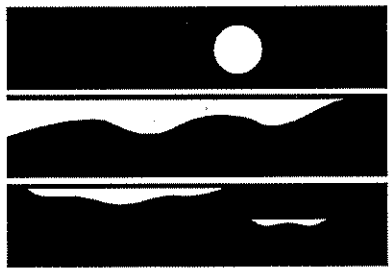


WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

City of Chehalis
Wastewater Treatment Plant
Class II Inspection, June 1997

January 1998

Publication No. 98-303
printed on recycled paper

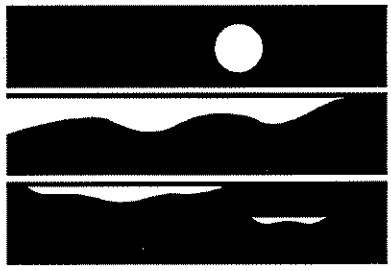
The Department of Ecology is an equal opportunity agency and does not discriminate on the basis of race, creed, color, disability, age, religion, national origin, sex, marital status, disabled veteran's status, Vietnam Era veteran's status or sexual orientation.

If you have special accommodation needs or require this document in alternative format, please contact the Environmental Investigations and Laboratory Services Program, Toxics Investigations Section, Joan LeTourneau at (360) 407-6764 (voice). Ecology's telecommunications device for the deaf (TDD) number at Ecology Headquarters is (360) 407-6006.

For additional copies of this publication, please contact:

Department of Ecology
Publications Distributions Office
P. O. Box 47600
Olympia, Washington 98504-7600
(360) 407-7472

Refer to Publication Number 98-303



City of Chehalis
Wastewater Treatment Plant
Class II Inspection, June 1997

by
Steven Golding

Environmental Investigations and Laboratory Services Program
Olympia, Washington 98504-7710

January 1998

Water Body No. WA-23-1020

Publication No. 98-303
printed on recycled paper

Table of Contents

List of Figures and Tables

Page

Figures

Tables

Abstract

An announced Class II Inspection was conducted at the City of Chehalis Wastewater Treatment Plant on June 2 – 4, 1997. The plant was performing well during the inspection. The conventional parameters of BOD_5, TSS and fecal coliform indicate a well-treated, high quality effluent. Effective nitrification was being achieved by the plant.

All unit processes were operating within or close to design parameters typical of their type with the exception of the south aeration basin. The south aeration basin has a volume of 128,000 ft^3, and its four aerators provide only 0.47 $hp/1000ft^3$ of power as compared with 0.75 to 1.50 $hp/1000ft^3$ necessary for complete mixing. If aeration basin performance is inadequate under conditions more demanding than those of this inspection, increased mixing horsepower in the aeration basin might resolve the problem.

The fecal coliform count in the sludge sample was well within the maximum limit for Class A sewage sludge in accordance with EPA regulations. Twelve priority pollutant metals were detected in the sludge sample. All metals were found in concentrations lower than EPA sludge application limits and ceiling concentrations for land application of municipal sludge.

Summary

Flume Configuration and Flow Measurements

Chehalis determines its effluent flow from wastewater depth in a 12-inch Parshall flume. Ecology took an instantaneous reading of flow depth in the flume and determined a corresponding flow that differed from the plant's flow meter less than 1%, indicating good agreement between the depth measurement and the plant's flow meter reading. The flow during the 24-hour period from 0800 on June 3, 1997 to 0800 on June 4, 1997 was 2.736 MGD, prorated from measurements at 0800 on June 3 and 0805 on June 4.

NPDES Permit Compliance/General Chemistry

The WWTP was performing well during the inspection. The conventional parameters of BOD_5, TSS and fecal coliform indicate a well-treated, high quality effluent. The effluent met National Pollutant Discharge Elimination System (NPDES) permit limits for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, pH, and ammonia. Removal rates of BOD_5 and TSS during the inspection were 91% and 90% respectively, as compared with monthly average permitted minimum removals of 85%. The plant was achieving effective nitrification at the time of the inspection.

Plant Performance and Comparison with Design

Process unit operating parameters at the time of the inspection based on flow from 0800 June 3 to 0800 June 4 were compared with typical operating parameters.

Primary Clarifiers

Overflow rate and hydraulic detention time for the primary clarifiers was within an appropriate typical range. Weir loading for the primary clarifiers was lower than typical, the result of the clarifiers' relatively small diameters and double-weir construction. TSS and BOD_5 removal rates across the primary clarifiers during the inspection were in agreement with recommended rates.

Trickling Filters

Trickling filter hydraulic loading was within the typical range. BOD_5 loading was slightly below the typical range.

South Aeration Basin

The south aeration basin was on line following the trickling filters. The hydraulic detention time was 8.4 hours, somewhat longer than the 3 – 5 hour typical hydraulic detention time for activated-sludge, complete-mix reactors but shorter than the 18 – 36 hour hydraulic detention time typically associated with extended aeration plants.

Four mechanical surface aerators provide mixing and aeration. Typical power requirements for maintaining a completely mixed flow regime with mechanical aerators vary from 0.75 to 1.50 hp/1000ft^3. With a volume of 128,000 ft^3, the south aeration basin's four aerators provide only 0.47 hp/1000ft^3 of power.

Secondary Clarifier

The new secondary clarifier (center feed with 18-foot sidewall depth) was being operated alone during the inspection, providing sedimentation for the entire plant wastewater flow.

While the effluent TSS was low at the time of the inspection (10 mg/l) and the plant was producing a high quality effluent, the operation of one secondary clarifier alone resulted in an overflow rate slightly above the typical range at the time of the inspection. Solids loading was slightly below the average typical range.

Split Sample Results

Split sample results showed good agreement between all Ecology and Chehalis influent and effluent results for both TSS and BOD_5 analyses. This indicates good agreement between the results of the two laboratories and consistent sample collection techniques between Ecology and Chehalis. NH3-N results were close but Ecology results were consistently lower than Chehalis results.

Priority Pollutant Metals

Cadmium, copper, lead, mercury, selenium, silver, thallium, and zinc were detected in the effluent. Because cadmium and mercury were found in the transfer blank in concentrations close to those found in the effluent sample, the finding of cadmium and mercury in the effluent may be false. A permit appeals process has been completed covering effluent metals limitations. Revised metals limits will be included in the final consent decree.

Sludge

The sludge is treated by one primary and one secondary anaerobic digester, then dried on covered drying beds. The biosolids are applied to approximately 200 acres on a farm near Winlock in Lewis County.

The fecal coliform count was less than 2.3/100g-dry (1.8/100g-wet). The total coliform count was 29.9/100g-dry (23/100g-wet). The fecal coliform count is well within the 1,000/g-dry (100,000/100 g-dry) maximum limit for Class A sewage sludge in accordance with EPA regulations. Class A sewage sludge is suitable for use on agricultural lands without time restrictions to harvesting. All metals found in the sludge were in concentrations lower than EPA sludge application limits and ceiling concentrations for land application of municipal sludge.

Recommendations

- If aeration basin performance is found to be inadequate under conditions more demanding than those of this inspection, consideration should be made to increasing mixing horsepower in the aeration basin so that complete mixing is achieved.

- Chehalis replaced sampling lines just prior to the inspection. Sampling lines should be cleaned regularly to ensure that they do not contaminate samples or allow for degradation of sampled liquids within the lines.

