements. A few priority pollutant compounds were found in WTP effluent, but levels were not sufficiently high enough to be a cause of concern. No pesticides/polychlorinated biphenyls (PCBs) or volatile organic compounds (VOCs) were found in the effluent. Three base neutral acid (BNA) compounds were detected in the effluent stream but were judged to be of little or no concern. No whole effluent toxicity was indicated by rainbow trout or fathead minnow. However, toxicity to *Ceriodaphnia dubia* was very evident: the 7-day survival and reproduction test resulted in 100% mortality in all dilutions of effluent. Also, some chronic toxicity was indicated by the echinoderm sand dollar sperm fertilization and inland silverside minnow bioassays. Among priority pollutant metals, barium was detected in sludge cake and ash leachate samples, but below the hazardous waste regulatory level. Influent five-day biochemical oxygen demand ($BOD_5$) load and flow exceeded 85% of design criteria.

## INTRODUCTION

The Washington State Department of Ecology (Ecology) conducted a Class II Inspection at the City of Lynnwood (CL) Municipal Wastewater Treatment Plant (WTP) in Lynnwood, Washington, on June 17-19, 1991 (Figure 1). Tapas Das, Norm Glenn, and Rebecca Inman from Ecology's Environmental Investigations and Laboratory Services Program (EILS) conducted the inspection. Dale Van Donsel and Perry Brake of EILS' Quality Assurance Section

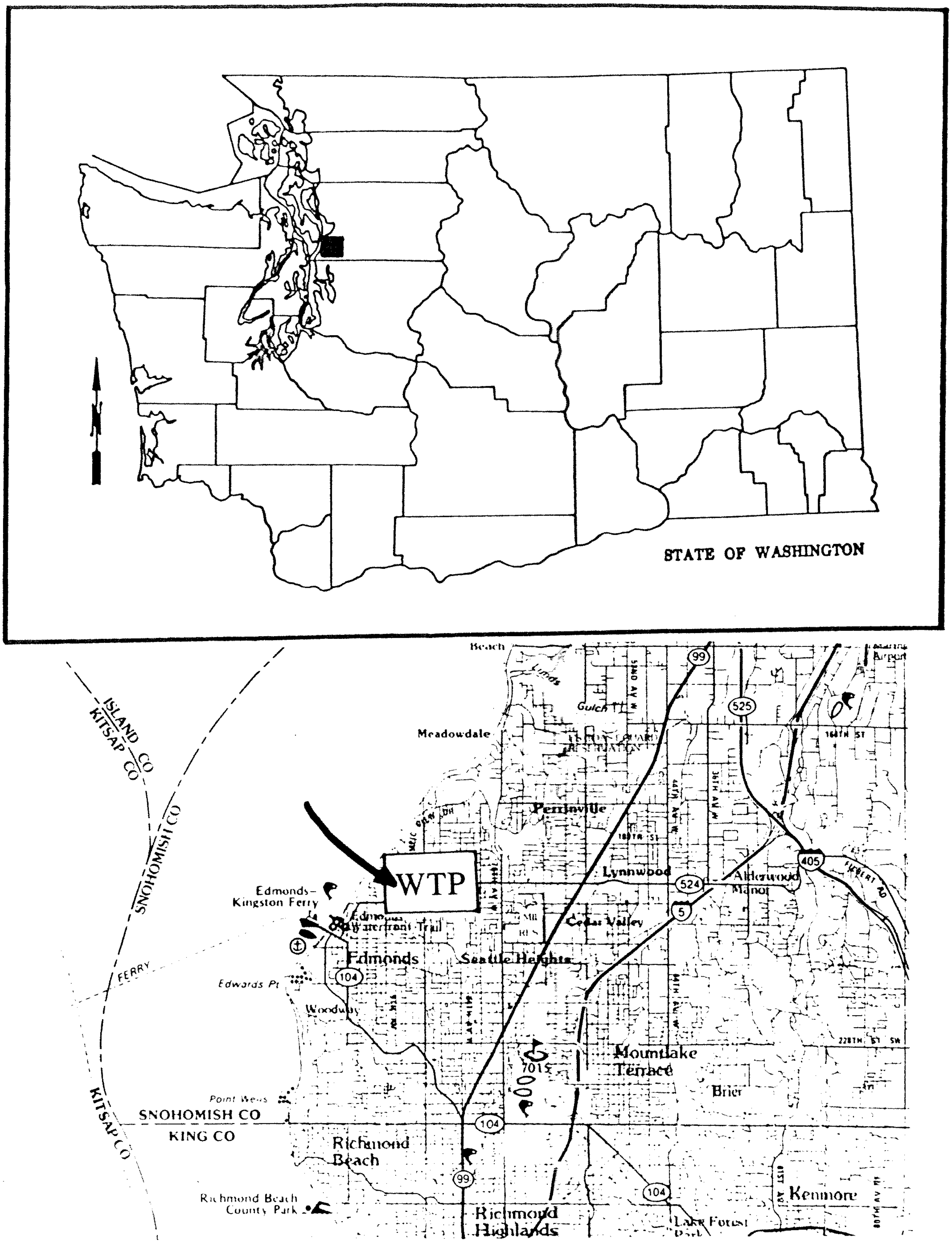


Figure 1. Location Map, City of Lynnwood WTP, June 1991.

conducted an on-site laboratory inspection on June 18. The inspection was requested by David Wright of the Ecology Northwest Regional Office (NWRO). Duke Dungan, lab manager and Don Davis, plant supervisor, provided assistance during the inspection.

Primary sources of wastewater to the facility are domestic sewage from residential and light commercial activities in the city and portions of the neighboring city of Edmonds. The CL discharge into Puget Sound is regulated by NPDES Permit No. WA-002403-1, which expired on August 1, 1992.

The original treatment plant was built in 1962 to provide primary treatment. The plant was upgraded in 1984, and underwent extensive modification to achieve secondary treatment capability in 1990 (Wright, 1992) (Figure 2). The existing wastewater treatment system consists of a mechanically cleaned bar screen, degritter, communitor, primary clarifier, aeration basin, secondary clarifier, chlorine contact chamber, Parshall flume, and sonic flow meter. Sludge removed from the clarifiers is hydraulically degritted, thickened by gravity, dewatered in a centrifuge, then incinerated in a fluidized bed reactor. Sludge ash from the incinerator is removed and disposed of by private disposal companies.

The WTP has a unique feature. The aeration basin is divided into four cells, designed to operate as follows:

- Cells 1 and 2 are small with short detention times. They operate in parallel as high oxygen-demand, low dissolved oxygen (D.O. $<0.3$ mg/L) zones. Soluble BOD is absorbed into the biological mass in these cells.

- Cell 3, with a much longer detention time, is designed for the removal of remaining soluble BOD and the more refractory colloidal and particulate BOD. The D.O. concentration in this cell is maintained in the range of 2-4 mg/L by the use of fine pore aeration.

- Cell 4 provides some residual BOD removal and serves as a stabilized zone. It is designed to operate at D.O. concentrations greater than 2 mg/L.

The compartmentalization, particularly the first two cells of the train, is designed to create an environment which favors the growth of floc-forming bacteria over the less desirable filamentous forms. The high food-to-microorganism (F/M) ratio, low D.O., and short detention time in cells 1 and 2 are believed to be the controlling environmental factors in this effect. The use of such an aeration basin configuration has proven successful at this WTP (Albertson, 1987).

Thickened primary sludge, gravity thickened waste activated sludge (WAS), and scum are mixed in a sludge blending tank and pumped to a centrifuge. The centrifuge dewaters the sludge mixture prior to incineration. The system is designed to achieve 92% recovery of suspended solids and produce a sludge cake with solids content of about 28%.

