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SEQUIM WTP
CLASS II INSPECTION
AUGUST 1990

by
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ABSTRACT

A Class II Inspection was conducted at the City of Sequim Wastewater Treatment Plant (WTP) on August 6-8, 1990. The influent flume was properly configured but comparison of Ecology instantaneous flow measurements to WTP influent flowmeter records could not confirm its accuracy. The WTP effluent V-notch weir needed recalibration. The WTP was performing well during the inspection; the effluent was within all NPDES permit limits. The WTP may be approaching 85 percent of design capacity for BOD_5 and TSS mass loadings; loadings should be recalculated after the effluent weir is recalibrated. No acute toxicity was indicated in the WTP effluent by rainbow trout or *Ceriodaphnia dubia*. No chronic toxicity was indicated by *Ceriodaphnia dubia*, but some chronic toxicity was indicated by the echinoderm sperm fertilization bioassay. Further calculations to determine if sludge stabilization is adequate are suggested. Priority pollutants were at low concentrations in the digested sludge. The automatic chlorine addition system was not functioning properly during the inspection. WTP and Ecology lab results from sample splits for permit parameter analysis compared well.

INTRODUCTION

A Class II inspection was conducted at the City of Sequim Wastewater Treatment Plant (WTP) on August 6-8, 1990. Conducting the inspection were Keith Seiders and Lisa Zinner from the Washington State Department of Ecology (Ecology) Compliance Monitoring section. The inspection was requested by Darrel Anderson and Sandra Stephens of the Ecology South West Regional Office (SWRO). Wayne Balholm, Sequim WTP plant operator, provided assistance during the inspection.

Sequim is a small community located in Clallam county on the Olympic Peninsula (Figure 1). The Sequim WTP collection system serves approximately 3600 residential users. No industrial wastes are contributed to the plant, but chemical toilet wastes are accepted. The WTP discharge into the Strait of Juan de Fuca near the entrance to Sequim Bay is regulated by discharge permit WA-002234-9.

The Sequim facility uses the oxidation ditch method of activated sludge biological treatment. The original Sequim WTP, built in 1966, consisted of an oxidation ditch, clarifier, and sludge drying beds. An upgrade in 1983 added another oxidation ditch, another clarifier, a sludge storage tank, and a gravity dewatering system. A chlorination system was added in 1985. Presently, wastewater is treated using the new oxidation ditch, clarifier, and chlorination system. The old oxidation ditch, clarifier, sludge storage tank and drying beds compose the sludge treatment system. The digested sludge is presently land applied. The operation mode at the time of the inspection is shown schematically in Figure 2.

The objectives of the inspection were:

- Assess WTP effluent compliance with NPDES permit limits.
- Determine WTP performance by determining plant loading and treatment efficiency.
- Chemically characterize the WTP influent, effluent, and sludge.
- Determine WTP effluent toxicity using Trout, Bivalve, *Ceriodaphnia*, and Echinoderm bioassays.
- Evaluate the WTP sludge stabilization process.
- Evaluate the locations of the WTP sample sites.
- Assess the automated chlorination/alarm system.
- Split samples with the permittee to determine comparability of laboratory results.

PROCEDURES

Ecology twenty-four hour composite samples and grab samples were taken at four locations: influent at a point between the bar screen and the sludge storage tank supernatant return line (Inf-A), influent at the outlet of the Parshall flume (Inf-B), effluent at a wet well between the secondary clarifier and the chlorine contact chamber (Eff-A), and chlorinated effluent at the effluent weir (Eff-B) (Figure 2). Approximately 200 to 300 ml of sample were collected at 30 minute intervals using ISCO composite samplers. The composite samplers were cleaned for priority pollutant sampling prior to the inspection (Table 1). Transfer blanks were taken for both grab and composite samples (Table 1).

Hand composites, consisting of three grab samples of chlorinated effluent, were collected at the effluent weir for bioassay tests. Grab samples were collected at a manhole just prior to the outfall in order to assess possible biological contamination of the effluent in the discharge line.

Sludge grab samples were taken at three locations: waste activated sludge (WAS) from the secondary clarifier underflow (Sldg-A), well-mixed sludge from the sludge storage tank (Sldg-B), and digested sludge at a point between the aerobic digestion ditch and the gravity thickener (Sldg-C) (Figure 2). These grab samples were analyzed for total volatile solids (TVS) and total and fecal coliforms in order to assess the current sludge treatment system. A twenty-four hour hand composite sample consisting of three grabs was taken at the Sldg-C sample point to chemically characterize the digested sludge.

The sampling schedule, parameters analyzed, and sample splits are included in Table 2. All samples were kept on ice and delivered to Manchester laboratory on August 8, 1990, following chain-of-custody procedures. A summary of analytical methods, references, and the laboratory conducting the analysis is given in Appendix A.

The WTP's influent Parshall flume and effluent V-notch weir were checked for correct dimensions, installation, and maintenance. Ecology instantaneous flow measurements were made and compared to the WTP's flowmeters.

RESULTS AND DISCUSSION

Flow

The WTP influent Parshall flume was found to be adequately installed and maintained. Comparison of Ecology instantaneous flow measurements to WTP influent flowmeter strip charts records were inconclusive. It was difficult to obtain precise instantaneous flow measurements from the seven-day chart recorder. Instantaneous flow measurements should be repeated during the next Class II inspection by having one inspector take the measurement at the flume while another inspector records the plant flowmeter measurement.

Several problems were found at the WTP effluent flowmeter. The V-notch weir was found to be a 50 degree weir, although the plant Operation Manual indicated a 60 degree weir and the as-built drawings indicated a 45 degree weir. Flowmeter calibration for a 45 degree weir would underestimate the true flow rate and calibration for a 60 degree weir would overestimate the flow rate. Ecology instantaneous flow measurements indicated the flowmeter was probably calibrated as a 45 degree weir at the time of the inspection (Table 3). The notch angle was also found to be askew by approximately ½ degree. The zero line on the measuring strip provided for manual head readings was not even with the crest of the weir (the base of the notch), but was found to be approximately ½ inch high. The existing effluent flowmeter should be recalibrated to take into account the true notch angle until a new weir plate can be properly installed. The measuring strip should be zeroed to the crest of the new weir after installation.

WTP influent flowmeter totalized flow has historically tended to be higher than the effluent totalized flow (Balholm, 1990). The influent totalized flow for 8/8/90 (0.47 MGD) was approximately 12 percent higher than the effluent totalized flow. Due to the inadequacy of the effluent flowmeter, the influent totalized flow was used to calculate the mass loadings for permit parameters.

General Chemistry and NPDES Permit Compliance

The WTP was performing well during the inspection. The conventional parameters of BOD_5, TSS, and fecal coliform indicated a well-treated, high quality effluent (Table 4). The unusually high COD of the WTP effluent composite sample (595 mg/L) was probably due to laboratory error. The effluent met permit limits for BOD_5, TSS, fecal coliforms, and pH (Table 5).

Effluent ammonia and nitrate-nitrite concentrations indicated that the WTP was nitrifying and denitrifying at the time of the inspection. The effluent total ammonia concentration (0.390 mg/L NH_3 as N) was much less than the freshwater and saltwater acute and chronic EPA water quality criteria (EPA, 1986; EPA, 1989c). The acute water quality criteria based on total ammonia in freshwater is 8.5 mg/L NH_3 as N and the chronic criteria is 1.2 mg/L NH_3 as N at typical effluent conditions (pH = 7.75, T = 20 °C). The acute water quality criteria based on total ammonia in saltwater is 10.7 mg/L NH_3 as N and the chronic criteria is 1.6 mg/L NH_3 as N at typical Sequim Bay conditions (pH = 8.0, salinity = 30 g/kg, T = 12 °C) (Jantzen, 1991).

The WTP appeared to be approaching 85 percent of design capacity for BOD_5 and TSS influent mass loading (Table 5). The flow rate used to calculate the mass loading was taken from the WTP influent totalizer, as indicated above. These loadings should be re-examined following installation of a new effluent weir plate.

Results for the fecal coliform analysis (membrane filter method) show that fecal coliform counts did not significantly increase between the effluent weir and the manhole just prior to the outfall (Table 4). Therefore, at the time of the inspection, the pasture land adjacent to the discharge line did not impact the quality of the WTP effluent. A noticeable impact was not expected due to the lack of precipitation during the inspection. Some impact might be more likely to occur at a time of high precipitation when runoff from the pasture land could create inflow to the discharge line through the manholes located in the field.

Both the WTP influent and effluent composite sample temperatures (Inf-Sqm - 17.7 °C and Eff-Sqm - 20.7 °C) showed inadequate sample cooling during collection (Table 4). The blue ice packs used by the WTP for composite sample cooling cannot normally cool wastewater to 4 °C as required by Standard Methods (APHA, 1989). Either refrigerated compositors or ice cubes should be used to achieve adequate sample cooling during collection.

Priority Pollutant Scans - Water

A number of organic priority pollutants were detected at low levels in the WTP influent (Table 6). Only three volatile organics compounds (VOAs) were detected in the effluent: chloroform, bromodichloromethane, and total xylenes. All three were estimated at levels much less than acute and chronic water quality criteria (EPA, 1986). No semivolatile compounds (BNAs), pesticides, or PCBs were detected in the effluent.

Several metals were detected in the WTP effluent: arsenic, cadmium, copper, lead, mercury, and zinc. Arsenic, cadmium, copper, lead, and mercury concentrations were all estimated due to a response below the accurate quantification limit. The estimated effluent copper concentration (7.8 μg/L) was greater than both the acute and chronic marine water quality criteria (2.9 μg/L, each). The estimated effluent mercury concentration (0.08 μg/L) was greater than the chronic marine water quality criteria (0.025 μg/L).

Quantification limits for three metals (copper - 5.0 μg/L, mercury - 0.04 μg/L, and nickel - 10 μg/L) were greater than chronic marine water quality criteria (Table 6). Only the copper quantification limit was greater than the acute marine water quality criteria. The quantification limits were not different enough from the water quality criteria to be a concern in this case.