Introduction

An announced Class II Inspection was conducted at the City of Chehalis (Chehalis) Wastewater Treatment Plant (WWTP) June 2-4, 1997. Conducting the inspection were Steven Golding and Guy Hoyle-Dodson of the Washington Department of Ecology (Ecology). Plant Lead Operator Ron Moeller assisted with the inspection.

The City of Chehalis operates a wastewater treatment facility regulated under NPDES Permit No. WA-002110-5 (expiration date June 30, 2000). The WWTP serves the City of Chehalis, the City of Napavine, and Lewis County Sewer District No. 1 (Figure 1). In 1992 the facility served a population of 7,671 and is projected to serve a population of 10,300 by the year 2013. The collection system is old and deteriorating and suffers from large volumes of groundwater (infiltration) and stormwater (inflow) entering the system during wet weather. Because of the infiltration and inflow (I/I), the system is experiencing occasional bypasses of raw sewage and the WWTP is not meeting federal and state treatment standards (Ecology, 1996).

The Chehalis River is designated as a Class A (excellent) Freshwater receiving water in the vicinity of the outfall. The Chehalis River in the vicinity of Chehalis has historically been an area of concern. The slow moving characteristics of the river in this area and the existence of holes up to 30 feet deep create phenomena more typically associated with lakes and impoundments. Earlier water quality studies (1980-1982) of this stretch of the Chehalis River indicated mid-summer thermal stratification and depressed oxygen concentrations in late summer and early fall. There have been subsequent upgrades to the Chehalis treatment and collection system to provide some mitigation of the oxygen depletion events (Ecology, 1996). This Class II inspection was conducted in June to coincide with the beginning of the summer season.

Beginning in 1991, the upper Chehalis River basin from the headwaters to Porter was studied by Ecology to establish a Total Maximum Daily Load (TMDL) for pollutants of concern. A TMDL Study for the Upper Chehalis River, dry season, was published in 1994 (Ecology, 1994a). The City of Chehalis WWTP is located at the upper end of the Centralia Reach in the study area. Discharges from the plant are limited by these water quality wasteload allocations (Ecology, 1996).

The treatment facility consists of headworks, rag removal and grit removal equipment, two primary clarifiers, two trickling filters, two secondary clarifiers, two structures functioning as chlorine contact tanks, and sulfur dioxide injection for dechlorination of the effluent (Figures 2 and 3). The effluent is discharged to the Chehalis River with a single 24-inch pipe perpendicular to the river flow. The sludge is treated by one primary and one secondary anaerobic digester, then dried on covered drying beds. The biosolids are applied to approximately 200 acres on a farm near Winlock in Lewis County.

During wet weather conditions, flows exceeding 7.5 MGD are diverted to two large settling/aeration basins for holding and later pumping back to the headworks. During dry weather conditions, the north settling/aeration basin has been used for activated sludge aeration, following the trickling filters. Flooding during the winter of 1995-1996 caused heavy damage to the north settling/aeration basin.

The south aeration basin was used during the inspection to treat trickling filter effluent. The old secondary clarifier was being used to route trickling filter effluent to the south aeration basin. The north aeration basin was not in operable condition and was not in service. Chehalis was operating the new secondary clarifier to handle the total plant flow. To prevent the influent sample from including return flows during the inspection, the digester supernatant return flow was shut off during the inspection.

Objectives

Specific objectives include:

- Evaluate NPDES permit compliance
- Evaluate plant performance
- Evaluate sampling and laboratory procedures with split samples
- Compare effluent sample results with state and federal water quality criteria

Procedures

Composite samples were collected by Ecology at influent (Inf), primary effluent (Prm), and final effluent (Eff) locations. Grab samples were collected by Ecology at influent (Inf), aeration (Aer), effluent (Eff), sludge (Sludge) and receiving water (RcvWtr) locations (Figure 2). Ecology conducted field measurements on all except sludge samples. Chehalis collected composite samples of influent (Inf-C) and effluent (Eff-C).

A more detailed description of sampling procedures appears in Appendix A. Sampling station descriptions appear in Table 4. The sampling schedule, parameters analyzed, and sample splits are included in Appendix B. Ecology analytical methods and laboratories performing the analyses are summarized in Appendix C. Ecology field and laboratory QA/QC are summarized in Appendix D. Quality Assurance cleaning procedures are included in Appendix E. A glossary appears in Appendix F.

Results and Discussion

Flume Configuration and Flow Measurements

Chehalis determines effluent flow from wastewater depth in a 12-inch Parshall flume. The flume is located at the downstream end of the No. 2 chlorine contact tank. The flume was found to be level and free-flowing. Ecology took an instantaneous reading of flow depth in the flume at 1038 on June 3, 1997 and found a depth of 14.0 inches. This corresponds to a flow of 3.27 MGD. The plant's flow meter was concurrently reading 3.30 MGD. This is 0.9% higher than the flow value determined from the Ecology depth measurement, indicating good agreement between the plant's flow meter and the flow calculated from measured depth. The flow during the 24-hour period from 0800 on June 3, 1997 to 0800 on June 4, 1997 was 2.736 MGD, prorated from measurements at 0800 on June 3 and 0805 on June 4.

NPDES Permit Compliance/General Chemistry

The WWTP was performing well during the inspection. The conventional parameters of BOD_5, TSS and fecal coliform indicate a well-treated, high quality effluent (Table 5). The effluent met National Pollutant Discharge Elimination System (NPDES) permit limits for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, pH, and ammonia (Table 6). Removal of BOD_5 and TSS during the inspection was 91% and 90% respectively, as compared with monthly average permitted minimum removals of 85%. The plant was achieving effective nitrification at the time of the inspection.

Plant Performance and Comparison with Design

The operating parameters of the plant's process units at the time of the inspection (based on a flow of 2.736 MGD) are compared with typical operating parameters from Metcalf and Eddy, Inc. (1991) in the tables below. The plant is designed on the basis of an average dry weather flow of 2.0 MGD, an average wet weather flow of 4.0 MGD, and a peak wet weather flow of 13.0 MGD.

Primary Clarifiers

At the time of the inspection, both primary clarifiers were on line. The clarifiers have a sidewall depth of 9 feet and a diameter of 50 feet (Gibbs and Olson, 1988). From Table 1 it can be seen that overflow rate and hydraulic detention time for the primary clarifiers was within a typical range. Weir loading for the primary clarifiers was lower than typical, the result of the clarifiers' relatively small diameters and double-weir construction.

Table 1 – Primary Clarifier Design Parameters

Parameter	Chehalis	Typical*
Overflow Rate (gpd/ft^2)	696	600-800
Hydraulic Detention Time (hours)	2.32	1.5 - 2.5
Weir Loading (gpd/ lin ft)	3,543	10,000 - 40,000

*typical design values from Metcalf and Eddy, Inc., 1991.

The primary clarifier effluent 24-hour composite sample had 46 mg/L TSS and 64 mg/L BOD_5 (Table 5). This corresponds to a TSS removal rate of 54% and a BOD_5 removal rate of 40%. These removal rates are within the ranges recommended by Metcalf and Eddy, Inc. (1991).