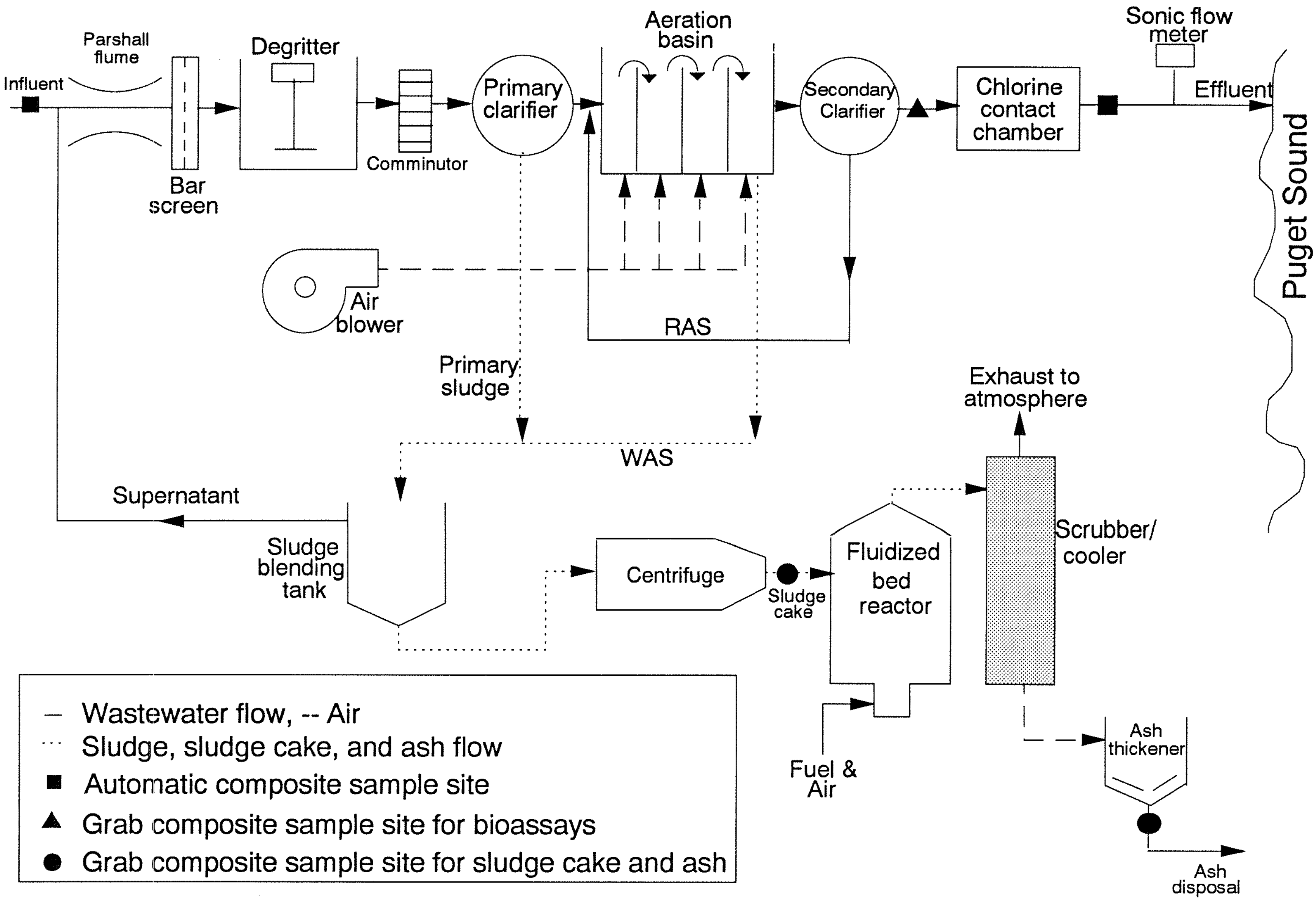


Figure 2. Plant schematic showing location of sampling sites, Lynnwood WTP, 6/91

Sludge cake is fed into an incinerator. Gases and ash produced by the combustion process are scrubbed. The ash-laden water is pumped to the ash thickener while the gas is discharged to the atmosphere. Settled ash from the thickener is further dewatered in a vacuum filter for final disposal in a landfill.

The WTP flow measuring devices are a Parshall flume and sonic flow meter installed at the influent and effluent stations, respectively (Figure 2).

Objectives of the inspection were:

- Assess effluent compliance with NPDES permit limits;
- chemically characterize influent, effluent, sludge cake and ash;
- determine effluent toxicity using rainbow trout, fathead minnow, *Ceriodaphnia dubia*, inland silverside minnow, and echinoderm sperm cell bioassays;
- split samples with the permittee to determine comparability of both sampling methods and laboratory analyses; and
- verify flow meter accuracy.

## PROCEDURES

Twenty-four hour composite samples and grab samples of wastewater were taken at two locations: (1) near the entrance to the Parshall flume; and (2) at the end of the chlorine contact chamber upstream of the sonic flow meter (Figure 2). ISCO® compositors were set for time proportional collection of 320 mL of sample every 30 minutes. The city of Lynnwood's influent and effluent composite samplers were installed at approximately the same locations. They were set for flow proportional collection, and took 250 mL of sample every 50,000 gallons.

The composite samplers were cleaned for priority pollutant sampling prior to the inspection (Table 1). Transfer blank samples were taken for volatile organic compounds (VOCs), base neutral acids (BNAs), pesticides/PCBs, and metals analyses.

Effluent grab samples for fecal coliform, VOCs, and oil and grease were collected at the end of the chlorine contact chamber. Hand composites, consisting of three consecutive grab samples of unchlorinated effluent, were taken for bioassay tests. They were collected at a wet well between the secondary clarifier and the chlorine contact chamber (Figure 2).

Grab-composite samples of sludge cake were collected at the exit of the centrifuge. Grab composites of dewatered sludge-ash produced in the incinerator were collected at the outlet of the ash thickener (Figure 2).

The sampling schedule and parameters analyzed are included in Table 2. All samples were held on ice until delivery to Ecology's Manchester Laboratory. A summary of the analytical methods and laboratories conducting the analyses is given in Appendix A.

Table 1. Priority Pollutant Cleaning and Field Transfer Blank Procedures, Lynnwood WTP, 6/91.

Priority Pollutant Sampling Equipment Cleaning Procedure

1. Wash with laboratory detergent (phosphate free).
2. Rinse several times with tap water.
3. Rinse with 10% nitric acid solution.
4. Rinse three times with distilled/deionized water.
5. Rinse with high purity methylene chloride.
6. Rinse with high purity acetone.
7. Allow to dry and seal with aluminum foil.

Field Transfer Blank Procedure

1. Pour organic free water directly into appropriate bottles for parameters to be analyzed from grab samples, namely VOCs.

2. Run approximately 1 liter of organic free water through a compositor and discard.

3. Run approximately 6 liters of organic free water through the same compositor and put the water into appropriate bottles for parameters to be analyzed from composite samples, namely BNA, Pesticides/PCBs, and priority pollutant metals.