A complete listing of influent and effluent priority pollutant scan results is included in Appendix B.

Effluent Bioassays

No acute toxicity was indicated in the WTP effluent by rainbow trout or *Ceriodaphnia dubia* (Table 7). LC50s were greater than 100 percent for both species. No chronic toxicity was indicated by *Ceriodaphnia dubia*; the NOEC was greater than 100 percent effluent.

Chronic toxicity was also indicated by the echinoderm sperm fertilization (purple sea urchin) bioassay. The LOEC was 2.8 percent effluent. Residual chlorine was not detected in the effluent sample, therefore is not thought to be the toxicant. Without an exact NOEC level, the dilution required to reduce the effluent concentration to the no effect level at the edge of the dilution zone can not be calculated. A dilution of 1:36 would be required to reduce the effluent concentration to 2.8 percent, therefore the receiving water dilution must be greater than this.

The echinoderm sperm fertilization bioassay should be repeated using a dilution series which could pinpoint the exact NOEC level.

A bivalve larvae bioassay was attempted but declared invalid due to the lack of viable bivalve larvae in the control. This bioassay should be performed in the next Class II inspection.

Digested Sludge Analysis

The digested sludge was sampled for chemical characterization as it flowed over a weir from the digester to the thickener (Figure 2). It was not physically possible to sample the sludge at the point of disposal. The chosen sample point was representative of the quality of the land applied sludge and provided a well-mixed sample.

The digested sludge was partially analyzed for priority pollutants using two alternative approaches. Priority pollutant metals and volatile organic compounds (VOAs) were analyzed using procedures which measured the concentration of the compound of interest in the whole sludge (see Appendix A for methods). Due to failed communications between Ecology inspectors and the Ecology laboratory at Manchester, the sludge sample was extracted using the Toxicity Characteristic Leachate Procedure (TCLP) prior to analysis for semivolatiles (BNAs), pesticides, and PCBs. TCLP analysis is used to estimate the amount of inorganic and organic contaminants which may be leached from sludge after disposal in a landfill or surface impoundment. The TCLP procedure has replaced the Extraction Procedure Toxicity (EP Tox) procedure for designation of a wastestream as a dangerous waste (EPA, 1990a).

No volatile organic compounds were detected in the digested sludge (Table 8). Several priority pollutant metals were detected at low levels in the sludge. Four of the metals (cadmium, chromium, copper, and zinc) were detected in the method blank as well as in the sample, indicating possible contamination originating in the laboratory. Sequim sludge metals concentrations were typical of municipal WTP sludge when compared to data from the National Sewage Sludge Survey (EPA, 1990b), except for low concentrations of cadmium and lead.

The TCLP analysis results were incomplete due to the lack of analysis for the volatile organic compounds, metals, and two herbicides (2,4 D and 2,4,5 T - Silvex) included in the TCLP list (Table 9). No semivolatile, pesticide, or PCB compounds were detected in the TCLP extract. Total analysis of the waste demonstrated that none of the TCLP volatile organic compounds were present and that the metals were in such low concentrations that it would be unlikely that the TCLP regulatory levels would be exceeded. It is also unlikely that the two herbicides would be detected in the sludge. Therefore, a complete TCLP analysis on the digested sludge was unnecessary (EPA, 1990a).

State guidelines on land application indicate that a sludge must be analyzed for nutrients and heavy metals prior to land application (Ecology, 1982). The only priority pollutants regulated in sludges applied to food chain crops are cadmium and total PCBs. Sludge application to non-food chain crops and forest application guidelines are based on the nitrogen needs of the crop or trees (the agronomic rate) and the storage capacity of the soil. Nutrient analysis of the WTP digested sludge is presented in Table 8.

Federal guidelines for land application were proposed in draft form in 1989 (EPA, 1989a). These guidelines have not been presented because proposed revisions could significantly increase the numerical limits presented in the draft (EPA, 1990b). Priority pollutant analysis on the sludge may be necessary after the final regulations are promulgated.

A complete listing of priority pollutant scan results on the digested sludge is included in Appendix C.

Sludge Treatment System

The sludge treatment system at the time of the inspection consisted of an aerated sludge storage tank, an aerobic digester (the old oxidation ditch), and a thickener (the old clarifier). Waste activated sludge (WAS) was pumped to the sludge storage tank every evening. The WAS volume, determined daily by the WTP operator, was the volume required to maintain a 30 day solids retention time (SRT) in the oxidation ditch. The sludge storage tank aeration was shut off in the morning and the sludge was allowed to settle. The supernatant was then pumped either to the digester for dilution or returned to the influent channel. Sludge from the storage tank was allowed to flow by gravity into the digester.

The digested sludge flowed over a weir to the thickener. Thickening was not occurring at the time of the inspection. Recycle between the thickener and the digester through an overground line was continuous. No thickener supernatant was being recycled to the oxidation ditch. Sludge for disposal was pumped from the thickener to a sludge truck. Sludge disposal during the inspection occurred only on the first day due to mechanical problems with a sludge truck.

State and federal regulations require that all sludge which is land applied be treated to reduce pathogen levels and to reduce the attractiveness of sludge to disease vectors such as rodents, flies, and mosquitoes (O'Brien, 1991; EPA, 1979). Specific treatment processes are divided into two categories based on the level of pathogen control they can achieve: Processes to Significantly Reduce Pathogens (PSRP) and Processes to Further Reduce Pathogens (PFRP). These processes can be found in Appendix II of 40 CFR Part 257 (EPA, 1979). Sludge treated by any of these processes or equivalent processes can be land applied, but the management practices required for each category are different. Aerobic digestion (a PSRP) is defined in the regulation as agitation of sludge with oxygen to maintain aerobic conditions at residence times ranging from 60 days at 15 °C (59 °F) to 40 days at 20 °C (68 °F), with a volatile solids reduction of at least 38 percent.

The 40 CFR Part 257 regulations for municipal sludge use and disposal practices are currently being revised. New regulations, 40 CFR Part 503, were proposed on February 6, 1989 (EPA, 1989a) and should be finalized in 1992. Land application will be governed by the 40 CFR Part 257 regulations until the final 503 regulations are promulgated.

The hydraulic retention time (HRT) in the sludge treatment system, including the sludge storage tank, digester, and thickener, was approximately 44 days assuming an average of 10,000 gallons per day of sludge was wasted from the digester. The solids retention time (SRT) in the digestion system was equal to the HRT during the inspection when no thickening occurred in the thickener. The combination of the SRT in the oxidation ditch (30 days) and the sludge treatment system would equal approximately 74 days. This residence time may be sufficient to reduce pathogen levels for the majority of the year, but a longer SRT may be required in the cold winter months.

In cases where separate aerobic digestion follows an oxidation ditch process, the requirement for a volatile solids (VS) reduction of 38 percent applies to the combination of the separate digester and oxidation ditch process (EPA, 1985). Therefore, VS reduction can be determined through a mass balance on VS using the influent wastewater, the final sludge product, and the effluent wastewater (EPA 1989b; Appendix D). A calculation made with inspection data found a 33 percent volatile solids reduction in the system (Appendix D). A mass balance of the weighted averages of several volatile solids samples collected during a period of time would be necessary to make an accurate determination of the VS reduction.

Treatment schemes that deviate from the specified operating conditions or are not described in the regulations may be shown to be equivalent to PSRP processes (EPA, 1989b). Special consideration is taken in the equivalency procedure for treatment systems which include a Process Treating Sludges Generated by No Primary/Long Sludge Age (NP/SLA), such as the Sequim WTP system. Equivalent processes must reduce pathogens and vector attraction to an extent equivalent to a PSRP.

Adequate viral and bacterial pathogen reduction can be demonstrated for an equivalent process by measuring fecal coliform and fecal streptococci concentrations (EPA, 1989b). The geometric mean of the concentrations must have an average $\log_{10}$ density (No./g TSS) of less than 6.0 in the digested sludge. The average $\log_{10}$ density of fecal coliforms in two digested sludge samples taken during the inspection was found to be 7.4. Calculations for decision making should be based on data from at least nine sludge samples to account for sampling and laboratory variability.

Adequate VS reduction to reduce vector attraction of aerobic sludges can be demonstrated by the Specific Oxygen Uptake Rate (SOUR) test (APHA, 1989; Method 2710B). The oxygen uptake rate must be less than 1 mg O_2/hour/g TSS.

Volatile solids reduction calculations should be repeated by the permittee using flow weighted average data collected over the course of one to two months. If volatile solids reduction is found to be inadequate, the two alternative tests can be used to determine if the sludge treatment system is equivalent to a PSRP.

Location of WTP Sample Sites

The WTP influent sample site is located downstream of the sludge storage tank supernatant return line (Figure 2). Analysis of Ecology composite samples collected upstream (Inf-A) and downstream (Inf-B) of the return line found BOD_5 and TSS concentrations at the Inf-A site greater than the concentrations at the Inf-B site (Table 10). The anomaly was probably due to the shallow depth of the influent at the Inf-A sample point. The sample intake strainer had to rest on the bottom of the channel and consequently trapped solids and concentrated them in the sample. Also, it is possible the strainer was not completely submerged at low flow levels in the early morning hours. The WTP sample point at the end of the Parshall flume provided a well-mixed sample and adequate water depth. The intermittent flow from the sludge storage tank supernatant return line was approximately 4,000 to 6,000 gallons per day or roughly one percent of the total influent flow. The small volume of return flow is less of a concern than the poor sampling configuration required upstream of the return line. The WTP influent sample site was suitable to obtain a representative sample and should be retained.

Ecology sampled two alternative effluent sample sites: the WTP sample site prior to the chlorine contact chamber (Eff-A) and at the effluent weir (Eff-B) (Figure 2). The Eff-A sample site had slightly higher BOD_5 and TSS concentrations than the Eff-B sample (Table 10). This is probably due to the deposition of suspended solids in the chlorine contact chamber. The Eff-A sample site was an easier site to sample and was more practical with respect to worker safety. The Eff-B site was below ground level and required the use of a ladder, making sample retrieval difficult. Also, the unchlorinated Eff-A samples do not require seeding for the BOD_5 test. The Eff-A site was a satisfactory effluent composite sample site.