Trickling Filters

At the time of the inspections both trickling filters were on line. The filters are 90 feet in diameter (7 foot rock depth) and 66 feet in diameter (6 foot rock depth) (Gibbs and Olson, 1988). A splitter box diverts one-third of the flow to the small trickling filter and two-thirds of the flow to the large trickling filter. Comparisons in Table 2 are made with typical high-rate trickling filters. BOD_5 loading is based on conditions during the inspection.

Table 2 – Trickling Filter Design Parameters

Parameter	Chehalis		Typical*
	90' filter	66' filter	
Hydraulic loading (gpd/ft^2)	580	520	230 - 922
BOD_5 loading (lb/day-1000ft^3)	25	28	30 – 60

*typical design values from Metcalf and Eddy, Inc., 1991.

Trickling filter hydraulic loading was within the typical range. BOD_5 loading was slightly below the typical range.

South Aeration Basin

The south aeration basin was on line following the trickling filters. With a volume of 0.955 MG, the hydraulic detention time in the south aeration basin for the flow measured during the inspection was 8.4 hours. This is somewhat longer than the 3 – 5 hour typical hydraulic detention time for activated-sludge, complete-mix reactors but shorter than the 18 – 36 hour hydraulic detention time typically associated with extended aeration plants. An average of 2,325 mg/L mixed liquor suspended solids (MLSS) was found in the aeration basin samples during the inspection. Moeller (1997) reports that the plant is operated in the range of 2,000 to 2,500 mg/L MLSS. He reports that a higher MLSS results in excessive suspended solids in the effluent.

The aeration basin is aerated and mixed by four, 15-horsepower mechanical surface aerators, providing 60 horsepower total power. Metcalf and Eddy, Inc. (1991) state that typical power requirements for maintaining a completely mixed flow regime with mechanical aerators vary from 0.75 to 1.50 hp/1000ft^3. With a volume of 128,000 ft^3, the south aeration basin's four aerators provide only 0.47 hp/1000ft^3. If aeration basin performance is found to be inadequate under conditions more demanding than those of this inspection, consideration should be made to increasing mixing horsepower in the aeration basin so that complete mixing is achieved.

In most instances power requirements for aeration basin mixing exceed those for oxygenation (Metcalf and Eddy, Inc., 1991). It is likely that with the trickling filters preceding the aeration basin and providing oxygenation and partial treatment, oxygen requirements in the basin were being met at the time of the inspection.

The primary function of the aeration basin is to achieve nitrification (Moeller, 1997). A comparison of influent ammonia and nitrate-nitrite concentrations indicates that the WWTP was achieving substantial nitrification at the time of the inspection. Ammonia concentrations were reduced from 11.3 mg/L in the influent to 1.15 mg/L in the effluent. The nitrate-nitrite concentration correspondingly increased from 1.01 mg/L in the influent to 12.8 mg/L in the effluent. Alkalinity was reduced as a result of nitrification from 130 mg/L in the influent to 63.3 mg/L in the effluent. The remaining 63.3 mg/L alkalinity in the effluent remains so further nitrification is not inhibited.

Secondary Clarifier

The new secondary clarifier (center feed with 18-foot sidewall depth) was being operated alone during the inspection, providing sedimentation for the plant's total wastewater flow.

Table 3 – Secondary Clarifier Design Parameters

Parameter	Chehalis	Typical*	
		Average	Peak
Overflow Rate (gpd/ft^2)	824	400-800	1,000-1,200
Hydraulic Detention Time (hrs)	3.92		
Weir Loading (gpd/ lin ft)	7,354		
Solids Loading (lb/ft^2-hr)	0.7	0.8-1.2	2.0

*typical design values from Metcalf and Eddy, Inc., 1991.

While the effluent TSS was low at the time of the inspection (10 mg/l) and the plant was producing a high quality effluent, the operation of a one secondary clarifier alone resulted in an overflow rate slightly above the typical range at the time of the inspection. Solids loading was slightly below the average typical range. This is the result of the plant being operated in a long aeration mode, with the aeration basin operated in the range of 2000 to 2,500 mg/L MLSS compared with a typical range of MLSS of 2,500 – 6,500 mg/L for complete-mix activated sludge systems and 1,500 to 5,000 mg/L for extended aeration.

Split Sample Results

Samples were split to compare Ecology and permittee laboratory results and sampling methods (Table 7). Split sample results showed good agreement between all Ecology and Chehalis influent and effluent results for both TSS and BOD_5 analyses. This indicates good agreement between the results of the two laboratories and consistent sample collection techniques between Ecology and Chehalis. NH3-N results were close but Ecology results were consistently lower than Chehalis results. It is unclear whether the discrepancy is the result of degradation of the Ecology sample before analysis or some difference in analytical technique.

Priority Pollutant Metals

Cadmium, copper, lead, mercury, selenium, silver, thallium, and zinc were detected in the effluent (Table 8). Because cadmium and mercury were found in the transfer blank in concentrations close to those found in the effluent sample, the finding of cadmium and mercury in the effluent may be false. It should be noted that the effluent concentrations (Eff-E) in Table 8 cannot be compared directly with water quality criteria without application of mixing zone dilution factors. A permit appeals process has been completed covering effluent metals limitations. Revised metals limits will be included in the final consent decree (Anderson, 1997).

Sludge

The sludge is treated by one primary and one secondary anaerobic digester, then dried on covered drying beds. The biosolids are applied to approximately 200 acres of a farm near Winlock in Lewis County.

The dried sludge sample contained 76.8% solids and 19.7% volatile solids. The fecal coliform count was less than 2.3/100g-dry (1.8/100g-wet). The total coliform count was 29.9/100g-dry (23/100g-wet – Table 5). The fecal coliform count is well within the 1,000/g-dry (100,000/100 g-dry) maximum limit for Class A sewage sludge in accordance with EPA regulations (EPA, 1993). Class A sewage sludge is suitable for use on agricultural lands without time restrictions to harvesting.

Twelve priority pollutant metals were detected in the sludge sample (Table 9). Zinc was found in the highest concentrations (739 mg/Kg-dry). All metals were found in concentrations lower than EPA sludge application limits and ceiling concentrations for land application of municipal sludge (Table 9).

References

Anderson, Jerry, 1997. Washington State Department of Ecology, Southwest Regional Office, Olympia, Washington.

Ecology, 1994a. Upper Chehalis River Dry Season Total Maximum Daily Load Study. Publication No. 94-126. July 1994.

Ecology, 1994b. Laboratory User's Manual (Fourth Edition). Manchester Environmental Laboratory, Manchester, Washington.

Ecology, 1996. Fact Sheet for NPDES Permit WA-002110-5, City of Chehalis.

EPA, 1993. Standards for the Use or Disposal of Sewage Sludge; Final Rules. U.S. Environmental Protection Agency. 40 CFR Part 257.

Gibbs and Olson, Inc., 1988. Operation and Maintenance Manual, Chehalis Wastewater Treatment Plant, Amended 1988.

Metcalf and Eddy, Inc., 1991. Wastewater Engineering: Collection, Treatment, & Disposal. Third Edition, New York, NY.

Moeller, Ron, 1997. Personal communication. City of Chehalis, Washington.