Table 2 - Sampling Schedule and Parameters Analyzed - Lynnwood WTP, 6/91

| | Blank | Inf-E | Inf-L | Inf-1 | Eff-1 | Eff-E | Eff-L | Inf-2 | Eff-2 | Effluent | Sludge-C | Sludge-A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station: | Blank | Inf-E | Inf-L | Inf-1 | Eff-1 | Eff-E | Eff-L | Inf-2 | Eff-2 | Effluent | Sludge-C | Sludge-A |
| Type: | trans | comp | comp | grab | grab | comp | comp | grab | grab | grab-comp | grab-comp | grab-comp |
| Date: | 6/17 | 6/18-19 | 6/18-19 | 6/18 | 6/18 | 6/18-19 | 6/18-19 | 6/19 | 6/19 | 6/18-19 | 6/18 | 6/18 |
| Time: | 1545 | 845-845 | 845-845 | 910 | 945 | 855-855 | 855-855 | 1120 | 1100 | 1315-1315 | 1330 | 1400 |
| Parameter Lab ID#2582: | -30 | -31 | -32 | -33 | -34 | -35 | -36 | -37 | -38 | -39 | -40 | -41 |
| **GENERAL CHEMISTRY** | | | | | | | | | | | | |
| Conductivity | E | E | E | E | E | E | E | E | E | E | | |
| Alkalinity | | E | E | | E | E | E | | E | E | | |
| Hardness | | E | E | | E | E | E | | E | E | | |
| **SOLIDS 4** | | E/L | E/L | | E | E/L | E/L | | E | | | |
| % Solids | | | | | | | | | | | E | E |
| % Volatile Solids | | | | | | | | | | | E | E |
| BOD5 | | E/L | E/L | | E | E/L | E/L | | E | | | |
| TOC (water) | | E | E | | E | E | E | | E | | | |
| TOC (sludge) | | | | | | | | | | | E | E |
| NH3-N | | E | E | | | E | E | | | | | |
| NO2+NO3-N | | E | E | | | E | E | | | | | |
| Phosphorus - Total | | E | E | | | E | E | | | | | |
| Oil and Grease (water) | | | | E | E | | | E | E | | | |
| F-Coliform MPN | | | | | E/L | | | | E/L | | | |
| **ORGANICS** | | | | | | | | | | | | |
| VOCs (water) | E | | | E | E | | | E | E | | | |
| BNAs (water) | E | | | | | E | | | | | | |
| Pesticides/PCBs (water) | E | E | E | | | E | | | | | | |
| Phenol Total (water) | | E | E | | | | | | | | | |
| **METALS** | | | | | | | | | | | | |
| PP Metals | E | E | E | | | E | E | | | | | E |
| Iron | | | | | | E | E | | | | E | E |
| TCLP (sludge) | | | | | | | | | | | E | E |
| **BIOASSAYS** | | | | | | | | | | | | |
| Rainbow trout (acute) | | | | | | | | | | E | | |
| Ceriodaphnia dubia (chronic) | | | | | | | | | | E | | |
| Fathead minnow (acute) | | | | | | | | | | E | | |
| Inland Silverside (acute & chronic) | | | | | | | | | | E | | |
| Echinoderm (chronic) | | | | | | | | | | E | | |
| **FIELD OBSERVATIONS** | | | | | | | | | | | | |
| Temp | | E | E | E | E | E | E | E | E | E | | |
| pH | | E | E | E | E | E | E | E | E | E | | |
| Conductivity | | E | E | E | E | E | E | E | E | E | | |
| Chlorine Free | | | | | E | | | | E | | | |
| Total | | | | | E | | | | E | | | |

Inf - Influent
E - Analysis by Ecology
L - Analysis by Lynnwood
Eff - Effluent
C - Cake
A - Ash

## QUALITY ASSURANCE/QUALITY CONTROL

Laboratory quality assurance and quality control (QA/QC) methods used are described by Huntamer and Hyre (1991) and Kirchmer (1988). Recommended holding times were met for all analyses performed.

For VOC analyses, the gas chromatograph/mass spectrometer (GC/MS) met contract laboratory protocol (CLP) requirements (EPA, 1990a). All initial and continuing calibration verification standards were within the control limits of $\pm 20\%$. For organic analyses, matrix spike/spike duplicate recoveries for all samples, and the associated method blank data, were reasonable and acceptable, and within quality control (QC) limits (Smith, 1991; Magoon, 1992). However, results of lead and zinc were qualified indicating that the analytes were found in the transfer blank as well as in the sample (Table 3). All $BOD_5$ data were flagged by the laboratory with "J" qualifiers, indicating values were estimated. On the other hand, all $BOD_5$ data reported by CL lab were not estimated. Therefore, CL's results were used in calculating BOD loadings to the plant (Table 4).

The *Ceriodaphnia dubia* test was validated by achieving 80% survival of control test organisms, at least 15 young produced per control adult, and three broods of young produced by at least 60% of control adults. Response to the reference toxicant was within the range normally expected. Chemical analyses of test solution were appropriate for health of the test organisms (Stinson, 1991).

## RESULTS and DISCUSSION

### Flow

It was not possible to assess the accuracy of flow meters during the inspection because no suitable access point was found to install portable flow meters for field verification. Also, the Parshall flume was out of service, so a verification of correct installation, physical measurements, and calibration of the meter was not possible. The totalizer reading for a 24-hour time period beginning at 0800 on June 18 indicated 3.97 million gallons per day (MGD); this flow was used to calculate mass loadings for permit parameters. An access point would be desirable around the effluent outfall location, so that flow can be monitored independently during an inspection.

### General Chemistry and NPDES Permit Compliance

Conventional pollutant data collected during the inspection are tabulated in Table 5. Nutrient data indicated that no nitrification or denitrification were taking place. The plant performed well during the inspection; $BOD_5$ and total suspended solids (TSS) results indicated a well-treated effluent.

Table 3 – Comparison of Effluent Priority Pollutants to Water Quality Criteria – Lynnwood WTP, 6/91

| Parameter | Location: / Field Station: / Lab Sample #: | Blank Trans 258230 | Effluent Ecology 258235 | Effluent Lynnwood 258236 | Water Quality Criteria* (μg/L) Marine water Acute | Chronic |
|---|---|---|---|---|---|---|
| **Metals (μg/L), Tot Rec** | | | | | | |
| Lead | | 5 | 8 B | – | 140 | 5.6 |
| Zinc | | 21 | 43 B | 37 B | 95 | 86 |
| Iron, dissolved | | – | 520 | 470 | – | – |
| **BNAs (μg/L)** | | | | | | |
| Di-n-Butylphthalate | | 19 | 32 J | | – | – |
| Butylbenzylphthalate | | 16 | 3 J | | – | – |
| Bis(2-ethylhexyl)phthalate | | – | 5 J | | – | – |

* – EPA, 1986.
J – The analyte was positively identified. The associated numerical result is an estimate.
B – The analyte was found in the transfer blank as well as the sample, and indicates possible/probable blank contamination.

Table 4 - Comparison of Inspection Results to NPDES Permit Limits - Lynnwood WTP, 6/91

| | NPDES Permit Limits | | Inspection Data | | Plant Loading | | |
|---|---|---|---|---|---|---|---|
| | Monthly | Weekly | Ecology | Design | | Inspection | |
| Parameter | Average | Average | Composite | Criteria | 85% of DC | Results | % of DC |
| Influent BOD5 | | | | | | | |
| (mg/L) | | | 214+ | | | | |
| (lbs/day) | | | | 7,500 | 6,375 | 7,085 | 94 |
| Effluent BOD5 | | | | | | | |
| (mg/L) | 30* | 45 | 15+ | | | | |
| (lbs/day) | 1,005 | 1,510 | | | | 497 | |
| (% removal) | 85 | | | | | 93 | |
| Influent TSS | | | | | | | |
| (mg/L) | | | 156 | | | | |
| (lbs/day) | | | | 7,500 | 6,375 | 5,165 | 69 |
| Effluent TSS | | | | | | | |
| (mg/L) | 30* | 45 | 15 | | | | |
| (lbs/day) | 1,065 | 1,600 | | | | 497 | |
| (% removal) | 85 | | | | | 90 | |
| Fecal Coliform^^ | | | | | | | |
| (#/100 mL) | 200^ | 400 | 230;20 U | | | | |
| pH^^ (S.U.) | $6.0 \leq pH \leq 9.0$ | | $7.2 \leq pH \leq 7.5$ | | | | |
| Flow (MGD) | | | | 4.5 | 3.83 | 3.97 | 88 |

\+ Data obtained from CL's laboratory.
* or 15% of the respective influent concentrations, whichever is more stringent.
^ The average for fecal coliform bacteria is based on the geometric mean of the samples taken.
^^ Grab sample.
U The analyte was not detected at or above the reported result.