Chlorination System

The automatic chlorine addition system was not functioning properly at the time of the inspection. The system was historically unreliable and required high maintenance (repair by the WTP operator approximately once a week). The system was removed on the last day of inspection for repairs and has been in the shop for at least four months (Balholm, 1990). Chlorine addition is now controlled manually. The automatic addition system should be replaced as soon as possible in order to ensure compliance with the fecal coliform permit limit.

Sample Splits

Sequim WTP and Ecology lab results for permitted parameters compared well (Table 11), except for one influent TSS result (Inf-Sqm: WTP - 180 mg/L, Ecology - 363 mg/L).

The WTP laboratory procedures were not reviewed due to recent accreditation by the Ecology Quality Assurance/Quality Control group. This accreditation is valid through June 30, 1991.

RECOMMENDATIONS AND CONCLUSIONS

Flow

The WTP influent Parshall flume was found to be adequately installed and maintained. Comparison of Ecology instantaneous flow measurements to WTP influent flowmeter records were inconclusive. Instantaneous flow measurements should be repeated during the next Class II inspection.

Several problems were found at the WTP effluent V-notch weir. The existing effluent flowmeter should be recalibrated to the proper notch angle until a new V-notch weir plate can be properly installed.

General Chemistry and NPDES Permit Compliance

The WTP was performing well during the inspection. The effluent met permit limits for BOD_5, TSS, fecal coliforms, and pH. The plant was achieving nitrification and denitrification during the inspection.

The WTP may be approaching 85 percent of design capacity for BOD_5 and TSS mass loadings. The loadings should be re-examined following installation of a new effluent weir plate.

The WTP influent and effluent composite samples were not properly cooled during collection. Refrigerated compositors or ice cubes should be used to cool samples to 4 °C during collection.

Priority Pollutant Scans - Water

Three volatile organic compounds were detected in the effluent at levels below water quality criteria. No semivolatiles, pesticides, or PCBs were detected.

The estimated effluent copper concentration was greater than both the acute and chronic marine water quality criteria. The estimated mercury concentration was greater than the chronic criteria.

Effluent Bioassays

No acute toxicity was indicated in the WTP effluent by rainbow trout or *Ceriodaphnia dubia*. LC50s were greater than 100 percent for both species. No chronic toxicity was indicated by *Ceriodaphnia dubia*; the NOEC was greater than 100 percent effluent. Some chronic toxicity was indicated by the echinoderm sperm fertilization (purple sea urchin) bioassay. The LOEC was 2.8 percent effluent. Possible causes of the toxicity could not be identified. The bivalve larvae bioassay was attempted but declared invalid and should be performed in the next Class II inspection.

Digested Sludge Analysis

No volatile organic compounds were detected in the digested sludge. Several priority pollutant metals were detected at low levels in the sludge. No semivolatile, pesticide, or PCB compounds were detected in TCLP extract. Priority pollutant analysis of the sludge may be necessary after the final federal regulations on land disposal are promulgated.

Sludge Treatment System

Preliminary calculations were made using inspection data. The calculations should be repeated by the permittee using flow weighted average data collected over a one to two month time period to determine if the sludge is adequately stabilized for land application.

Location of WTP Sample Sites

The WTP influent and effluent sample sites were suitable points to obtain representative samples.

Chlorination System

The automatic chlorine addition system was not functioning properly at the time of the inspection. The automatic addition system should be replaced as soon as possible in order to ensure compliance with the fecal coliform permit limit.

Sample Splits

Lab results for permitted parameters compared well between Sequim WTP and Ecology. The WTP laboratory procedures were not reviewed due to recent accreditation by the Ecology Quality Assurance/Quality Control group.

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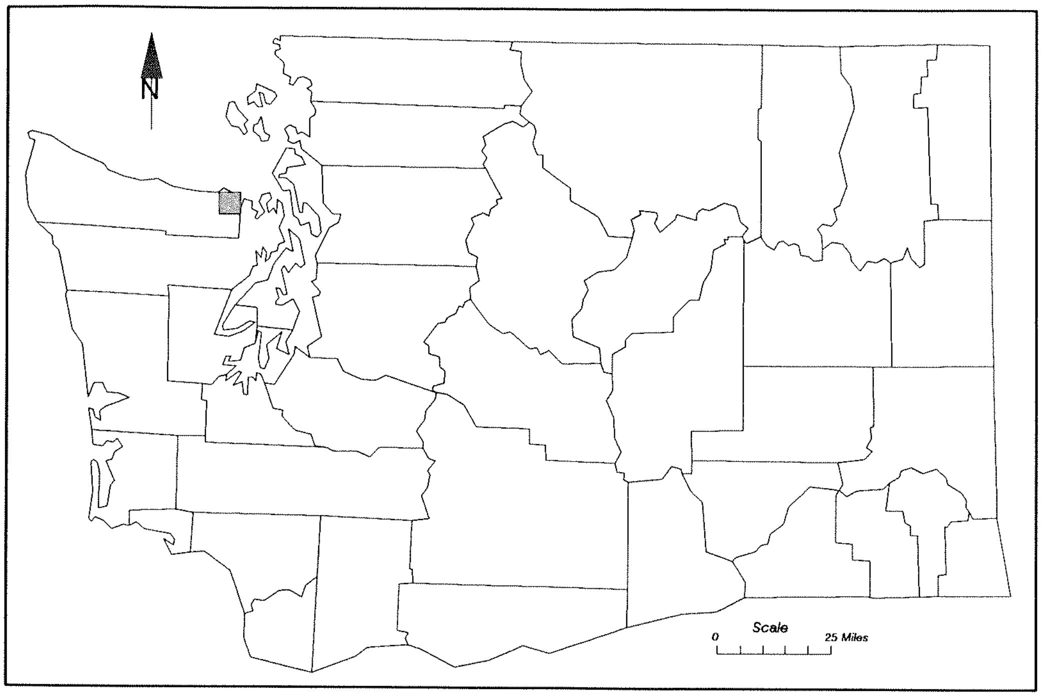
FIGURES