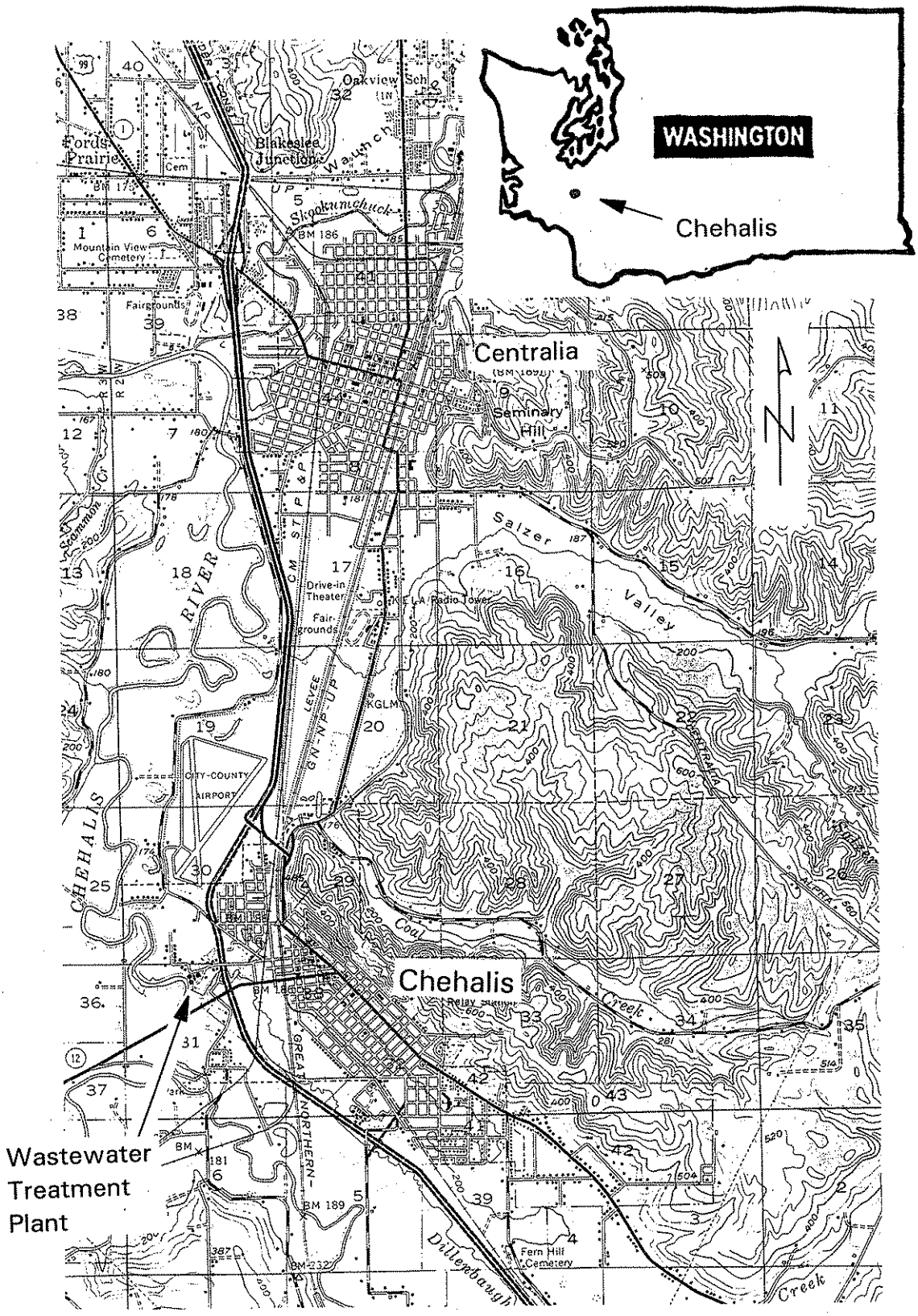


Figure 1 - Location Map - Chehalis, June 1997.

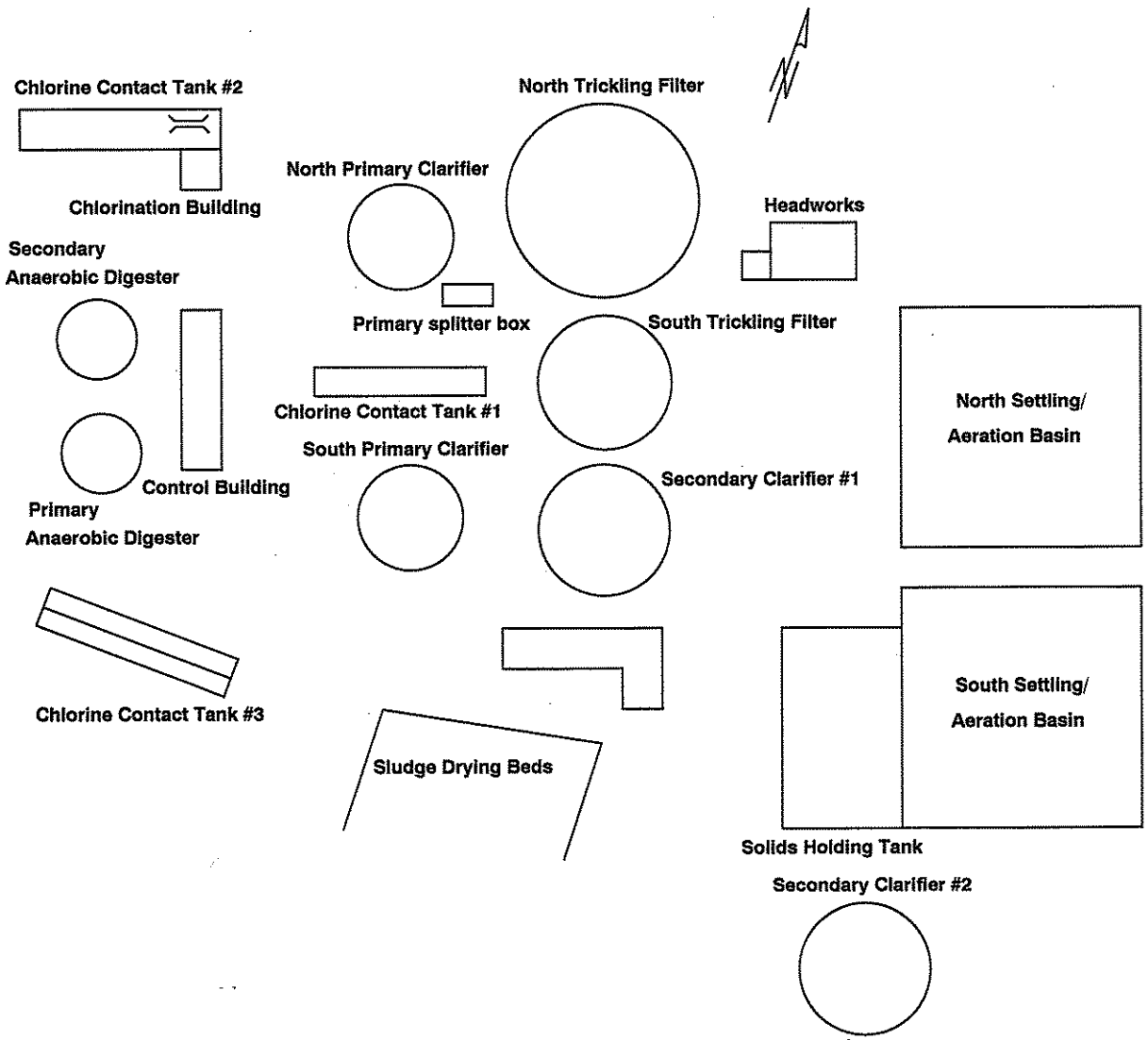


Figure 2 - Plan View of Wastewater Treatment Plant - Chehalis, June 1997.