Table 5 - Results of General Chemistry Analyses - Lynnwood WTP, 6/91

| Station: | Blank | Inf-E | Inf-L | Inf-1 | Eff-1 | Eff-E | Eff-L | Inf-2 | Eff-2 | Effluent | Sludge-C | Sludge-A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type: | trans | comp | comp | grab | grab | comp | comp | grab | grab | grab-comp | grab-comp | grab-comp |
| Date: | 6/17 | 6/18-19 | 6/18-19 | 6/18 | 6/18 | 6/18-19 | 6/18-19 | 6/19 | 6/19 | 6/18-19 | 6/18 | 6/18 |
| Time: | 1545 | 0845-0845 | 0845-0845 | 0910 | 0945 | 0855-0855 | 0855-0855 | 1120 | 1100 | 1315-1315 | 1330 | 1400 |
| Parameter Lab ID#2582: | -30 | -31 | -32 | -33 | -34 | -35 | -36 | -37 | -38 | -39 | -40 | -41 |
| **GENERAL CHEMISTRY** | | | | | | | | | | | | |
| Conductivity, µmhos/cm | 2.04 | 457 | 472 | 435 | 485 | 477 | 476 | 453 | 470 | 479 | | |
| Alkalinity, mg/L $CaCO_3$ | | 133 | 141 | | 137 | 136 | 133 | | 134 | 136 | | |
| Hardness, mg/L $CaCO_3$ | | 51.5 J | 54.0 J | | 45.2 | 42.0 | 42.6 | | 42.2 | 41.6 | | |
| TS, mg/L | | 504 | 463 | | 308 | 296 | 279 | | 271 | | | |
| TNVS, mg/L | | 132 | 157 | | 147 | 152 | 140 | | 102 J | | | |
| TSS, mg/L | | 156 | 204 | | 13 | 15 | 17 | | 15 | | | |
| TNVSS, mg/L | | 3 | 13 | | 1 | 1 | 1 U | | 1 U | | | |
| % Solids | | | | | | | | | | | 23 | 58 |
| % Volatile Solids | | | | | | | | | | | 82 | 1.9 |
| BOD5, mg/L | | 700 J | 640 J | | 13 J | 17 J | 20 J | | <10 J | | | |
| TOC (water), mg/L | | 81.1 | 110 | | 30.9 | 27.2 | 22.8 | | 28.2 | | | |
| TOC (sludge) | | | | | | | | | | | 9.3* | 0.38* |
| $NH_3$-N, mg/L | | 23 | 24 | | | 22 | 20 | | | | | |
| $NO_2$+$NO_3$-N, mg/L | | 0.13 | 0.23 | | | 0.02 | 0.32 | | | | | |
| Phosphorus-T, mg/L | | 6.2 | 6.6 | | | 3.2 | 3.0 | | | | | |
| Phenol, mg/L | | 0.020 | 0.023 | | | | | | | | | |
| Oil & Grease, mg/L | | | | 58.5 | 7.96 | | | 38.7 | 0.95 | | | |
| F-Coliform, #/100 mL | | | | | 230 | | | | 20 U | | | |
| **FIELD OBSERVATIONS** | | | | | | | | | | | | |
| Temperature, °C | | 4.3^ | 7.9^ | 16.9 | 18.3 | 5.7^ | 5.7^ | 17.9 | 19.1 | 19.0 | | |
| pH, S.U. | | 7.7 | 7.6 | 7.5 | 7.2 | 7.6 | 7.7 | 7.2 | 7.2 | 6.9 | | |
| Conductivity, µmhos/cm | | 420 | 410 | 430 | 390 | 460 | 440 | 460 | 390 | 410 | | |
| Chlorine Residual, mg/L | | | | | | | | | | | | |
| Free | | | | | 0.1 | | | | 0.6 | | | |
| Total | | | | | 1.0 | | | | 0.7 | | | |

U - The analyte was not detected at or above the reported result.

J - The analyte was positively identified. The associated numerical result is an estimate.

* - % dry weight.

^ - Iced composite sample.

A comparison of effluent parameters to NPDES permit limits is presented in Table 4. The effluent met permit limits for $BOD_5$, TSS, and pH. However, the fecal coliform bacteria count on June 18 was 230 colony forming units (cfu) per 100 mL, which exceeded the monthly average limit. The permit also specifies that when the actual flow or waste load reaches 85% of design criteria, the permittee shall submit to Ecology a plan and schedule for continuing to maintain adequate capacity. Table 4 indicates $BOD_5$ loading and flow exceeded 85% of the design criteria.

**Effluent Priority Pollutant Scan**

A listing of priority pollutants detected in the effluent composite sample is presented in Table 3. A complete listing of effluent priority pollutant scan results is included in Appendix B. No volatile organic compounds (VOCs) or pesticides/PCBs were detected in the effluent stream. Among BNAs, three compounds were detected: all are commonly used as plasticizers for polyvinyl chloride and other polymers. Because of this, they are usually present in wastewater.

A summary of priority pollutant metals detected in transfer blank and WTP effluent samples is presented in Table 3. Most metals detected were at a concentration less than acute and chronic marine water quality criteria (EPA, 1986). Among these, lead was found in the transfer blank sample at 5.0 $\mu$g/L, and in effluent at 8.0 $\mu$g/L. Lead concentration in effluent was above the chronic marine water quality criterion. Zinc was detected in both transfer blank and effluent samples at 21.0 $\mu$g/L and 43.0 $\mu$g/L, respectively, below marine water quality criteria. However, these priority pollutant metals would not pose any threat if the receiving water dilution factors exceeded 2:1 under critical design conditions.

Iron was found in both Ecology and CL composite samples at 520 $\mu$g/L and 470 $\mu$g/L, respectively (Appendix B). Both concentrations were below the chronic freshwater quality criterion of 1,000 $\mu$g/L (EPA, 1986). Presently, there are no marine water quality criteria available for iron. However, it is worth mentioning here that the presence of iron in effluent was suspected due to the reddish-brown appearance of sludge cake and ash materials.

**Effluent Bioassays**

Bioassays determine the relative toxicity of WTP effluent by measuring the response of organisms to solutions containing various percentages of effluent and dilution water. For this inspection, rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas)*, water flea (*Ceriodaphnia dubia*), sand dollar (*Dendraster excentricus)*, and inland silverside minnow (*Menidia beryllina)* were used as test organisms. Results are given in Table 6.

No acute toxicity was indicated by rainbow trout or fathead minnow larvae. A No Observed Effects Concentration (NOEC) of 100% indicated no chronic toxicity to either species. Thus, the effluent had no apparent effect on vertebrates.

Table 6 - Effluent Bioassay Results - Lynnwood WTP, 6/91

Rainbow trout *(Oncorhynchus mykiss)* - 96 hour survival test
(Lab ID# 258239)

| Sample (% vol) | # Tested^ | Percent Survival |
|---|---|---|
| Control | 30 | 100 |
| 65 | 30 | 100 |
| 100 | 30 | 97 |

^ - Three replicates of ten organisms.
No Observed Effects Concentration (NOEC) - 100% effluent.

Fathead minnow larvae - 96 hour survival test
*(Pimephales promelas)*

| Concentration (% vol/vol) | Number Tested* | Average % Survival |
|---|---|---|
| Control | 20 | 100 |
| 6.25 | 20 | 90 |
| 12.5 | 20 | 100 |
| 25.0 | 20 | 100 |
| 50.0 | 20 | 100 |
| 100 | 20 | 90 |

* - Two replicates of ten organisms.
No Observed Effects Concentration (NOEC) - 100% effluent.
Lethal Concentration for 50% organisms (LC50) - 100% effluent.

Table 6 - continued - Lynnwood WTP, 6/91

*Ceriodaphnia dubia* - 7 day Survival and Reproduction Test

| Concentration (% vol) | # Tested^ | % Mortality | Average Number of Young/Female |
|---|---|---|---|
| Control | 10 | 10 | 32.3 |
| 6.25 | 10 | 100* | 0 |
| 12.5 | 10 | 100* | 0 |
| 25 | 10 | 100* | 0 |
| 50 | 10 | 100* | 0 |
| 100 | 10 | 100* | 0 |

^ - Ten replicates of one organism.
* - Results were found to be significantly different than the control.
No Observed Effects Concentration (NOEC) - <6.25% effluent.
Lethal Concentration for 50% organisms (LC50) - <6.25% effluent.