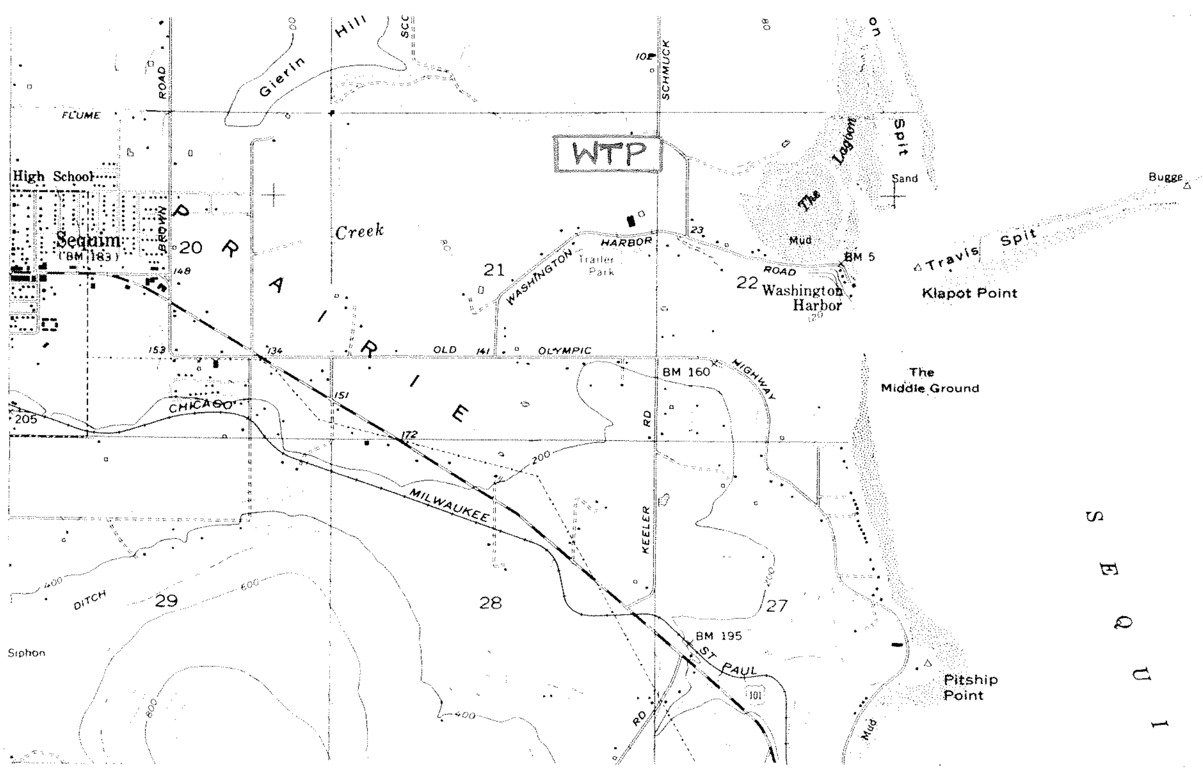


Figure 1 - Location Map - Sequim WTP, 8/90

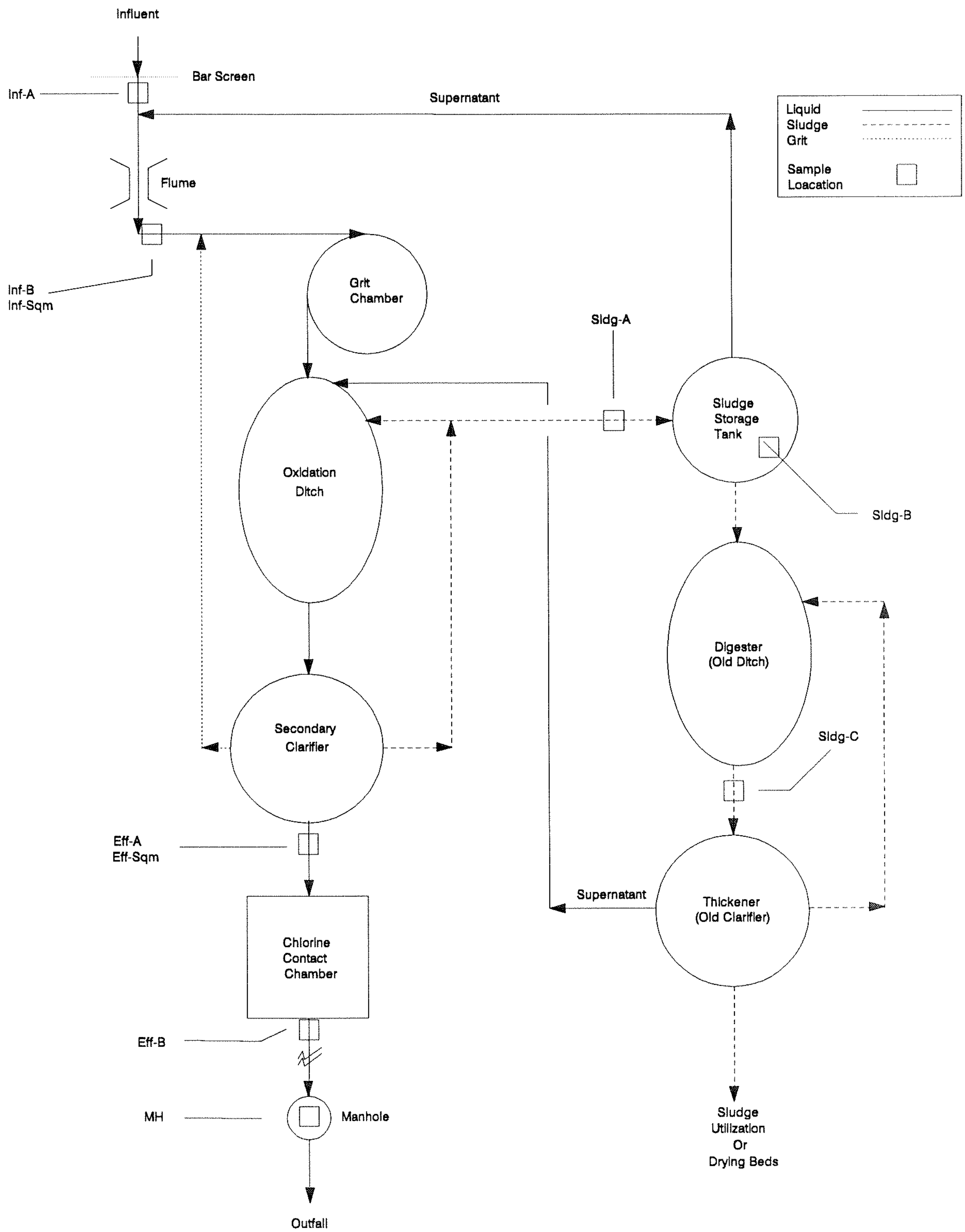


Figure 2 - Waste Treatment Plant Schematic & Sample Locations - Sequim WTP, 8/90

TABLES

Table 1 – Priority Pollutant Cleaning and Field Transfer Blank Procedure – Sequim WTP, 8/90.

PRIORITY POLLUTANT SAMPLING EQUIPMENT CLEANING PROCEDURE

1. Wash with laboratory detergent.
2. Rinse several times with tap water.
3. Rinse with 10% nitric acid solution.
4. Rinse three (3) 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 (VOA).

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 (BNA, Pesticide/PCB, and metals).

Table 2 – Sampling Schedule and Parameters Analyzed – Sequim WTP – 8/90.

Parameter	Station:	Inf-A	Inf-A	Inf-A	Inf-A-Eco	Inf-B	Inf-B	Inf-B	Inf-B-Eco	Inf-Sqm	Eff-A-Eco	Eff-Sqm	Eff-B	Eff-B
	Date:	08/07/90	08/07/90	08/08/90	8/7-8/90	08/07/90	08/07/90	08/08/90	8/7-8/90	8/7-8/90	8/7-8/90	8/7-8/90	08/07/90	08/07/90
	Time:	1100	1530	0927	1000-0930	1055	1540	0935	1000-0930	1000-0930	1000-0930	1000-0930	1130	1610
	Type:	grab	grab	grab	composite	grab	grab	grab	composite	composite	composite	composite	grab	grab
	Lab ID #:	328130	328131	328132	328139	328133	328134	328135	328140	328141	328142	328143	328136	328137
<u>FIELD</u>														
Temperature		E	E	E	E	E	E	E	E	E	E	E	E	E
pH		E	E	E	E	E	E	E	E	E	E	E	E	E
Conductivity		E	E	E	E	E	E	E	E	E	E	E	E	E
Chlorine Residual													E	E
<u>GENERAL CHEMISTRY</u>														
Turbidity		E	E	E	E	E	E	E	E	E	E	E	E	E
Conductivity		E	E	E	E	E	E	E	E	E	E	E	E	E
Alkalinity		E	E	E	E	E	E	E	E	E	E	E	E	E
Hardness					E									
SOLIDS														
TSS		E	E	E	E	E	E	E	E/S	E/S	E/S	E/S	E	E
TNVS					E				E	E	E	E		
TS					E				E	E	E	E		
TNVSS					E				E	E	E	E		
BOD5					E				E/S	E/S	E/S	E/S		
COD		E	E	E	E	E	E	E	E	E	E	E	E	E
TOC														
NUTRIENTS														
NH3-N		E	E	E	E	E	E	E	E	E	E	E	E	E
NO3+NO2-N		E	E	E	E	E	E	E	E	E	E	E	E	E
Total-P		E	E	E	E	E	E	E	E	E	E	E	E	E
Fecal Coliform														E
Total Coliform														
E. Coli														
Oil & Grease		E	E	E									E	E
Phenols					E									
Cyanide (Total)					E									
<u>PRIORITY POLLUTANTS</u>														
pp metals & Mo					E									
BNA (water)					E									
VOA (water)		E	E										E	E
Pest/PCB (water)					E									
BNA (solids)														
VOA (solids)														
Pest/PCB (solids)														
<u>BIOASSAYS</u>														
Rainbow Trout														
Ceriodaphnia														
Echinoderm														

E – Analysis by Ecology.
S – Analysis by Sequim.

Table 2 – Continued.

Sample:	Eff–B	Eff–B	Eff–B–Eco	Blank	MH	MH	Sldg–A	Sldg–B	Sldg–C	Sldg–A	Sldg–B	Sldg–C	Sldg–C
Date:	08/08/90	08/07/90	8/7–8/90	08/07/90	08/08/90	08/08/90	08/08/90	08/08/90	08/7–8/90	08/08/90	08/08/90	08/08/90	08/08/90
Time:	0945	0832	1000–0930	0925	0900	1355	1225	1228	24 hours	1235	1238	1245	1230
Type:	grab	grab	composite	transfer	grab	grab	grab	grab	composite	grab	grab	grab	grab
Parameter Lab ID #:	328138	328151	328144	328145	328146	328147	328148	328149	328150	328152	328153	328154	328180
FIELD													
Temperature	E		E		E	E							
pH	E		E		E	E							
Conductivity	E		E		E	E							
Chlorine Residual	E		E		E	E							
GENERAL CHEMISTRY													
Turbidity	E		E										
Conductivity	E		E										
Alkalinity	E		E										
Hardness			E										
SOLIDS			E										
TSS	E				E	E							
TNVS							E	E	E	E	E	E	E
TS							E	E	E	E	E	E	E
TNVSS													
BOD5			E										
COD	E		E		E	E			E				
TOC			E						E				
NUTRIENTS													
NH3–N	E		E		E	E			E				
NO3+NO2–N	E		E		E	E			E				
Total–P	E		E		E	E			E				
Fecal Coliform	E	E			E	E	E	E		E	E	E	E
Total Coliform					E	E	E	E		E	E	E	E
E. Coli					E	E							
Oil & Grease	E								E				
Phenols			E						E				
Cyanide (Total)			E	E					E				
PRIORITY POLLUTANTS													
pp metals & Mo			E	E					E				
BNA (water)			E	E									
VOA (water)				E									
Pest/PCB (water)			E	E									
BNA (solids)									E				
VOA (solids)									E				
Pest/PCB (solids)									E				
BIOASSAYS													
Rainbow Trout			E										
Ceriodaphnia			E										
Echinoderm			E										

E – Analysis by Ecology.

S – Analysis by Sequim.

Table 3 – Effluent Flow Measurements – Sequim WTP, 8/90.

DATE	TIME	ECOLOGY READING (ft)	FLOW 45 deg.* (mgd)	50 deg.* (mgd)	60 deg.* (mgd)	PLANT METER (mgd)
8/6/90	1545	0.70	0.27	0.31	0.39	0.43
8/7/90	0825	0.79	0.37	0.42	0.52	0.44
8/7/90	0951	0.92	0.54	0.61	0.76	0.54
8/7/90	1144	0.89	0.50	0.56	0.70	0.50
8/8/90	0806	0.75	0.33	0.37	0.46	0.56

*Flow calculated using V-notch weir angle and Ecology reading.

Table 4 - Summary of General Chemistry - Sequim WTP, 8/90.