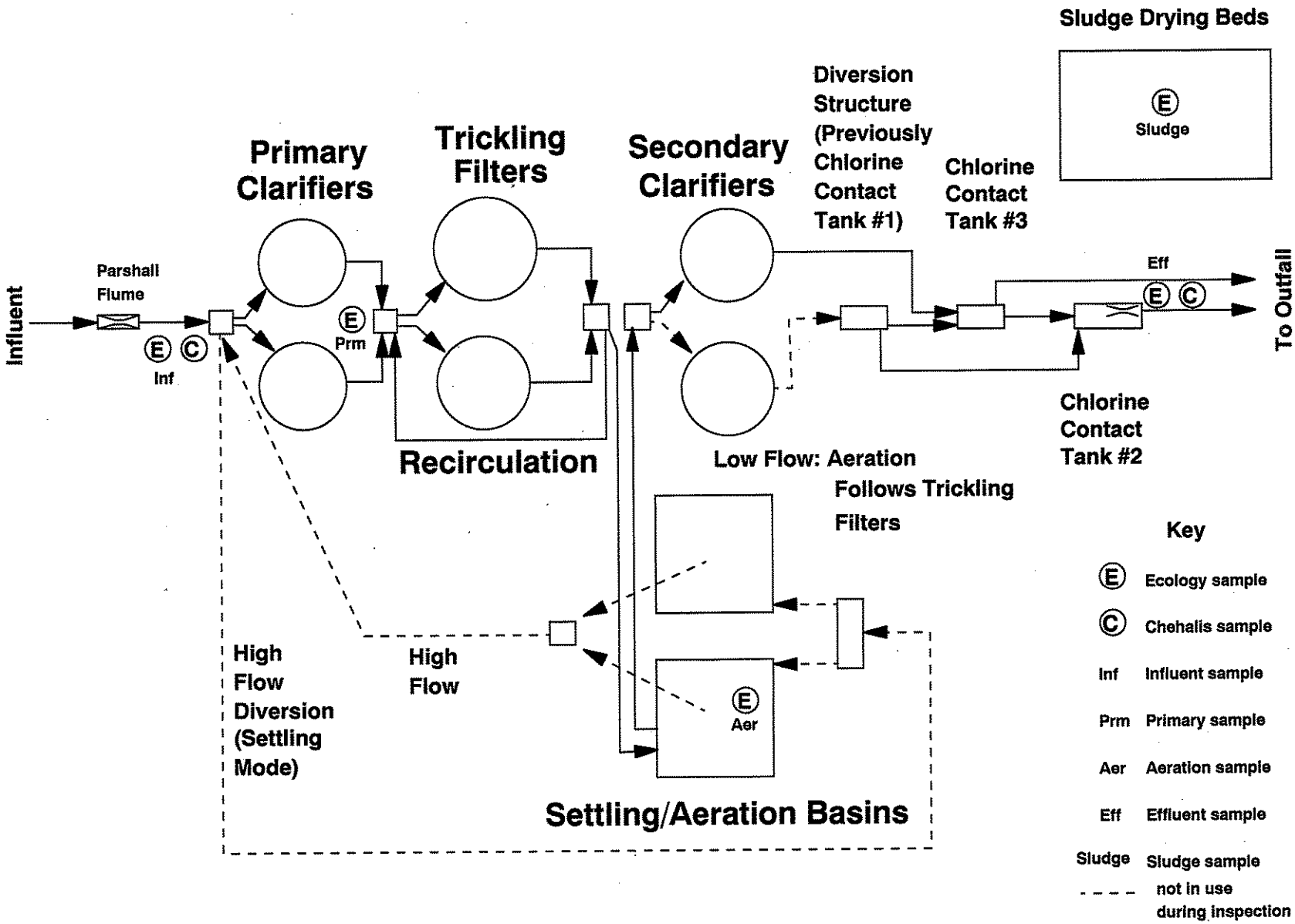


Figure 3 - Simplified Flow Schematic and Sampling Locations - Chehalis, June 1997.

Table 4 - Sampling Station Descriptions – Chehalis, June 1997.

Ecology influent grab and composite samples (Inf-1,2; Inf-E)

Influent grab samples were collected upstream of the weir in the influent box. The influent composite sample was taken with an intake hose one foot upstream of the influent box weir, two inches below the surface.

Chehalis influent composite sample (Inf-C)

The influent composite sample was collected with an intake hose mounted so as to sample downstream of the influent box weir, downstream of rag removal equipment.

Ecology effluent grab and composite samples (Eff-1,2; Eff-E)

Effluent grab samples were collected upstream of the Parshall flume. The effluent composite sample was collected with an intake hose positioned two feet upstream of the Parshall flume, one foot below the surface.

Chehalis effluent composite sample (Eff-C)

Effluent grab samples were collected from a permanently mounted submerged intake hose upstream of the Parshall flume.

Ecology primary effluent composite sample (Prim-E)

The primary effluent composite sample was taken with an intake hose suspended in the primary effluent box, one foot below the surface.

Ecology aeration basin grab samples (Aer-1, 2)

The aeration basin (mixed liquor) sample was taken from the walkway, four feet from the west aerator box in a well-mixed region.

Ecology sludge sample (Sludge)

Sludge was collected as a grab-composite sample from a sludge drying bed. The sludge sampled was ready to be trucked off-site.

Table 5 - General Chemistry Results - City of Chehalis, June, 1997.

Location:	Inf-1	Inf-2	Inf-E	Inf-C
Type:	grab	grab	comp	comp
Date:	6/3	6/3	6/3-4	6/3-4
Time:	855	1320	0800-0800	0800-0800
Lab Log #:	238130	238131	238132	238133
GENERAL CHEMISTRY				
Conductivity (umhos/cm)	574	291	381	380
Alkalinity (mg/L)			130	131
Hardness (mg/L CaCO3)			54.5	54.5
TS (mg/L)			323	396
TNVS (mg/L)			177J	163J
'TSS (mg/L)	94	131	100	97
TNVSS (mg/L)			27	21
% Solids				
% Volatile Solids				
OXYGEN DEMAND PARAMETERS				
BOD5 (mg/L)			106	89
TOC (water mg/L)	52.6	37.4	57.0	60.7
TOC (soil/sed - %C)				
CN total (mg/L)				
CN weak & dissoc. (mg/L)				
NUTRIENTS				
NH3-N (mg/L)	21.6	7.51	11.3	11.2
NO2+NO3-N (mg/L)	1.24	0.416	1.01	0.992
Total-P (mg/L)	2.90	1.95	2.16	2.11
MISCELLANEOUS				
Oil and grease (mg/L)				
F-Coliform MF (#/100mL)				
Fecal Coliform (soil/sed - /100g)				
Total Coliform (soil/sed - /100g)				
FIELD OBSERVATIONS				
Temperature (C)	17.2	16.8		
Temp-cooled (C)			5.5	9.5
pH	7.2	7.1	7.4	7.3
Conductivity (umhos/cm)	561	281	395	391
Chlorine (mg/L) Free (mg/L)				
Total (mg/L)				

E - Ecology sample
C - Chehalis sample
grab - grab sample
comp - composite sample
Inf - Influent sample
Prm- primary effluent sample
Aer - aeration basin sample
Sludge digested sludge sample
Rcv Wtr - receiving water sample
J - estimated value

Table 5 - (cont'd) - June, 1997.