Echinoderm Sperm Fertilization - Sand dollar (Dendraster excentricus) - 1hr 30 mins chronic test

| Concentration (% vol) | Replicate | Percent of Eggs Fertilized | Average Percent per Concentration |
|---|---|---|---|
| Control | a | 84 | |
| | b | 93 | |
| | c | 91 | |
| | d | 98 | 89.3 |
| Brine Control | a | 89 | |
| | b | 91 | |
| | c | 94 | |
| | d | 90 | 91.0 |
| 3.13 | a | 6 | |
| | b | 12 | |
| | c | 15 | |
| | d | 45 | 11.8 |
| 6.25 | a | 10 | |
| | b | 8 | |
| | c | 13 | |
| | d | 13 | 11.0 |
| 12.5 | a | 17 | |
| | b | 15 | |
| | c | 12 | |
| | d | 6 | 12.5 |
| 25.0 | a | 20 | |
| | b | 13 | |
| | c | 17 | |
| | d | 13 | 15.8 |
| 45.0 | a | 40 | |
| | b | 46 | |
| | c | 31 | |
| | d | 51 | 42 |

NOEC - <3.13%

Table 6 - continued - Lynnwood WTP, 6/91

Inland Silverside larvae *(Menidia beryllina)* - 7 day Survival and Growth Test

| Concentration (% vol) | Replicate | Initial Count | Final Count | Percent Survival | Average Survival | Weight per Larvae (mg) | Average Weight (mg) |
|---|---|---|---|---|---|---|---|
| Control | a | 15 | 14 | 93.3 | | 1.7 | |
| | b | 15 | 12 | 80.0 | | 1.6 | |
| | c | 15 | 15 | 100 | 91.1 | 1.3 | 1.65 |
| 6.25 | a | 15 | 15 | 100 | | 1.6 | |
| | b | 15 | 15 | 100 | | 1.7 | |
| | c | 15 | 15 | 100 | 100 | 1.6 | 1.63 |
| 12.5 | a | 15 | 15 | 100 | | 1.6 | |
| | b | 15 | 15 | 100 | | 1.4 | |
| | c | 15 | 14 | 93.3 | 97.8 | 1.6 | 1.53 |
| 25 | a | 15 | 14 | 93.3 | | 1.6 | |
| | b | 15 | 15 | 100 | | 1.7 | |
| | c | 15 | 15 | 100 | 97.8 | 1.6 | 1.63 |
| 50.0 | a | 15 | 9 | 60 | | 1.9 | |
| | b | 15 | 11 | 73 | | 1.9 | |
| | c | 15 | 15 | 100 | 78.0 | 1.7 | 1.83 |
| 100 | a | 15 | 11 | 73 | | - | |
| | b | 15 | 6 | 40 | | - | |
| | c | 15 | 3 | 20 | 44.0 | - | - |

No Observed Effects Concentration (NOEC) - 50% effluent.
Lethal Concentration for 50% organisms (LC50) - 78% effluent.

Response of *Ceriodaphnia dubia* to the effluent was significant. Toxicity to the organisms was evidenced by 100% mortality over the full range of effluent dilutions (*i.e.*, 6.25-100%). Lethal concentration for 50% of the organisms ($LC_{50}$) and NOEC for the test were both less than 6.25% effluent. A dilution of at least 210:1 would be required at the edge of the zone of acute criteria exceedance to alleviate this potential toxicity. Chronic toxicity was indicated by the echinoderm sand dollar sperm fertilization bioassay, where the NOEC was less than 3.13% effluent. Concern over this toxicity would be minimized by a dilution factor of 420:1 at the edge of the chronic mixing zone, assuming a "reasonable potential" multiplier of 13.2 (EPA, 1991). A seven-day survival and growth test of inland silverside larvae indicated mild toxicity as $LC_{50}$ and NOEC results were 78% and 50%, respectively. Possible causes of the toxicity could not be identified.

## Sludge Cake and Ash Analyses

General chemistry data for the sludge samples collected during the inspection are listed in Table 5. A listing of priority pollutant metal results is included in Table 7 and Appendix C. Both sludge cake and ash were analyzed for priority pollutant metals using the "total recoverable" procedure and the Toxicity Characteristic Leachate Procedure (TCLP). TCLP analysis is used to estimate the amount of metals which may be leached from sludge after disposal in a landfill or surface impoundment. Table 7 shows that among the priority pollutant metals, only barium was detected in sludge cake and ash samples, but well below the regulatory level. Iron was found at 9,500 mg/kg and 55,000 mg/kg in sludge cake and ash, respectively (Appendix C). The sources of iron in sludge are unknown.

## Laboratory Review

Table 8 shows a comparison of data resulting from the four-way split of composite samples during the inspection. Results from samples collected (e.g., influent) by two different compositors (Ecology and CL) but analyzed at the same lab (e.g., CL) address the issue of sample representativeness. For the example presented, $BOD_5$ data were 214 versus 285 mg/L; TSS data were 284 versus 230 mg/L. These results indicate that there are discrepancies between labs and possibly between samplers, though the latter may be due to time versus flow-proportion sampling. CL should reassess exactly how and from where their samples are being collected. Regular cleaning of sampling lines and containers is also important.

Results from samples collected (e.g., influent) by the same compositor (e.g., CL) but analyzed at two different labs (Ecology and CL) address the issue of laboratory performance. For the example presented, $BOD_5$ data were 640 versus 285 mg/L; TSS data were 204 versus 230 mg/L. The $BOD_5$ result analyzed by Ecology was flagged with a qualifier "J" -- indicating the result was an estimate. Ecology's results for $BOD_5$ are highly questionable. TSS results show not very good agreement. No definite conclusions on lab performance can be drawn from these limited lab data. Therefore, in addition to four-way splits, a performance evaluation (PE) sample should be analyzed in the future.

Table 7 – Comparison of Sludge TCLP Data to Hazardous Waste – Regulatory Level – Lynnwood WTP, 6/91

| Field station: | Sludge-cake | Sludge-ash | |
|---|---|---|---|
| Type: | grab-comp | grab-comp | Hazardous Waste |
| Date: | 6/18 | 6/18 | Regulatory Level* |
| Lab sample #: | 258240 | 258241 | |
| | (mg/L) | (mg/L) | (mg/L) |
| Arsenic | <0.1 | <0.1 | 5.0 |
| Barium | 0.7 | 0.1 | 100 |
| Cadmium | <0.1 | <0.1 | 1.0 |
| Chromium | <0.1 | <0.1 | 5.0 |
| Lead | <0.2 | <0.1 | 5.0 |
| Mercury | <0.002 | <0.002 | 0.2 |
| Selenium | <0.1 | <0.1 | 1.0 |
| Silver | <0.1 | <0.1 | 5.0 |

* – EPA, 1990b.

Table 8 – Comparison of Sample Splits – Lynnwood WTP, 6/91

| Sample | Sampler | Laboratory | BOD5 (mg/L) | TSS (mg/L) | F–Coliform* (cfu/100 mL) |
|---|---|---|---|---|---|
| Inf–E | Ecology | Ecology | 700 J | 156 | |
| (258231) | | Lynnwood | 214 | 284 | |
| Inf–L | Lynnwood | Ecology | 640 J | 204 | |
| (258232) | | Lynnwood | 285 | 230 | |
| Eff–E | Ecology | Ecology | 17 J | 15 | 230;<20 |
| (258235) | | Lynnwood | 15 | 20 | |
| Eff–L | Lynnwood | Ecology | 20 J | 17 | |
| (258236) | | Lynnwood | 21 | 21 | 49;24 |

* – Grab sample.
J – The analyte was positively identified. The associated numerical result is an estimate.

Fecal coliform results from chlorinated effluent reported by Ecology were 230 and $<20$ cfu/100 mL compared to 49 and 24 cfu/100 mL reported by CL. The data revealed a slight disparity, however, they didn't indicate any serious lab procedural problems.

Dale Van Donsel and Perry Brake of Ecology's Quality Assurance Section conducted an on-site laboratory evaluation on June 18, 1991. Their report indicates that the WTP's laboratory is currently providing reliable analytical data to Ecology (Appendix D).

## CONCLUSIONS and RECOMMENDATIONS

### Conclusions

1. Conventional parameters indicated a well-treated effluent. Permit limits for $BOD_5$, TSS, and pH were being met during the inspection. However, the fecal coliform bacteria count on June 18, 1991, slightly exceeded the monthly average limit.

2. Influent BOD load and flow during inspection exceeded 85% of design criteria specified in the permit.

3. No pesticides/PCBs or volatile organic compounds (VOCs) were found in the effluent. Three base neutral acids (BNAs) were detected, but since all three are commonly used as plasticizers, their presence is no cause for concern. Among priority pollutant metals, lead and zinc were found in both blank and effluent samples.

4. No effluent toxicity was indicated by using rainbow trout and fathead minnow. However, toxicity to *Ceriodaphnia dubia* was evident: the 7-day survival and reproduction test resulted in 100% mortality in all dilutions of effluent. Chronic toxicity was indicated by the echinoderm (sand dollar) sperm fertilization test and silverside minnow.