	Station:	Inf-A	Inf-A	Inf-A	Inf-A-Eco	Inf-B	Inf-B	Inf-B	Inf-B-Eco	Inf-Sqm	Eff-A-Eco	Eff-Sqm
	Date:	08/07/90	08/07/90	08/08/90	8/7-8/90	08/07/90	08/07/90	08/08/90	8/7-8/90	8/7-8/90	8/7-8/90	8/7-8/90
	Time:	1100	1530	0927	000-093	1055	1540	0935	1000-0930	1000-0930	1000-0930	1000-0930
	Type:	grab	grab	grab	composite	grab	grab	grab	composite	composite	composite	composite
Parameter	Lab ID#:	328130	328131	328132	328139	328133	328134	328135	328140	328141	328142	328143
<u>LABORATORY</u>	<u>UNITS</u>											
Turbidity	NTU	72	75	83	86	66	72	94	70	68	2.2	1.4
Conductivity	umho/cm	647	584	719	663	574	532	721	648	611	450	450
Alkalinity	mg/l as CaCO3	251	222	284	242	209	197	283	228	226	143	142
Hardness	mg/l as CaCO3				101							
SOLIDS												
TS	mg/l				707				639	681	323	291
TNVS	mg/l				236				275	244	219	233
TSS	mg/l	229	123	376	315	143	204	317	259	363	17	5
TNVSS	mg/l				56				52	52	6	2
BOD5	mg/l				364				260	228	7	7
COD	mg/l	651	654	648	727	548	639	595	603	499	26.9	595
TOC	mg/l											
NUTRIENTS												
NH3-N	mg/l as N	26.7	18.1	37.6	37.6	20.7	21.5	54.9	25.0	32.6	0.390	0.291
NO3+NO2-N	mg/l as N	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.026	0.010 U	0.018(0.017)*	1.46	1.66
T. Phosphorous	mg/l as P	6.10	6.65	7.00	7.75	9.20	7.00	7.00	7.90	7.20	6.55	10.4
Fecal Coliform	#/100 ml											
Total Coliform	#/100 ml											
E. Coli	#/100 ml											
Oil & Grease	mg/l	18	39	42(37)*								
Phenol	mg/l				0.032							
Cyanide	mg/l				0.005 U							
<u>FIELD</u>												
pH	S.U.	7.4	7.1	7.9	7.4	7.2	7.2	7.7	7.6	7.4	7.6	7.7
Conductivity	umho/cm	606	640	666	660	567	576	565	670	630	526	433
Temperature	deg. C	21.2	21.5	21.1	5.4	21.0	21.2	20.9	4.0	17.7	5.2	20.7
Chlorine Residual												
Free:	mg/l											
Total:	mg/l											

U - Compound was analyzed for but not detected at the given detection limit.
*Duplicate Analysis.
**Triplicate Analysis.

Table 4 - Continued.

Parameter	Station:	Eff-B	Eff-B	Eff-B	Eff-B	Eff-B-Eco	MH	MH
	Date:	08/07/90	08/07/90	08/08/90	08/07/90	8/7-8/90	08/08/90	08/08/90
	Time:	1130	1610	0945	0832	1000-0930	0900	1355
	Type:	grab	grab	grab	grab	composite	grab	grab
	Lab ID#:	328136	328137	328138	328151	328144	328146	328147
<u>LABORATORY</u>	<u>UNITS</u>							
Turbidity	NTU	1.2	1.1	1.5		1.7		
Conductivity	umho/cm	459	458	456		432		
Alkalinity	mg/l as CaCO3	141	136	142		141		
Hardness	mg/l as CaCO3					104		
SOLIDS								
TS	mg/l					282		
TNVS	mg/l					222		
TSS	mg/l	1U	1U	1		1	1 U	1 U
TNVSS	mg/l					1		
BOD5	mg/l					3		
COD	mg/l	27.4	26.2	29.3		33.8	27.1	19.5
TOC	mg/l					5.10(5.43)*		
NUTRIENTS								
NH3-N	mg/l as N	0.086	0.513	0.116(0.121)*		0.442	0.086	0.059(0.056)*
NO3+NO2-N	mg/l as N	1.64(1.72)*	2.63	1.33		1.52	1.42	2.50
T. Phosphorous	mg/l as P	13.6	16.3	7.20		5.90	4.62	4.80(4.84, 4.88)**
Fecal Coliform	#/100 ml		10	25	5		35(110)+	27(49)+
Total Coliform	#/100 ml						(950)+	(1600)+
E. Coli	#/100 ml						79	11
Oil & Grease	mg/l	1.0 U	1.0 U	1.1(1.0 U)*				
Phenol	mg/l					0.005 U		
Cyanide	mg/l					0.005 U		
<u>FIELD</u>								
pH	S.U.	7.2	7.3	7.3		7.6	7.5	7.5
Conductivity	umho/cm	454	463	460		476	420	517
Temperature	deg. C	20.7	21.6	20.0		6.9	19.4	20.8
Chlorine Residual								
Free:	mg/l	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Total:	mg/l	0.6	0.9	0.5		0.1	0.2	0.5

U - Compound was analyzed for but not detected at the given detection limit.
*Duplicate Analysis. +Coliform Method - MF(MPN)
**Triplicate Analysis.

Table 5 – Comparison of Inspection Results to NPDES Permit Limits – Sequim WTP, 8/90.

	NPDES Permit Limits		Inspection Data		Plant Loading			
	Monthly	Weekly	Ecology	Grab	Design		Inspection	
Parameter	Average	Average	Composite*	Samples	Criteria	85% of DC	Results	% of DC
Influent BOD5								
(mg/l)			260					
(lbs/d)					1210	1030	1017	84
Effluent BOD5								
(mg/l)	30	45	3					
(lbs/d)	164	245	12					
(% removal)	85		98.8					
Influent TSS								
(mg/l)			259					
(lbs/d)					1210	1030	1013	84
Effluent TSS								
(mg/l)	30	45	1					
(lbs/d)	164	245	4					
(% removal)	85		99.6					
Fecal Coliform								
(#/100 ml)	200	400		10, 25, 5				
pH (S.U.)	6.0 - 9.0	6.0 - 9.0	7.6	7.2, 7.3, 7.3				
Flow (mgd)					0.725	0.616	0.469**	65

DC - Design Criteria.

* Inf-B-Eco (328140) and Eff-A-Eco (328142).

**WTP influent totalizer readings were: 114718 at 0930 on 8/7/90; 115675 at 1030 on 8/9/90. Therefore, the average flow for 8/8-9/90 was: 957 gallons/2.04 days = 0.469 mgd.

Table 6 – Priority Pollutants Detected in Water Samples – Sequim WTP, 8/90.

	Station: Lab ID#:	Inf-A 328130	Inf-A 328131	Eff-B 328136	Eff-B 328137	EPA Water Quality Criteria Summary+ Fresh Water Acute	Fresh Water Chronic	Marine Water Acute	Marine Water Chronic
VOA Compounds (ug/L)									
Acetone		58	42						
Chloroform		4.2 J	2.6 J	9.9 J	2.7 J	28,900*	1,240*		
Bromodichloromethane++				1.3 J		11,000*		12,000*	6,400*
Toluene			1.5 J			17,500*		6,300*	5,000*
Total Xylenes			2.4 J	1.3 J					
1,4-Dichlorobenzene+++		1.4 J	1.3 J			1,120*	763*	1,970*	

	Station: Lab ID#:	Inf-A-Eco 328139	Eff-B-Eco 328144	Transfer Blank 328145	EPA Water Quality Criteria Summary+ Fresh Water Acute	Fresh Water Chronic	Marine Water Acute	Marine Water Chronic
BNA Compounds (ug/L)								
Diethyl Phthalate++++		10 J			940*	3*	2,949*	3.4*
Bis(2-Ethylhexyl)phthalate++++		17 J			940*	3*	2,949*	3.4*
Phenol		17 J			10,200*	2,560*	5,800*	
Benzyl Alcohol		34						
4-Methylphenol		42						
Metals – Total Recoverable (ug/L)								
Arsenic***			1.7 J		850*(360)	48*(190)	2,319*(69)	13*(36)
Cadmium		0.83	0.14 J	0.27 J	4.1**	1.2**	43	9.3
Copper		159	7.8 J		18**	12**	2.9	2.9
Lead		12.8	2.2 J	4.6 J	86**	3.3**	140	5.6
Mercury****		1.76	0.08 J		2.4	0.012	2.1	0.025
Zinc		234	79		120**	110**	95	86
Nickel					1470**	163**	75	8.3

J – Indicates an estimated value. Value was calculated from a response below the known linear range.
+EPA, 1986.
++Toxicity values for total Halomethanes.
+++Toxicity values for total Dichlorobenzenes.
++++Toxicity values for total Phthalate Esters.
*Insufficient data to develop criteria, value presented is the L.O.E.L. – Lowest Observed Effect Level.
** Hardness dependent criteria (Hardness = 104 mg/L).
***Toxicity values for pentavalent(trivalent) species.
****Mercury procedure uses a total digestion.

Table 7 – Effluent Bioassay Results – Sequim WTP, 8/90.

Rainbow Trout 96-Hour Survival *(Oncorhynchus mykiss)*

Treatment	Replicate	Initial Count	Final Count	Percent Mortality	Average Mortality
Control	A	10	10	0	
	B	10	10	0	0
6.25% Effluent	A	10	10	0	
	B	10	10	0	0
12.5% Effluent	A	10	10	0	
	B	10	10	0	0
25.0% Effluent	A	10	10	0	
	B	10	10	0	0
50.0% Effluent	A	10	10	0	
	B	10	10	0	0
100.0% Effluent	A	10	9	10	
	B	10	10	0	5
					LC50 = >100%

Echinoderm Sperm Fertilization – Purple Sea Urchin *(Strongylocentrotus purpuratus)*

Treatment	Replicate	Percent of Eggs Fertilized	Average Percent per Concentration
Control	A	81	77.8
	B	74	
	C	80	
	D	76	
Brine Control	A	63	70.5
	B	78	
	C	73	
	D	66	
2.8% Effluent	A	16	20.3
	B	19	
	C	26	
	D	20	
5.6% Effluent	A	8	10.5
	B	11	
	C	12	
	D	11	
11.3% Effluent	A	12	10.2
	B	15	
	C	10	
	D	4	
22.5% Effluent	A	8	8.2
	B	12	
	C	11	
	D	2	
45.0% Effluent	A	7	9.0
	B	8	
	C	11	
	D	10	
			LOEC = 2.8%
			NOEC = <2.8%

Ceriodaphnia dubia 7-Day Survival and Reproduction

Treatment	Initial Count	Final Count	Percent Mortality	Average Young per Female
Control	10	10	0	24.4
6.25% Effluent	10	6	40	17.5
12.5% Effluent	10	10	0	17.9
25.0% Effluent	10	10	0	18.1
50.0% Effluent	10	10	0	17.6
100.0% Effluent	10	9	10	20.2
			LC50 = >100.0%	NOEC = >100.0%

NOEC – No Observed Effect Concentration: the highest concentration of effluent that did not cause an observable effect.
LOEC – Lowest Observed Effect Concentration: the lowest concentration of effluent that caused an observable adverse effect.
LC50 – Concentration lethal to 50% of the organisms.