Location	Aer-1	Aer-2	Eff-1	Eff-2	Eff-E	Eff-C	Prm-E
Type:	grab	grab	grab	grab	comp	comp	comp
Date:	6/3	6/3	6/3	6/3	6/3-4	6/3-4	6/3-4
Time:	0915	1330	0935	1345	0800-0800	0800-0800	0800-0800
Lab Log #:	238134	238135	238136	238137	238138	238139	238140
GENERAL CHEMISTRY							
Conductivity (umhos/cm)			389	409	388	387	373
Alkalinity (mg/L)					63.3	63.4	117
Hardness (mg/L CaCO3)					87.4	86.9	
TS (mg/L)	2410	2450			282	334	326
TNVS (mg/L)	1050J	1050J			185J	169J	116J
'TSS (mg/L)	2400	2250	5	7	10	10	46
TNVSS (mg/L)	920	950			4	4	15
% Solids							
% Volatile Solids							
OXYGEN DEMAND PARAMETERS							
BOD5 (mg/L)					10	11	64
TOC (water mg/L)			11.9	13.2	15.7	15.8	43.7
TOC (soil/sed - %C)							
CN total (mg/L)			0.005U				
CN weak & dissoc. (mg/L)			0.005U				
NUTRIENTS							
NH3-N (mg/L)			0.056	0.898	1.15	1.13	
NO2+NO3-N (mg/L)			14.8	13.8	12.8	14.1	
Total-P (mg/L)			1.64	1.31	1.97	1.96	
MISCELLANEOUS							
Oil and grease (mg/L)							
F-Coliform MF (#/100mL)			3	1U			
Fecal Coliform (soil/sed - /100g)							
Total Coliform (soil/sed - /100g)							
FIELD OBSERVATIONS							
Temperature (C)	16.7	17.6	17.3	17.7			
Temp-cooled (C)					4.9	10.0	4.9
pH	7.8	7.1	7.0	7.2	7.7	7.3	7.3
Conductivity (umhos/cm)	434	423	403	423	414	394	393
Chlorine (mg/L) Free (mg/L)			<0.1	<0.1			
Total (mg/L)			<0.1	<0.1			

Table 5 - (cont'd) - June, 1997.

Location:	Sludge	RcvWtr	TrnsBlk
Type:	grab	grab	grab
Date:	6/3	6/3	6/2
Time:	1005	1025	1645
Lab Log #:	238141	238142	238143
GENERAL CHEMISTRY			
Conductivity (umhos/cm)			
Alkalinity (mg/L)			
Hardness (mg/L CaCO3)		23.2	
TS (mg/L)			
TNVS (mg/L)			
'TSS (mg/L)		14J	
TNVSS (mg/L)			
% Solids	76.8		
% Volatile Solids	19.7		
OXYGEN DEMAND PARAMETERS			
BOD5 (mg/L)			
TOC (water mg/L)			
TOC (soil/sed - %C)			
CN total (mg/L)			
CN weak & dissoc. (mg/L)			
NUTRIENTS			
NH3-N (mg/L)			
NO2 + NO3-N (mg/L)			
Total-P (mg/L)			
MISCELLANEOUS			
Oil and grease (mg/L)			
F-Coliform MF (#/100mL)			
Fecal Coliform (soil/sed - /100g)	1.8U		
Total Coliform (soil/sed - /100g)	23		
FIELD OBSERVATIONS			
Temperature (C)		15.7	
Temp-cooled (C)			
pH		7.1	
Conductivity (umhos/cm)		63.4	
Chlorine (mg/L) Free (mg/L)			
Total (mg/L)			

Table 6 - Interim NPDES Permit Limits and Inspection Results - Chehalis, June 1997.*

	NPDES Limits		Inspection Results	
Parameter	Monthly Average	Weekly Average	Composite Samples	Grab Samples
BOD5	20 mg/L 334 lbs/day 85% removal	30 mg/L 500 lbs/day	10 mg/L 228 lbs/day 91% removal	
TSS	25 mg/L 417 lbs/day 85% removal	37.5 mg/L 626 lbs/day	10 mg/L 228 lbs/day 90% removal	
Fecal Coliform	200/100 mL	400/100 mL		3/100 mL < 1/100 mL
pH	6.0 to 9.0 (continuous)			7.0; 7.2
Flow	--	--	2.736 MGD**	

	NPDES Limits		Inspection Results	
Parameter	Monthly Average	Daily Maximum	Composite Samples	Grab Samples
Total Chlorine Residual	0.021 mg/L	0.023 mg/L		<0.1; <0.1
Ammonia (NH3-N)	18.6 mg/L	28.6 mg/L	1.15 mg/L	

* Permit limits apply May - October.

** prorated effluent totalizer reading from 0800 on 06-03-97 to 0805 on 06-04-97.

Table 7 - Split Sample Results Comparison - Chehalis, June 1997.

	Location:	Inf-E	Inf-C	Eff-E	Eff-C
	Type:	comp	comp	comp	comp
	Date:	6/3-4	6/3-4	6/3-4	6/3-4
	Time:	0800-0800	0800-0800	0800-0800	0800-0800
	Lab Log #:	238132	238133	238138	238139
	Sampled by:	Ecology	Chehalis	Ecology	Aberdeen
Parameter	Analysis by:				
TSS (mg/L)	Ecology	100	97	10	10
	Chehalis	90	86	8.5	8.5
BOD5 (mg/L)	Ecology	106	89	10	11
	Chehalis	96.3	95.2	9.7	11.1
NH3 - N (mg/L)	Ecology	11.3	11.2	1.15	1.13
	Chehalis	13.53	12.88	1.541	1.472

Inf - influent sample
Eff - effluent sample

E - Ecology sample
C - Chehalis sample
comp - composite sample

Table 8 - Comparison of Metals Detected to Water Quality Criteria - Chehalis, June 1997.

Location:	Eff-E	Trnsblk	EPA/Ecology Water Quality Criteria	
Type:	comp	grab		
Date:	6/3-4	6/2	Acute	Chronic
Time:	0800-0800	1645	Freshwater	Freshwater
Lab Log#:	238138	238143		
	(ug/L)	(ug/L)	(ug/L)	(ug/L)
Metals (total recoverable)				
Antimony	30 U	30 U	9,000	1,600
Arsenic	1 U	1 U	360	190
Beryllium	1 U	1 U	130	5.30
Cadmium	**0.19**	**0.10**	0.76 +	0.35 +
Chromium	5 U	5 U		
Hexavalent			15	10
Trivalent			1658.44 +	53.80 +
Copper	**19**	4 U	4.30 +	3.26 +
Lead	**2.2 J**	1 UJ	12.76 +	0.50 +
Mercury (Total)	**0.13**	**0.10**	2.10	0.012
Nickel	10 U	10 U	411.23 +	45.67 +
Selenium	**1.3**	1 U	20	5
Silver	**2.5**	0.1 U	0.28 +	
Thallium	**0.11**	0.1 U	1400	40
Zinc	**70.9**	**5.9**	33.19 +	30.31 +

Eff - Effluent
E - Ecology sample
Trnsblk - transfer blank

Bold -detected value
\+ -hardness dependent criteria (23.2 mg/L hardness used to represent receiving water).