5. According to priority pollutant metals TCLP results, only barium was detected in sludge cake and ash leachate, but samples were below the hazardous waste regulatory level.

6. The results of split samples analyzed by both Ecology and CL could not be fully evaluated because Ecology BOD results were estimated and TSS discrepancies were observed. However, an on-site review of CL's laboratory procedures did not indicate any serious procedural problems in sample collection and analyses.

### Recommendations

1. The influent Parshall flume should be repaired and installed immediately, and an inspection on correct installation and calibration should be performed soon after the job is completed. The sonic flow meter should be calibrated at least once a year according to the manufacturer's specification. An access point would be desirable at the effluent discharge location so that flow can be monitored independently during an inspection.

2. The permit manager should inquire into CL's current loadings compared to its design criteria to determine whether there is a need to begin planning for an upgrade to the plant to meet present and future demands.

3. A regular program of biomonitoring should be instituted using *Ceriodaphnia dubia* and echinoderm bioassays. Once toxicity is established with more reliability and the "reasonable potential" multiplier is reduced, a clear assessment can be made of the discharger's ability to meet or exceed the dilution factors determined by a mixing zone analysis.

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# APPENDICES

Appendix A. Chemical Analytical Methods - Lynnwood WTP, 6/91

| Parameters | Method | Lab Used |
|---|---|---|
| **GENERAL CHEMISTRY** | | |
| Conductivity | EPA, 1983: 120.1 | Ecology; Manchester, WA |
| Alkalinity | EPA, 1983: 310.1 | Ecology; Manchester, WA |
| Hardness | EPA, 1983: 130.2 | Ecology; Manchester, WA |
| **SOLIDS 4** | | |
| TS | EPA, 1983: 160.3 | Ecology; Manchester, WA |
| TNVS | EPA, 1983: 106.4 | Ecology; Manchester, WA |
| TSS | EPA, 1983: 160.2 | Ecology; Manchester, WA |
| TNVSS | EPA, 1983: 106.4 | Ecology; Manchester, WA |
| % Solids | APHA, 1989: 2540G | AMTest Inc.; Redmond, WA |
| % Volatile Solids | EPA, 1983: 160.4 | AMTest Inc.; Redmond, WA |
| BOD5 | EPA, 1983: 405.1 | AMTest Inc.; Redmond, WA |
| TOC (water) | EPA, 1983: 415.2 | AMTest Inc.; Redmond, WA |
| TOC (soil) | APHA, 1989: 5310 | AMTest Inc.; Redmond, WA |
| **NUTRIENTS** | | |
| NH3-N | EPA, 1983: 350.1 | AMTest Inc.; Redmond, WA |
| NO2+NO3-N | EPA, 1983: 353.2 | AMTest Inc.; Redmond, WA |
| Phosphorus-Total | EPA, 1983: 365.1 | AMTest Inc.; Redmond, WA |
| Oil and Grease | EPA, 1983: 413.1 | Ecology; Manchester, WA |
| F-Coliform MPN | APHA, 1989: 908C | Ecology; Manchester, WA |
| **ORGANICS** | | |
| VOCs (water) | EPA, 1984: 624 | Sound Analytical Services, Inc.; Tacoma, WA |
| BNAs (water) | EPA, 1984: 625 | Sound Analytical Services, Inc.; Tacoma, WA |
| Pest/PCBs (water) | EPA, 1984: 608 | Sound Analytical Services, Inc.; Tacoma, WA |
| Phenol (water) | EPA, 1983: 420.2 | AMTest Inc.; Redmond, WA |
| **METALS** | | |
| PP Metals | | |
| Total (sludge) | EPA, 1983: 200.7 | Sound Analytical Services, Inc.; Tacoma, WA |
| Iron (water) | EPA, 1983: 200.7 | Sound Analytical Services, Inc.; Tacoma, WA |
| Iron (sludge) | EPA, 1983: 200.7 | Sound Analytical Services, Inc.; Tacoma, WA |
| TCLP (sludge cake) | EPA, 1990b: 1311 | Sound Analytical Services, Inc.; Tacoma, WA |
| TCLP (sludge ash) | EPA, 1990b: 1311 | Sound Analytical Services, Inc.; Tacoma, WA |
| **BIOASSAYS** | | |
| Rainbow trout (acute) | Ecology, 1981 | Ecology; Manchester, WA |
| Fathead minnow (acute) | EPA, 1985 | ERCE & Bioassay Lab; San Diego, CA |
| Ceriodaphnia dubia (chronic) | EPA, 1989 | ERCE & Bioassay Lab; San Diego, CA |
| Inland Silverside (acute & chronic) | EPA, 1989 | ERCE & Bioassay Lab; San Diego, CA |
| Echinoderm sperm cell (chronic) | Dinnel, 1987 | ERCE & Bioassay Lab; San Diego, CA |

Appendix B. Results of Blank, Influent & Effluent Pesticides/PCBs and Metals Analyses - Lynnwood WTP, 6/91

| | Field Station: | Blank | Inf-E | Inf-L | Eff-E |
|---|---|---|---|---|---|
| | Type: | trans | comp | comp | comp |
| | Date: | 6/17 | 18-19 | 18-19 | 18-19 |
| | Time: | 1545 | 845-845 | 845-845 | 855-855 |
| Parameter (μg/L) | Lab sample#2582: | -30 | -31 | -32 | -35 |
| alpha-BHC | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| gamma-BHC (Lindane) | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| beta-BHC | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Heptachlor | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| delta-BHC | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Aldrin | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Heptachlor Epoxide | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Endosulfan I | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| 4,4'-DDE | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Dieldrin | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Endrin | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| 4,4'-DDD | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Endosulfan II | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| 4,4'-DDT | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Endrin Ketone | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Endosulfan Sulfate | | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Methoxychlor | | 0.02 U | 0.02 U | 0.02 U | 0.02 U |
| Toxaphene | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Chlordane (technical) | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1016 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1221 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1232 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1242 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1248 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1254 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1260 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1262 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |
| Aroclor-1268 | | 0.1 U | 0.1 U | 0.1 U | 0.1 U |

| | Field Station: | Blank | Inf-E | Inf-L | Eff-E | Eff-L |
|---|---|---|---|---|---|---|
| | Type: | trans | comp | comp | comp | comp |
| | Date: | 6/17 | 18-19 | 18-19 | 18-19 | 18-19 |
| | Time: | 1545 | 845-845 | 845-845 | 855-855 | 855-855 |
| | Lab sample#2582: | -30 | -31 | -32 | -35 | -36 |
| Metal (mg/L) Tot Rec | | | | | | |
| Antimony | | 0.06 U | 0.06 U | 0.06 U | 0.06 U | 0.06 U |
| Arsenic | | 0.01 U | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Beryllium | | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.005 U |
| Cadmium | | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.005 U |
| Chromium | | 0.01 U | 0.043 | 0.075 | 0.01 U | 0.01 U |
| Copper | | 0.025 U | 0.065 | 0.068 | 0.025 U | 0.025 U |
| Lead | | 0.005 | 0.012 | 0.009 | 0.008 B | 0.005 U |
| Mercury | | 0.0002 U | 0.0002 U | 0.0002 U | 0.0002 U | 0.0002 U |
| Nickel | | 0.04 U | 0.04 U | 0.04 U | 0.04 U | 0.04 U |
| Selenium | | 0.005 U | 0.005 U | 0.005 U | 0.005 U | 0.005 U |
| Silver | | 0.01 U | 0.01 | 0.011 | 0.01 U | 0.01 U |
| Thallium | | 0.01 U | 0.01 U | 0.01 U | 0.01 U | 0.01 U |
| Zinc | | 0.021 | 0.12 | 0.13 | 0.043 B | 0.037 B |
| Iron (dissolved) | | - | - | - | 0.52 | 0.47 |

U - Indicates compound was analyzed for but not detected at the given detection limit.

B - The analyte was also found in the method blank.

Shaded area denotes metal detected.