Table 8 – Priority Pollutants Detected in Sludge and General Chemistry Results – Sequim WTP, 8/90.

				National Sewage Sludge Survey+		
		Station: Digested Sludge		Geometric	Number of	Percent
Parameter	Units	Lab ID#: 328150		Mean	Samples	Detect++
Metals - Total						
Cadmium	mg/kg-dry	0.070	B	5.78	42	64
Chromium	mg/kg-dry	118	JB	102.77	42	88
Copper	mg/kg-dry	1180	B	755.86	42	100
Lead	mg/kg-dry	0.94		125.36	42	76
Mercury	mg/kg-dry	17.5		5.58	42	57
Silver	mg/kg-dry	61	J	--	--	--
Zinc	mg/kg-dry	983	B	1,080.02	42	100
General Chemistry						
Solids						
TS	mg/L	11910				
TNVS	mg/L	3420				
Nutrients						
NH3-N	mg/L	27.2				
NO3+NO2-N	mg/L	1.96	(2.07)*			
Phosphate - Total	mg/L	133	(129)*			
COD	mg/L	11800				
TOC	% dry weight	8.1	(7.4, 5.9)**			
Cyanide - Total	mg/kg	0.006	(0.007)*			
Phenols	mg/kg	0.005	U			
Oil & Grease	mg/kg	2.3				

U - Indicates compound was analyzed for but not detected at the given quantification limit.
J - Indicates an estimated value. Value was calculated from a response below the know linear range.
B - Indicates analyte was found in the method blank as well as the sample, possible/probable method blank contamination.
*Duplicate analysis.
**Triplicate Analysis.
+EPA, 1990b. Values presented are for WTPs with flows less than or equal to 1 MGD.
++Percent of samples in which the compound was detected above the quantification limit.

Table 9 – Toxicity Characteristic Constituents and Regulatory Levels – Sequim WTP, 8/90.

Constituent	Station: Lab ID#:	Digested Sludge 328150 (mg/L)	Regulatory Level (mg/L)
Arsenic		NA	5.0
Barium		NA	100.0
Benzene		NA	0.5
Cadmium		NA	1.0
Carbon Tetrachloride		NA	0.5
Chlordane		0.003 U	0.03
Chlorobenzene		NA	100.0
Chloroform		NA	6.0
Chromium		NA	5.0
o-Cresol		0.005 U	200.0*
m-Cresol		NA	200.0*
p-Cresol		0.005 U	200.0*
Cresol		0.020 U	200.0*
2,4-D		NA	10.0
1,4-Dichlorobenzene		NA	7.5
1,2-Dichloroethane		NA	0.5
1,1-Dichloroethylene		NA	0.7
2,4-Dinitrotoluene		0.005 U	0.13
Endrin		0.0002 U	0.02
Heptachlor (and its epoxide)		0.0002 U	0.008
Hexachlorobenzene		0.005 U	0.13
Hexachloro-1,3-butadiene		0.005 U	0.5
Hexachloroethane		0.005 U	3.0
Lead		NA	5.0
Lindane		0.0002 U	0.4
Mercury		NA	0.2
Methoxychlor		NA	10.0
Methyl ethyl ketone		NA	200.0
Nitrobenzene		0.005 U	2.0
Pentachlorophenol		0.020 U	100.0
Pyridine		0.020 U	5.0
Selenium		NA	1.0
Silver		NA	5.0
Tetrachloroethylene		NA	0.7
Toxaphene		0.005 U	0.5
Trichloroethylene		NA	0.5
2,4,5-Trichlorophenol		0.005 U	400.0
2,4,6-Trichlorophenol		0.005 U	2.0
2,4,5-TP (Silvex)		NA	1.0
Vinyl Chloride		NA	0.2

*If o-, m-, and p-cresol concentrations cannot be differentiated, the total cresol concentration is used. The regulatory level for total cresol is 200 mg/L.

NA - Not Analyzed

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

Table 10 - Comparison of Sample Sites - Sequim WTP, 8/90.

Parameter	Station: Lab ID#:	Inf-A-Eco 328139	Inf-B-Eco 328140	Eff-A-Eco 328142	Eff-B-Eco 328144
LABORATORY	UNITS				
Turbidity	NTU	86	70	2.2	1.7
Conductivity	umho/cm	663	648	450	432
Alkalinity	mg/l as CaCO3	242	228	143	141
SOLIDS					
TS	mg/l	707	639	323	282
TNVS	mg/l	236	275	219	222
TSS	mg/l	315	259	17	1
TNVSS	mg/l	56	52	6	1
BOD5	mg/l	364	260	7	3
COD	mg/l	727	603	26.9	33.8
NUTRIENTS					
NH3-N	mg/l as N	37.6	25.0	0.390	0.442
NO3+NO2-N	mg/l as N	0.010 U	0.010 U	1.46	1.52
T. Phosphorous	mg/l as P	7.75	7.90	6.55	5.90
FIELD					
pH	S.U.	7.4	7.6	7.6	7.6
Conductivity	umho/cm	660	670	526	476
Temperature	deg. C	5.4	4.0	5.2	6.9

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

Table 11 - Comparison of Sample Splits - Sequim WTP, 8/90.

Sample	Sampler	Laboratory	BOD (mg/l)	TSS (mg/l)	TVSS (mg/l)
Inf-B-Eco	Ecology	Sequim WTP	251	248	214
(328140)		Ecology	260	259	207
Inf-Sqm	Sequim WTP	Sequim WTP	226	180	158
(328141)		Ecology	228	363	311
Eff-A-Eco	Ecology	Sequim WTP	6	12	
(328142)		Ecology	7	17	
Eff-Sqm	Sequim WTP	Sequim WTP	6	5	
(328143)		Ecology	7	5	

APPENDIX A

Appendix A – Ecology Analytical Methods – Sequim WTP, 8/90.

Analyses	Method Used	Laboratory
GENERAL CHEMISTRY		
Turbidity	EPA, 1979: 180.1	Ecology; Manchester, WA
Conductivity	EPA, 1979: 120.1	Ecology; Manchester, WA
Alkalinity	EPA, 1979: 310.1	Ecology; Manchester, WA
Hardness	EPA, 1979: 130.2	Ecology; Manchester, WA
SOLIDS		
TS	EPA, 1979: 160.3	Ecology; Manchester, WA
TNVS & TNVSS	APHA, 1989: 2540 E	Ecology; Manchester, WA
TSS	EPA, 1979: 160.2	Ecology; Manchester, WA
BOD5	EPA, 1979: 405.1	Ecology; Manchester, WA
COD	EPA, 1979: 410.1	Ecology; Manchester, WA
TOC, water	EPA, 1979: 415.1	Am Test Inc.; Redmond, WA
NUTRIENTS		
NH3–N	EPA, 1979: 350.1	Am Test Inc.; Redmond, WA
NO3+NO2–N	EPA, 1979: 353.2	Am Test Inc.; Redmond, WA
Phosphorous – Total	EPA, 1979: 365.1	Am Test Inc.; Redmond, WA
TOC, solids	APHA, 1989: 5310	Am Test Inc.; Redmond, WA
Fecal Coliform (MF)	APHA, 1989: 9222 D	Ecology; Manchester, WA
Total Coliform (MF)	APHA, 1989: 9222 B	Ecology; Manchester, WA
Fecal Coliform (MPN)	APHA, 1989: 9221 C	Ecology; Manchester, WA
Total Coliform (MPN)	APHA, 1989: 9221 B	Ecology; Manchester, WA
E. Coli	APHA, 1989: 9225 C	Ecology; Manchester, WA
Phenols	EPA, 1979: 420.2	Am Test Inc.; Redmond, WA
Oil & Grease	EPA, 1979: 413.1	Am Test Inc.; Redmond, WA
Cyanide	EPA, 1979: 335.2	Am Test Inc.; Redmond, WA
PRIORITY POLLUTANTS		
Semivolatiles, water	EPA, 1986: 3520/8270	Columbia Analytical Services, Inc.; Kelso, WA
Semivolatiles, solids	EPA, 1986: 3510/8270	Columbia Analytical Services, Inc.; Kelso, WA
Volatiles, water	EPA, 1986: 8240	Columbia Analytical Services, Inc.; Kelso, WA
Volatiles, solids	EPA, 1986: 8240	Columbia Analytical Services, Inc.; Kelso, WA
Pest/PCBs, water	EPA, 1986: 3510/8080	Columbia Analytical Services, Inc.; Kelso, WA
Pest/PCBs, solids	EPA, 1986: 3510/8080	Columbia Analytical Services, Inc.; Kelso, WA
Metals, water/solids	EPA, 1984: 200	Ecology; Manchester, WA
TCLP Extraction	EPA, 1990: 1311	Columbia Analytical Services, Inc.; Kelso, WA
BIOASSAYS		
Rainbow Trout	EPA, 1985	ERC Environmental and Energy Services Company, Inc.; San Diego, CA
Ceriodaphnia dubia	EPA, 1985 or 1989	ERC Environmental and Energy Services Company, Inc.; San Diego, CA
Echinoderm Fertilization	Dinnel, 1987 and EPA, 1989	ERC Environmental and Energy Services Company, Inc.; San Diego, CA

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APPENDIX B

Appendix B - Priority Pollutant Scans on Water Samples - Sequim WTP, 8/90.