U - The analyte was not detected at or above the reported result.
J - estimated value
UJ - undetected at estimated detection level

Table 9 - Sludge Metals and Comparison with EPA Criteria for Land Application - Chehalis, June 1997.

Location:	Sludge		
Type:	grab	EPA Sludge	
Date:	6/3	Application Limits	EPA Ceiling
Time:	1005	(monthly avg.)	Concentrations
Lab Log #:	238141		
	mg/Kg-dry	mg/Kg-dry	mg/Kg-dry
Metals (total)			
Antimony	3 UJ		
Arsenic	5.52	41	75
Beryllium	0.43		
Cadmium	3.05	39	85
Chromium	42.4	1200	3000
Copper	344	1500	4300
Lead	86.4	300	840
Mercury	5.08 J	17	57
Nickel	22.5	420	420
Selenium	3.1	36	100
Silver	9.94 J		
Thallium	0.18		
Zinc	739	2800	7500

Sludge - sludge sample

grab - grab sample

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

UJ - The analyte was undetected at estimated detection level.

Appendices

Appendix A - Sampling Procedures – Chehalis, June 1997.

Ecology Isco composite samplers were set up to collect equal volumes of sample every 30 minutes for 24 hours. The samples were then divided into subsamples for analysis. The compositors were iced to preserve samples.

The composite influent and effluent samplers operated by Chehalis were set to collect equal volumes of sample every 10 minutes for 24 hours. The samples were kept refrigerated during sampling.

Ecology influent and effluent composite samples and Chehalis influent and effluent composite samples were split for both Ecology and Chehalis laboratory analysis. Sampler configurations and locations are summarized in Figure 3 and Table 1.

Appendix B - Sampling Schedule - City of Chehalis, June, 1997.

Location:	Inf-1	Inf-2	Inf-E	Inf-C
Type:	grab	grab	comp	comp
Date:	6/3	6/3	6/3-4	6/3-4
Time:	855	1320	0800-0800	0800-0800
Lab Log #:	238130	238131	238132	238133
GENERAL CHEMISTRY				
Conductivity (umhos/cm)	E	E	E	E
Alkalinity (mg/L)			E	E
Hardness (mg/L CaCO3)			E	E
TS (mg/L)			E	E
TNVS (mg/L)			E	E
'TSS (mg/L)	E	E	EC	E
TNVSS (mg/L)			E	E
% Solids				
% Volatile Solids				
OXYGEN DEMAND PARAMETERS				
BOD5 (mg/L)			EC	E
TOC (water mg/L)	E	E	E	E
TOC (soil/sed - %C)				
CN total (mg/L)				
CN weak & dissoc. (mg/L)				
NUTRIENTS				
NH3-N (mg/L)	E	E	EC	E
NO2+NO3-N (mg/L)	E	E	E	E
Total-P (mg/L)	E	E	E	E
MISCELLANEOUS				
Oil and grease (mg/L)				
F-Coliform MF (#/100mL)				
Fecal Coliform (soil/sed - /100g)				
Total Coliform (soil/sed - /100g)				
FIELD OBSERVATIONS				
Temperature (C)	E	E		
Temp-cooled (C)			E	E
pH	E	E	E	E
Conductivity (umhos/cm)	E	E	E	E
Chlorine (mg/L) Free (mg/L)				
Total (mg/L)				

E - Ecology analysis
C - Chehalis analysis
- E- Ecology sample
- C- Chehalis sample
grab - grab sample
comp - composite sample
Inf - Influent sample
Prm- primary effluent sample
Aer - aeration basin sample
Sludge digested sludge sample
Rcv Wtr - receiving water sample
J - estimated value

Appendix B - (cont'd) - June, 1997.

Location	Aer-1	Aer-2	Eff-1	Eff-2	Eff-E	Eff-C	Prm-E
Type:	grab	grab	grab	grab	comp	comp	comp
Date:	6/3	6/3	6/3	6/3	6/3-4	6/3-4	6/3-4
Time:	0915	1330	0935	1345	0800-0800	0800-0800	0800-0800
Lab Log #:	238134	238135	238136	238137	238138	238139	238140
GENERAL CHEMISTRY							
Conductivity (umhos/cm)			E	E	E	E	E
Alkalinity (mg/L)					E	E	E
Hardness (mg/L CaCO3)					E	E	
TS (mg/L)	E	E			E	E	E
TNVS (mg/L)	E	E			E	E	E
'TSS (mg/L)	E	E	E	E	EC	E	E
TNVSS (mg/L)	E	E			E	E	E
% Solids							
% Volatile Solids							
OXYGEN DEMAND PARAMETERS							
BOD5 (mg/L)					EC	E	E
TOC (water mg/L)			E	E	E	E	E
TOC (soil/sed - %C)							
CN total (mg/L)			E				
CN weak & dissoc. (mg/L)			E				
NUTRIENTS							
NH3-N (mg/L)			E	E	EC	E	
NO2 + NO3-N (mg/L)			E	E	E	E	
Total-P (mg/L)			E	E	E	E	
MISCELLANEOUS							
Oil and grease (mg/L)							
F-Coliform MF (#/100mL)			E	E			
Fecal Coliform (soil/sed - /100g)							
Total Coliform (soil/sed - /100g)							
FIELD OBSERVATIONS							
Temperature (C)	E	E	E	E			
Temp-cooled (C)					E	E	E
pH	E	E	E	E	E	E	E
Conductivity (umhos/cm)	E	E	E	E	E	E	E
Chlorine (mg/L) Free (mg/L)			E	E			
Total (mg/L)			E	E			

Appendix B - (cont'd) - June, 1997.

Location:	Sludge	RcvWtr	TrnsBlk
Type:	grab	grab	grab
Date:	6/3	6/3	6/2
Time:	1005	1025	1645
Lab Log #:	238141	238142	238143
GENERAL CHEMISTRY			
Conductivity (umhos/cm)			
Alkalinity (mg/L)			
Hardness (mg/L CaCO3)		E	
TS (mg/L)			
TNVS (mg/L)			
TSS (mg/L)		E	
TNVSS (mg/L)			
% Solids	E		
% Volatile Solids	E		
OXYGEN DEMAND PARAMETERS			
BOD5 (mg/L)			
TOC (water mg/L)			
TOC (soil/sed - %C)			
CN total (mg/L)			
CN weak & dissoc. (mg/L)			
NUTRIENTS			
NH3-N (mg/L)			
NO2 + NO3-N (mg/L)			
Total-P (mg/L)			
MISCELLANEOUS			
Oil and grease (mg/L)			
F-Coliform MF (#/100mL)			
Fecal Coliform (soil/sed - /100g)	E		
Total Coliform (soil/sed - /100g)	E		
FIELD OBSERVATIONS			
Temperature (C)		E	
Temp-cooled (C)			
pH		E	
Conductivity (umhos/cm)		E	
Chlorine (mg/L) Free (mg/L)			
Total (mg/L)			

Appendix C - Ecology Analytical Methods - Chehalis, June 1997.