Appendix B – Cont. – Results of Blank and Effluent BNA Analyses – Lynnwood WTP, 6/91

| Field Station: | Blank | Eff–E |
|---|---|---|
| Type: | trans | comp |
| Date: | 6/17 | 6/18–19 |
| Time: | 1545 | 0855–0855 |
| Parameters (µg/L) Lab sample#2582: | –30 | –35 |
| N–Nitrosodiphenylamine | 50 U | 50 U |
| bis(2–Chloroethyl)Ether | 10 U | 10 U |
| 1,3–Dichlorobenzene | 10 U | 10 U |
| 1,4–Dichlorobenzene | 10 U | 10 U |
| 1,2–Dichlorobenzene | 10 U | 10 U |
| bis(2–chloroisopropyl)ether | 10 U | 10 U |
| N–Nitroso–Di–n–Propylamine | 10 U | 10 U |
| Hexachloroethane | 10 U | 10 U |
| Nitrobenzene | 10 U | 10 U |
| Isophorone | 10 U | 10 U |
| bis(2–Chloroethoxy)Methane | 10 U | 10 U |
| 1,2,4–Trichlorobenzene | 10 U | 10 U |
| Naphthalene | 10 U | 10 U |
| 4–Chloroaniline | 20 U | 20 U |
| Hexachlorobutadiene | 10 U | 10 U |
| 4–Chloro–3–methylphenol | 20 U | 20 U |
| 2–Methylnaphthalene | 10 U | 10 U |
| Hexachlorocyclopentadiene | 10 U | 10 U |
| 2–Chloronaphthalene | 10 U | 10 U |
| 2–Nitroaniline | 50 U | 50 U |
| Dimethyl Phthalate | 10 U | 10 U |
| Acenaphthylene | 10 U | 10 U |
| 3–Nitroaniline | 50 U | 50 U |
| Acenaphthene | 10 U | 10 U |
| Dibenzofuran | 10 U | 10 U |
| 2,4–Dinitrotoluene | 10 U | 10 U |
| 2,6–Dinitrotoluene | 10 U | 10 U |
| Diethyl Phthalate | 10 U | 10 U |
| 4–Chlorophenyl–Phenylether | 10 U | 10 U |
| Fluorene | 10 U | 10 U |
| 4–Nitroaniline | 10 U | 10 U |
| 4–Bromophenyl–Phenylether | 10 U | 10 U |
| Hexachlorobenzene | 10 U | 10 U |
| Phenanthrene | 10 U | 10 U |
| Anthracene | 10 U | 10 U |
| Di–n–butylphthalate | 19 | 32 |
| Fluoranthene | 10 U | 10 U |
| Pyrene | 10 U | 10 U |
| Butylbenzylpthalate | 16 | 3 J |
| 3,3'–Dichlorobenzidine | 10 U | 10 U |
| Benzo(a)Anthracene | 10 U | 10 U |
| bis(2–Ethylhexyl)phthalate | 10 U | 5 J |
| Chrysene | 10 U | 10 U |
| Di–n–Octyl Phthalate | 10 U | 10 U |
| Benzo(b)Fluoranthene | 10 U | 10 U |
| Benzo(k)Fluoranthene | 10 U | 10 U |
| Benzo(a)Pyrene | 10 U | 10 U |
| Indeno(1,2,3–cd)Pyrene | 10 U | 10 U |
| Dibenzo(a,h)Anthracene | 10 U | 10 U |
| Benzo(g,h,i)Perylene | 10 U | 10 U |
| Phenol | 10 U | 10 U |
| 2–Chlorophenol | 10 U | 10 U |
| Benzyl Alcohol | 20 U | 20 U |
| 2–Methylphenol | 10 U | 10 U |
| 4–Methylphenol | 10 U | 10 U |
| 2–Nitrophenol | 10 U | 10 U |
| 2,4–Dimethylphenol | 10 U | 10 U |
| Benzoic Acid | 50 U | 50 U |
| 2,4–Dichlorophenol | 10 U | 10 U |
| 2,4,6–Trichlorophenol | 10 U | 10 U |
| 2,4,5–Trichlorophenol | 10 U | 10 U |
| 2,4–Dinitrophenol | 50 U | 50 U |
| 4–Nitrophenol | 50 U | 50 U |
| 4,6–Dinitro–2–Methylphenol | 50 U | 50 U |
| Pentachlorophenol | 50 U | 50 U |

U – None detected at or above the method reporting limit.
J – Indicates an estimated value when result is less than specified detection limit.
Shaded area denotes compound detected.

Appendix B. Cont. - Results of Blank, Influent, and Effluent VOC Analyses - Lynnwood WTP, 6/91

| | Field Station: | Blank | Inf-1 | Eff-1 | Inf-2 | Eff-2 |
|---|---|---|---|---|---|---|
| | Type: | trans | grab | grab | grab | grab |
| | Date: | 6/17 | 6/18 | 6/18 | 6/19 | 6/19 |
| | Time: | 1545 | 0910 | 0945 | 1120 | 1100 |
| Parameters (µg/L) | Lab sample#2582: | -30 | -33 | -34 | -37 | -38 |
| Chloromethane | | 20 U | 20 U | 20 U | 20 U | 20 U |
| Vinyl Chloride | | 20 U | 20 U | 20 U | 20 U | 20 U |
| Bromomethane | | 20 U | 20 U | 20 U | 20 U | 20 U |
| Chloroethane | | 20 U | 20 U | 20 U | 20 U | 20 U |
| 1,2-Dichloroethene (total) | | 10 U | 10 U | 10 U | 10 U | 10 U |
| 1,1-Dichloroethene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Acetone | | 200 U | 200 U | 200 U | 200 U | 200 U |
| Carbon Disulfide | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Methylene Chloride | | 10 UJ | 10 UJ | 10 UJ | 10 UJ | 10 UJ |
| 2-Butanone | | 200 U | 200 U | 200 U | 200 U | 200 U |
| Acrolein | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Chloroform | | 10 U | 10 U | 10 U | 10 U | 10 U |
| 1,1,1-Trichloroethane | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Carbon Tetrachloride | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Benzene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| 1,2-Dichloroethane | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Vinyl Acetate | | 100 U | 100 U | 100 U | 100 U | 100 U |
| Trichloroethene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| 1,2-Dichloropropane | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Bromodichloromethane | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Trans-1,3-Dichloropropene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| 2-Hexanone | | 10 U | 10 U | 10 U | 10 U | 10 U |
| 4-Methyl-2-Pentanone | | 100 U | 100 U | 100 U | 100 U | 100 U |
| Toluene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| cis-1,3-Dichloropropene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| 1,1,2-Trichloroethane | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Tetrachloroethene (PCE) | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Dibromochloromethane | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Chlorobenzene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Ethylbenzene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Styrene | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Total Xylenes | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Bromoform | | 10 U | 10 U | 10 U | 10 U | 10 U |
| Acrylonitrile | | 10 U | 10 U | 10 U | 10 U | 10 U |
| 1,1,2,2-Tetrachloroethane | | 10 U | 10 U | 10 U | 10 U | 10 U |

U - None detected at or above the method reporting limit.

UJ - Indicates compound was analyzed for but not detected at the given detection limit, and the internal standard on which the detection limit quantification was based was outside acceptance limits.

Appendix C. Results of Sludge TCLP and Priority Pollutant Metal Analyses – Lynnwood WTP, 6/91

| Field Station: | Sludge–cake | Sludge–ash | Sludge–ash |
|---|---|---|---|
| Type: | grab–comp | grab–comp | grab–comp |
| Date: | 6/18 | 6/18 | 6/18 |
| Time: | 1330 | 1400 | 1400 |
| Lab sample #: | 258240 | 258241 | 258241 |
| | TCLP | TCLP | PP Metals (tot rec) |
| Parameter | (mg/L) | (mg/L) | (mg/kg–dry) |
| Antimony | – | – | 2.7 |
| Arsenic | <0.1 | <0.1 | <1.4 |
| Barium | 0.7 | 0.1 | – |
| Beryllium | – | – | 0.31 |
| Cadmium | <0.1 | <0.1 | 25 |
| Chromium | <0.1 | <0.1 | 310 |
| Copper | – | – | 2,800 |
| Lead | <0.2 | <0.1 | 230 |
| Mercury | <0.002 | <0.002 | 0.81 |
| Nickel | – | – | 42 |
| Selenium | <0.1 | <0.1 | <0.71 |
| Silver | <0.1 | <0.1 | 160 |
| Thallium | – | – | <0.28 |
| Zinc | – | – | 4,600 |
| Iron (dissolved) | 9,500 | – | 55,000 |