	Station:										Transfer Blank	
	Station:	Inf-A		Inf-A		Eff-B		Eff-B			Blank	
	Lab ID#:	328130		328131		328136		328137			328145	
VOA Compounds (ug/L)												
Chloromethane		1	U	1	U	1	U	1	U		1	U
Vinyl Chloride		1	U	1	U	1	U	1	U		1	U
Bromomethane		1	U	1	U	1	U	1	U		1	U
Chloroethane		1	U	1	U	1	U	1	U		1	U
Trichlorofluoromethane		1	U	1	U	1	U	1	U		1	U
Freon 113		10	U	10	U	10	U	10	U		10	U
1,1-Dichloroethene		1	U	1	U	1	U	1	U		1	U
Acetone		58		42		10	U	10	U		10	U
Carbon Disulfide		1	U	1	U	1	U	1	U		1	U
Methylene Chloride		10	U	10	U	10	U	10	U		10	U
Trans 1,2-Dichloroethene		1	U	1	U	1	U	1	U		1	U
Cis 1,2-Dichloroethene		1	U	1	U	1	U	1	U		1	U
2-Butanone (MEK)		10	U	10	U	10	U	10	U		10	U
1,1-Dichloroethane		1	U	1	U	1	U	1	U		1	U
Chloroform		4.2	J	2.6	J	9.9	J	2.7	J		1	U
1,1,1-Trichloroethane		1	U	1	U	1	U	1	U		1	U
Carbon Tetrachloride		1	U	1	U	1	U	1	U		1	U
Benzene		1	U	1	U	1	U	1	U		1	U
1,2-Dichloroethane		1	U	1	U	1	U	1	U		1	U
Vinyl Acetate		10	U	10	U	10	U	10	U		10	U
Trichloroethene		1	U	1	U	1	U	1	U		1	U
1,2-Dichloropropane		1	U	1	U	1	U	1	U		1	U
Bromodichloromethane		1	U	1	U	1.3	J	1	U		1	U
2-Chloroethylvinyl ether		10	U	10	U	10	U	10	U		10	U
trans-1,3-Dichloropropene		1	U	1	U	1	U	1	U		1	U
2-Hexanone		10	U	10	U	10	U	10	U		10	U
4-Methyl-2-Pentanone (MIBK)		10	U	10	U	10	U	10	U		10	U
Toluene		1	U	1.5	J	1	U	1	U		1	U
cis-1,3-Dichloropropene		1	U	1	U	1	U	1	U		1	U
1,1,2-Trichloroethane		1	U	1	U	1	U	1	U		1	U
Tetrachloroethene		1	U	1	U	1	U	1	U		1	U
Dibromochloromethane		1	U	1	U	1	U	1	U		1	U
Chlorobenzene		1	U	1	U	1	U	1	U		1	U
Ethylbenzene		1	U	1	U	1	U	1	U		1	U
Ethenylbenzene (Styrene)		1	U	1	U	1	U	1	U		1	U
Total Xylenes		1	U	2.4	J	1.3	J	1	U		1	U
Bromoform		1	U	1	U	1	U	1	U		1	U
1,1,2,2-Tetrachloroethane		1	U	1	U	1	U	1	U		1	U
1,3-Dichlorobenzene		1	U	1	U	1	U	1	U		1	U
1,4-Dichlorobenzene		1.4	J	1.3	J	1	U	1	U		1	U
1,2-Dichlorobenzene		1	U	1	U	1	U	1	U		1	U

Appendix B - Continued.

	Station:	Inf-A-Eco		Eff-B-Eco		Transfer Blank	
	Lab ID#:	328139		328144		328145	
BNA Compounds (ug/L)							
N-Nitrosodimethylamine		5	U	5	U	5	U
Aniline		5	U	5	U	5	U
Bis(2-Chloroethyl)Ether		5	U	5	U	5	U
1,2-Dichlorobenzene		5	U	5	U	5	U
1,3-Dichlorobenzene		5	U	5	U	5	U
1,4-Dichlorobenzene		5	U	5	U	5	U
Bis(2-chloroisopropyl)ether		5	U	5	U	5	U
N-Nitroso-Di-n-Propylamine		5	U	5	U	5	U
Hexachloroethane		5	U	5	U	5	U
Nitrobenzene		5	U	5	U	5	U
Isophorone		5	U	5	U	5	U
Bis(2-Chloroethoxy)Methane		5	U	5	U	5	U
1,2,4-Trichlorobenzene		5	U	5	U	5	U
Naphthalene		5	U	5	U	5	U
4-Chloroaniline		5	U	5	U	5	U
Hexachlorobutadiene		5	U	5	U	5	U
2-Methylnaphthalene		5	U	5	U	5	U
Hexachlorocyclopentadiene		5	U	5	U	5	U
2-Chloronaphthalene		5	U	5	U	5	U
2-Nitroaniline		20	U	20	U	20	U
Dimethyl Phthalate		5	U	5	U	5	U
Acenaphthylene		5	U	5	U	5	U
3-Nitroaniline		20	U	20	U	20	U
Acenaphthene		5	U	5	U	5	U
Dibenzofuran		5	U	5	U	5	U
2,4-Dinitrotoluene		5	U	5	U	5	U
2,6-Dinitrotoluene		5	U	5	U	5	U
Diethyl Phthalate		10	J	5	U	5	U
4-Chlorophenyl phenyl ether		5	U	5	U	5	U
Fluorene		5	U	5	U	5	U
4-Nitroaniline		20	U	20	U	20	U
N-Nitrosodiphenylamine		5	U	5	U	5	U
4-Bromophenyl phenyl ether		5	U	5	U	5	U
Hexachlorobenzene		5	U	5	U	5	U
Phenanthrene		5	U	5	U	5	U
Anthracene		5	U	5	U	5	U
Dibutylphthalate		5	U	5	U	5	U
Fluoranthene		5	U	5	U	5	U
Pyrene		5	U	5	U	5	U
Butylbenzylpthalate		5	U	5	U	5	U
3,3'-Dichlorobenzidine		5	U	5	U	5	U
Benzo(a)anthracene		5	U	5	U	5	U
Bis(2-Ethylhexyl)phthalate		17	J	5	U	5	U
Chrysene		5	U	5	U	5	U
Di-n-Octyl Phthalate		5	U	5	U	5	U
Benzo(b)fluoranthene		5	U	5	U	5	U
Benzo(k)fluoranthene		5	U	5	U	5	U
Benzo(a)pyrene		5	U	5	U	5	U
Indeno(1,2,3-cd)pyrene		5	U	5	U	5	U

Appendix B – Continued.

Station:	Inf-A-Eco		Eff-B-Eco		Transfer Blank	
Lab ID#:	328139		328144		328145	
<u>BNA Compounds, Cont. (ug/L)</u>						
Dibenzo(a,h)anthracene	5	U	5	U	5	U
Benzo(g,h,i)perylene	5	U	5	U	5	U
Phenol	17	J	5	U	5	U
2-Chlorophenol	5	U	5	U	5	U
Benzyl Alcohol	34		5	U	5	U
2-Methylphenol	5	U	5	U	5	U
4-Methylphenol	42		5	U	5	U
2-Nitrophenol	5	U	5	U	5	U
2,4-Dimethylphenol	5	U	5	U	5	U
Benzoic Acid	50	U	50	U	50	U
2,4-Dichlorophenol	5	U	5	U	5	U
4-Chloro-3-Methylphenol	5	U	5	U	5	U
2,4,6-Trichlorophenol	5	U	5	U	5	U
2,4,5-Trichlorophenol	5	U	5	U	5	U
2,4-Dinitrophenol	50	U	50	U	50	U
4-Nitrophenol	50	U	50	U	50	U
2-Methyl-4,6-Dinitrophenol	20	U	20	U	20	U
Pentachlorophenol	20	U	20	U	20	U
<u>Pesticide/PCB Compounds (ug/L)</u>						
alpha-BHC	0.04	U	0.04	U	0.04	U
gamma-BHC (Lindane)	0.04	U	0.04	U	0.04	U
beta-BHC	0.1	U	0.1	U	0.1	U
Heptachlor	0.04	U	0.04	U	0.04	U
delta-BHC	0.04	U	0.04	U	0.04	U
Aldrin	0.04	U	0.04	U	0.04	U
Heptachlor Epoxide	0.04	U	0.04	U	0.04	U
alpha-Endosulfan	0.04	U	0.04	U	0.04	U
4,4'-DDE	0.04	U	0.04	U	0.04	U
Dieldrin	0.04	U	0.04	U	0.04	U
Endrin	0.04	U	0.04	U	0.04	U
4,4'-DDD	0.04	U	0.04	U	0.04	U
beta-Endosulfan	0.04	U	0.04	U	0.04	U
4,4'-DDT	0.04	U	0.04	U	0.04	U
Endrin Aldehyde	0.04	U	0.04	U	0.04	U
Endosulfan Sulfate	0.04	U	0.04	U	0.04	U
Methoxychlor	0.1	U	0.1	U	0.1	U
Toxaphene	1	U	1	U	1	U
Chlordane	0.5	U	0.5	U	0.5	U
Aroclor-1016	0.2	U	0.2	U	0.2	U
Aroclor-1221	0.2	U	0.2	U	0.2	U
Aroclor-1232	0.2	U	0.2	U	0.2	U
Aroclor-1242	0.2	U	0.2	U	0.2	U
Aroclor-1248	0.2	U	0.2	U	0.2	U
Aroclor-1254	0.2	U	0.2	U	0.2	U
Aroclor-1260	0.2	U	0.2	U	0.2	U

Appendix B – Continued.