Laboratory Analysis	Method Used for Ecology Analysis	Laboratory Performing Analysis
Conductivity	EPA, Revised 1983: 120.1	Manchester Laboratory
Alkalinity	EPA, Revised 1983: 310.1	Manchester Laboratory
Hardness	EPA, Revised 1983: 130.2	Manchester Laboratory
TS	EPA, Revised 1983: 160.3	Manchester Laboratory
TNVS	EPA, Revised 1983: 160.3	Manchester Laboratory
TSS	EPA, Revised 1983: 160.2	Manchester Laboratory
TNVSS	EPA, Revised 1983: 160.2	Manchester Laboratory
% Solids	APHA, 1992: 2540G.	Manchester Laboratory
% Volatile Solids	EPA, Revised 1983: 160.4	Manchester Laboratory
BOD5	EPA, Revised 1983: 405.1	Manchester Laboratory
TOC (water)	EPA, Revised 1983: 415.1	Manchester Laboratory
TOC (soil/sed)	EPA, Revised 1983: 415.1	Manchester Laboratory
NH3-N	EPA, Revised 1983: 350.1	Manchester Laboratory
NO2+NO3-N	EPA, Revised 1983: 353.2	Manchester Laboratory
NO2-N	EPA, Revised 1983: 353.2	Manchester Laboratory
Total-P	EPA, Revised 1983: 365.3	Manchester Laboratory
F-Coliform MF	APHA, 1992: 9222D.	Manchester Laboratory
F-Coliform (soil/sed)	APHA, 1992: 9221A.	Manchester Laboratory
T-Coliform (soil/sed)	APHA, 1992: 9221A.	Manchester Laboratory
Cyanide total	EPA, Revised 1983: 335.2	Manchester Laboratory
Cyanide (wk & dis)	APHA, 1992: 4500-CNI	Manchester Laboratory
PP Metals	EPA, Revised 1983: 200-299	Manchester Laboratory

METHOD BIBLIOGRAPHY

APHA-AWWA-WPCF, 1992. Standard Methods for the Examination of Water and Wastewater, 18th Edition.

EPA, Revised 1983. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020 (Rev. March, 1983).

Appendix D - Quality Assurance/Quality Control (QA/QC) – Chehalis, June 1997.

SAMPLING QA/QC

Ecology quality assurance procedures for sampling included cleaning of the sampling equipment for priority pollutant metals analyses prior to the inspection to prevent sample contamination (Appendix E). Chain-of-custody procedures were followed to assure the security of the samples (Ecology, 1994b).

LABORATORY QA/QC

General Chemistry Analysis

All total non-volatile (TNVS) results are estimates. Total suspended solids (TSS) results for sample 238142 (RcvWtr) is an estimate due to matrix homogeneity.

All analyses were performed within established EPA holding times. All initial and continuing calibration verification standards were within control limits. The procedural blanks showed no significant analytical levels of analytes. The procedural blanks showed no significant analytical levels of analytes. Spike samples were performed where applicable with all spike recoveries within acceptance limits of +/- 25%. Relative Percent Difference (RPD) for all parameters was within the 20% acceptance window for all duplicate analyses except TSS sample 238142 and TNVS sample 238140. Laboratory Control Sample (LCS) analyses were within the windows established for each parameter.

Priority Pollutant Metals Analysis

Liquid Samples

Data quality for this project is generally good with the exception that traces of lead were detected in the total recoverable procedure blank. No other significant quality assurance issues are noted with the data.

All analyses were performed within EPA holding times. All initial and continuing calibration verification standards were within the relevant EPA (CLP) control limits. AA calibration met CLP calibration requirements. The procedural blanks associated with these samples showed no analytically significant levels of analyte except traces of lead in the total recoverable procedure blank. Total recoverable lead values are qualified J, as estimated, due to detection of lead in the procedure blank.

All spike recoveries were within CLP acceptance limits of +/- 25%. The relative percent difference (RPD) for all analytes was within the 20% CLP acceptance window for duplicate analysis. Laboratory Control Sample (LCS) analyses were within the windows established for each parameter. Silver was not included in the LCS sample. Since silver was recovered, silver data were not qualified.

Sludge Samples

Data quality for this project was generally good with the exception that antimony recovery was low from the LCS sample and from spiked samples. Silver and mercury data showed a lack of precision that may indicate a nonhomogeneous sample. No other significant quality assurance issues were noted with the data.

All analyses were performed within EPA holding times. All initial and continuing calibration verification standards were within the relevant EPA (CLP) control limits. AA calibration met CLP calibration requirements. The procedural blanks associated with these samples showed no analytically significant levels of analyte except zinc. Sample levels of zinc were greater than ten times the blank level. Zinc data are not qualified.

All spike recoveries, except that of antimony, were within the CLP acceptance limits of +/- 25%. Antimony data are qualified UJ, as undetected at estimated detection level, due to low spike recovery. Silver spike recovery is not reported, but the silver sample level showed much variation. Silver data are qualified J, as estimated. Mercury spike recovery is reported NC, as not calculated, since sample level was greater than four times the spike level.

The relative percent difference (RPD) for all analytes, except mercury, is within the 20% CLP acceptance window for duplicate analysis. Mercury is acceptable based on duplicate precision, but when the unspiked sample (4.06 mg/Kg) is compared to the spiked sample (2.4 mg/Kg) lack of precision was evident. Spiking level was 0.1 mg/Kg. Mercury data are qualified J, as estimated. Silver data were also imprecise and results are qualified J, as estimated. LCS analyses are within the windows established for each parameter, except silver and antimony, whose recoveries were low. Silver and antimony results are qualified J, as estimated, or UJ, as undetected at the estimated detection level, if results were less than the detection level.

LABORATORY AUDIT

The Chehalis laboratory was accredited on July 1, 1992 and renewed most recently on June 23, 1997. The accreditation expires on June 30, 1998.

Appendix E - Priority Pollutant Metals Cleaning Procedures – Chehalis, June 1997.

PRIORITY POLLUTANT SAMPLING EQUIPMENT CLEANING PROCEDURES

1. Wash with laboratory detergent (phosphate-free)
2. Rinse several times with tap water
3. Rinse with 10% HNO_3 solution
4. Rinse one time with distilled/deionized water
5. Rinse with 10% HNO_3 solution
6. Rinse three times with distilled/deionized water
7. Seal with aluminum foil

Appendix F - Glossary of Terms – Chehalis, June 1997.

BOD_5 - five day biochemical oxygen demand
C - Chehalis
comp - composite sample
E - Department of Ecology
Eff - effluent
EPA - United States Environmental Protection Agency
F-coli - fecal coliform bacteria
g - gram
grab - grab sample
Inf - influent
MF - membrane filter
mg - milligram
mg/L - milligram per liter
MPN – most probable number
NPDES - National Pollutant Discharge Elimination System
pH - $-\log_{10}$ (hydrogen ion concentration)
Prm - primary clarifier effluent
QA - quality assurance
QC - quality control
TNVS - total nonvolatile solids
TNVSS - total nonvolatile suspended solids
TOC - total organic carbon
TS - total solids
TSS - total suspended solids
"U" or "<" - The analyte was not detected at or above the reported result; or less than
WWTP - wastewater treatment plant