Appendix D

WASHINGTON STATE DEPARTMENT OF ECOLOGY
ENVIRONMENTAL INVESTIGATIONS AND LABORATORY SERVICES
QUALITY ASSURANCE SECTION

# SYSTEM AUDIT REPORT

| | | |
|---|---|---|
| LABORATORY: | Lynnwood Water Pollution Control Plant Laboratory | |
| ADDRESS: | 19100 44th Avenue West<br>Lynnwood, WA 98020 | |
| DATE OF AUDIT: | June 18, 1991 | |
| AUDITORS: | Dale Van Donsel | Team Leader, Microbiology |
| | Perry Brake | Administration, General Chemistry |
| PERSONNEL INTERVIEWED: | Duke Dungan | Lab Manager |
| | Don Davis | Plant Supervisor |

AUTHENTICATION:

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Dale J. Van Donsel, Team Leader

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## GENERAL FINDINGS AND RECOMMENDATIONS

A system audit was conducted at the Lynnwood Water Pollution Control Plant Laboratory on June 18, 1991, pursuant to WAC 173-50-080. The purpose of the audit was to verify laboratory capabilities as stated in the application for accreditation and quality assurance manual (previously submitted by the laboratory in partial fulfillment of accreditation requirements), and to review analytical and quality control data. General audit findings and recommendations are documented below. Significant recommendations for improvement of laboratory operations are highlighted by *italics*.

1. <u>Personnel</u>. Mr. Dungan is responsible for all analytical procedures used in the lab and is the immediate supervisor of one assistant (a plant operator, cross-trained as a lab analyst who performs process control analyses on weekends). Mr. Dungan, who was present during the entire audit, was very enthusiastic and candid, and was obviously very knowledgeable in methods and techniques for which the laboratory is seeking accreditation.

2. <u>Facility</u>. Construction of the lab (along with the rest of the treatment plant) was completed in 1990. The lab facility consists of one large room and an adjoining, smaller room used for administrative functions (i.e., office space). Floor and bench space is more than adequate to support current lab operations. Well-conceived lab facility plans resulted in an environment which is efficient, functional, and conducive to doing good work.

a. There were no records available to indicate the fume hood used in the lab had been checked for adequacy of air flow. A check was made by the visiting team and the flow found to be 140 cubic feet per minute which is better than the ASTM-recommended flow of 125 CFM. *A recommendation was made to have the flow checked periodically (e.g., every year) or whenever there is suspicion that flow may have been reduced for some reason.* The Lynnwood plant could purchase an air velometer from any of several vendors or, given the infrequent need to measure airflow, a meter could be periodically borrowed from another lab or perhaps a fire department.

b. A recommendation was made for the lab to purchase a spill cleanup kit (as a safety matter and not a matter affecting quality of the analytical work done in the lab). Information on relatively inexpensive, liquid neutralizers is attached.

3. <u>Equipment and Supplies</u>. No deficiencies which would significantly affect lab capabilities were noted with regard to type, quantity, or quality of equipment and supplies. Judging from the quality and quantity of equipment and supplies on hand, the laboratory apparently has the full support of management in obtaining whatever is required.

a. The Mettler analytical balance had last been checked by a service representative in June, 1990 meaning another check should be scheduled during June, 1991 to meet the requirement for annual service checks.

b. Small (approximately 12 x 120 mm) screw-cap tubes are used for all volumes in the MPN test. The 10-mL of double-strength broth plus 10 mL sample brings the level to the lip of the tubes, and approximately half the tube extends above the water level. This can result in lowered temperature and loss of specificity with the fecal coliform test; the water bath level must be maintained above the level of the medium at all times. Mr. Dungan is aware of this problem and has ordered larger tubes for 10-mL aliquots.

c. The 35° air incubator used for initial incubation of A-1 tubes has only a digital temperature readout. It is recommended that its accuracy be verified by keeping a thermometer immersed in liquid on a shelf.

4. Sample Management. Because of the nature of plant operations, sample management, storage, and security is not a problem. Most samples are taken immediately before analysis. The Lynnwood plant lab analyzes samples for other wastewater treatment plant (e.g., Mountlake Terrace) and others, indicating a special need to assure sufficient chain-of-custody procedures are in effect. Chain-of-custody was evaluated and found to be adequate as long as the lab is secured during absence of the sample custodian, Mr. Dungan, or other authorized personnel.

5. Data Management

a. Complete data is recorded neatly, methodically, and in a manner which makes it easy to retrieve and review. No deficiencies were noted concerning management of analytical data.

b. Records were not being maintained on preparation of standard solutions (e.g., ammonia, phosphate). A recommendation was made to record preparation of stock standard solutions in a log book (or using the present sheets labeled "Reagent Preparation"), and to record in the same log any subsequent dilutions of the stock to make solutions of lower concentration.

6. PE Samples

Acceptable results had been reported for $NH_3$, BOD, TSS, and residual chlorine and a not acceptable result for pH in DMR-QA Study 10. Results for DMR-QA Study 11 will not be available for several months, so samples for all these parameters were furnished by the Quality Assurance Section. All were analyzed satisfactorily. Mr. Dungan will enroll in the WP series of samples during semesters when DMR-QA samples are not provided.

7. Quality Assurance/Quality Control

a. A thoroughly-researched and meticulously-written methods (procedures) manual, structured specifically for the Lynnwood lab, was readily available and used as often as necessary to assure required methods were being followed with care.

b. In accordance with the lab quality assurance manual, quality control tests are conducted routinely for all parameters of interest. For the BOD test, the glucose/glutamic acid (standard solution) test and duplicates are run with each batch. Duplicates are run for each pH, fecal coliform, residual chlorine, and TSS test. Additionally, a pH standard (purchased from Metrepak as pHydrion Buffers, gelatinous capsules which are certified to 7.00 or 10.00, ±0.02 pH units when dissolved in 100 mL of water) is analyzed with each batch. Standards were not run with each batch for TSS and residual chlorine because of the lack of a readily available standard. QC samples purchased from APG are tested quarterly for TSS and residual chlorine. As an alternative to purchasing QC samples from APG, *a recommendation was made to purchase a material suitable for preparing a stable suspension (such as cellulose fibers, available from Sigma Chemical Company as "Sigma Cell 20", described on the attached paper) and to analyze the solution with every TSS batch as done for other analytes.*

c. Precision control charts are maintained (and have been maintained since the fall of 1990 when Mr. Dungan was assigned to the lab) on BOD and TSS and are being constructed on the fecal coliform test. The charts were checked and found to be constructed properly. Furthermore, the charts were being used as intended as evidenced by the recent discovery and correction of a BOD test problem, first noted by an "out-of-control" situation on a control chart. Control of the pH test was by inspection of standard solution and duplicate results and, because precision was obviously well within reporting requirements, no need was seen for use of control charts. Inspection of control charts and other data proved the lab to be well within control for parameters of interest. For example, within batch standard deviation for the BOD test as indicated by analysis of duplicates is 9 mg/L. Batch-to-batch standard deviation is 11 mg/L as indicated by analysis of the glucose/glutamic acid standard. Both are well within the often-quoted guideline of 37 mg/L. (NOTE: None of the above-mentioned QC tests or control charts had been in use in the Lynnwood lab prior to the arrival of Mr. Dungan. The quality of work currently being done in the lab is a testament to his skill and knowledge and the effectiveness of a well-conceived QA program.)

d. The commercial (Hach) standards used to calibrate the turbidimeter had not been checked with a freshly prepared formazin standard solution as required by the method (i.e., Standard Method 2130 B). *A recommendation was made to check the standards, record the results, and then recheck periodically (not more often than once per year).*

e. Thermometers being used for BOD and fecal coliform incubators were neither NBS (NIST) certified nor traceable to NBS certified thermometers. The thermometer in each incubator was calibrated against an NBS certified thermometer provided by the audit team and a certificate is included for each, showing traceability to the certified thermometer.

8. <u>Methods</u>. Current copies of all methods employed in the lab, including all those for which the lab is requesting accreditation, are present and readily available to analysts at bench level.

Attach: Information on Spill Kits
Information on Suspension (TSS) Material
Thermometer Calibration Certificates

cc: Tapas Das w/o attachments