	Station:	Inf-A-Eco		Eff-B-Eco		Transfer Blank	
	Lab ID#:	328139		328144		328145	
<u>Metals - Total Recoverable (ug/L)</u>							
Antimony		1.0	UJ	1.0	UJ	1.0	UJ
Arsenic		1.5	U	1.7	J	1.5	U
Berylium		2.0	U	2.0	U	2.0	U
Cadmium		0.83		0.14	J	0.27	J
Chromium		10	U	10	U	10	U
Cooper		159		7.8	J	5.0	U
Lead		12.8		2.2	J	4.6	J
Mercury*		1.76		0.08	J	0.04	U
Molybdenum		10	UJ	10	U	10	UJ
Nickel		40	U	40	U	40	U
Selenium		2.0	U	2.0	U	2.0	U
Silver		4.0	UJ	4.0	U	4.0	UJ
Thallium		2.5	U	2.5	U	2.5	U
Zinc		234		79		10	U

U - Indicates compound was analyzed for but not detected at the given quantification limit.
J - Indicates an estimated value. Value was calculated from a response below the known linear range.
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.
*Total digestion for mercury.

APPENDIX C

Appendix C - Priority Pollutant Scans on Sludge Samples - Sequim WTP, 8/90.

	Station:	Digested Sludge	
	Lab ID#:	328150	
VOA Compounds (ug/kg-dry)			
Chloromethane		250	U
Vinyl Chloride		250	U
Bromomethane		250	U
Chloroethane		250	U
Trichlorofluoromethane		250	U
Freon 113		500	U
1,1-Dichloroethene		250	U
Acetone		500	U
Carbon Disulfide		250	U
Methylene Chloride		500	U
Trans 1,2-Dichloroethene		250	U
Cis 1,2-Dichloroethene		250	U
2-Butanone (MEK)		500	U
1,1-Dichloroethane		250	U
Chloroform		250	U
1,1,1-Trichloroethane		250	U
Carbon Tetrachloride		250	U
Benzene		250	U
1,2-Dichloroethane		250	U
Vinyl Acetate		500	U
Trichloroethene		250	U
1,2-Dichloropropane		250	U
Bromodichloromethane		250	U
2-Chloroethylvinyl ether		500	U
trans-1,3-Dichloropropene		250	U
2-Hexanone		500	U
4-Methyl-2-Pentanone (MIBK)		500	U
Toluene		250	U
cis-1,3-Dichloropropene		250	U
1,1,2-Trichloroethane		250	U
Tetrachloroethene		250	U
Dibromochloromethane		250	U
Chlorobenzene		250	U
Ethylbenzene		250	U
Ethenylbenzene (Styrene)		250	U
Total Xylenes		250	U
Bromoform		250	U
1,1,2,2-Tetrachloroethane		250	U
1,3-Dichlorobenzene		250	U
1,4-Dichlorobenzene		250	U
1,2-Dichlorobenzene		250	U

Appendix C – Continued.

	Station:	Digested Sludge
	Lab ID#:	328150
BNA Compounds* (ug/L)		
N-Nitrosodimethylamine		5 U
Aniline		5 U
Bis(2-Chloroethyl)Ether		5 U
1,2-Dichlorobenzene		5 U
1,3-Dichlorobenzene		5 U
1,4-Dichlorobenzene		5 U
Bis(2-chloroisopropyl)ether		5 U
N-Nitroso-Di-n-Propylamine		5 U
Hexachloroethane		5 U
Nitrobenzene		5 U
Isophorone		5 U
Bis(2-Chloroethoxy)Methane		5 U
1,2,4-Trichlorobenzene		5 U
Naphthalene		5 U
4-Chloroaniline		5 U
Hexachlorobutadiene		5 U
2-Methylnaphthalene		5 U
Hexachlorocyclopentadiene		5 U
2-Chloronaphthalene		5 U
2-Nitroaniline		20 U
Dimethyl Phthalate		5 U
Acenaphthylene		5 U
3-Nitroaniline		20 U
Acenaphthene		5 U
Dibenzofuran		5 U
2,4-Dinitrotoluene		5 U
2,6-Dinitrotoluene		5 U
Diethyl Phthalate		5 U
4-Chlorophenyl phenyl ether		5 U
Fluorene		5 U
4-Nitroaniline		20 U
N-Nitrosodiphenylamine		5 U
4-Bromophenyl phenyl ether		5 U
Hexachlorobenzene		5 U
Total Cresols		20 U
Phenanthrene		5 U
Anthracene		5 U
Dibutylphthalate		5 U
Fluoranthene		5 U
Pyrene		5 U
Butylbenzylpthalate		5 U
3,3'-Dichlorobenzidine		5 U
Benzo(a)anthracene		5 U
Bis(2-Ethylhexyl)phthalate		5 U
Chrysene		5 U
Di-n-Octyl Phthalate		5 U
Benzo(b)fluoranthene		5 U
Benzo(k)fluoranthene		5 U
Benzo(a)pyrene		5 U

Appendix C – Continued.

	Station: Lab ID#:	Digested Sludge 328150	
BNA Compounds*, Cont. (ug/L)			
Indeno(1,2,3-cd)pyrene		5	U
Dibenzo(a,h)anthracene		5	U
Benzo(g,h,i)perylene		5	U
Phenol		5	U
2-Chlorophenol		5	U
Benzyl Alcohol		5	U
2-Methylphenol		5	U
4-Methylphenol		5	U
2-Nitrophenol		5	U
2,4-Dimethylphenol		5	U
Benzoic Acid		50	U
2,4-Dichlorophenol		5	U
4-Chloro-3-Methylphenol		5	U
2,4,6-Trichlorophenol		5	U
2,4,5-Trichlorophenol		5	U
2,4-Dinitrophenol		50	U
4-Nitrophenol		50	U
2-Methyl-4,6-Dinitrophenol		20	U
Pentachlorophenol		20	U
Pyridine		20	U
Pesticide/PCB Compounds* (ug/L)			
alpha-BHC		0.2	U
gamma-BHC (Lindane)		0.2	U
beta-BHC		0.5	U
Heptachlor		0.2	U
delta-BHC		0.2	U
Aldrin		0.2	U
Heptachlor Epoxide		0.2	U
alpha-Endosulfan		0.2	U
4,4'-DDE		0.2	U
Dieldrin		0.2	U
Endrin		0.2	U
4,4'-DDD		0.2	U
beta-Endosulfan		0.2	U
4,4'-DDT		0.2	U
Endrin Aldehyde		0.2	U
Endosulfan Sulfate		0.2	U
Methoxychlor		0.5	U
Toxaphene		5	U
Chlordane		3	U
Aroclor-1016		1.0	U
Aroclor-1221		1.0	U
Aroclor-1232		1.0	U
Aroclor-1242		1.0	U
Aroclor-1248		1.0	U
Aroclor-1254		1.0	U
Aroclor-1260		1.0	U

Appendix C – Continued.

Station:	Digested Sludge	
Lab ID#:	328150	
<u>Metals - Total (mg/kg-dry)</u>		
Antimony	0.10	U
Arsenic	0.15	U
Berylium	8.4	U
Cadmium	0.070	B
Chromium	118	JB
Copper	1180	B
Lead	0.94	
Mercury*	17.5	
Molybdenum	0.2	U
Nickel	84	U
Selenium	0.20	U
Silver	61	J
Thallium	0.25	U
Zinc	983	B

U - Indicates compound was analyzed for but not detected at the given quantification limit.
J - Indicates an estimated value. Value was calculated from a response below the known linear range.
B - Indicates analyte was found in the blank as well as the sample, possible/probable blank contamination.
*Samples for BNAs and Pesticide/PCBs were extracted with the TCLP procedure prior to analysis.

APPENDIX D

Appendix D – Sludge Stabilization Analyses – Sequim WTP, 8/90.

INSPECTION RESULTS

Sample Station:		Sldg–A	Sldg–A	Sldg–B	Sldg–B	Sldg–C	Sldg–C
Sample Description:		WAS	WAS	TANK	TANK	DIGESTED	DIGESTED
Lab ID #:		328148	328152	328149	328153	328180	328154
Parameter	Units						
Total Solids	mg/L	7,160	7,330	8,340	8,570	12,220	12,230
Total Nonvolatile Solids	mg/L	1,670	1,720	2,020	2,020	3,470	3,230
Total Volatile Solids	mg/L	5,490	5,610	6,320	6,550	8,750	9,000
Total Coliform, MPN	#/100 mls	>1,600,000	>1,600,000	>1,600,000	>1,600,000	>1,600,000	1,600,000
Fecal Coliform, MPN	#/100 mls	>1,600,000	>1,600,000	920,000	540,000	110,000	950,000
E. Coli	#/100 mls	>1,600,000	>1,600,000	350,000	220,000	110,000	46,000

SLUDGE CALCULATIONS

Pathogen Reduction:

$$\frac{(110{,}000 \text{ fecal col./100 mls sludge})(1{,}000 \text{ mls/L})(1{,}000 \text{ mg/g})}{(12{,}150 \text{ mg TSS/L sludge})^*} = 9{,}050{,}000 \text{ \#/g TSS}$$

$$\frac{(950{,}000 \text{ fecal col./100 mls sludge})(1{,}000 \text{ mls/L})(1{,}000 \text{ mg/g})}{(12{,}150 \text{ mg TSS/L sludge})^*} = 78{,}200{,}000 \text{ \#/g TSS}$$

*Note: TSS in digested sludge taken as 12,150 mg/L. Measured by WTP operator on 8/6/90.

log10 (9,050,000) = 6.957
log10(78,200,000) = 7.893

Average log10 density = (6.957 + 7.893)/2 = 7.425

Volatile Solids Reduction:

Volatile solids input rate = Volatile solids output rate + Loss of volatile solids

Volatile solids reduction = Loss of volatile solids/Sum of volatile solids inputs
Volatile solids reduction = (Volatile solids input rate – Volatile solids output rate)/Sum of volatile solids inputs
Volatile solids reduction = [(QY)influent – (QY)sludge – (QY)effluent]/(QY)influent

where: Q = volumetric flow rate, mgd
Y = volatile solids concentration, mg/L

Volatile solids reduction = [(0.47)(400) – (0.01)(8875) – (0.46)(81)]/[(0.47)(400)]**
Volatile solids reduction = 0.33 (33%)

**Note: Y of influent taken as average of Inf–B–Eco and Inf–Sqm and Y of effluent taken as average of Eff–A–Eco and Eff–Sqm.