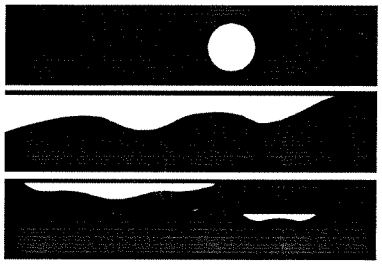


# Puyallup Basin Treatment Plant Metals Survey

April 1997

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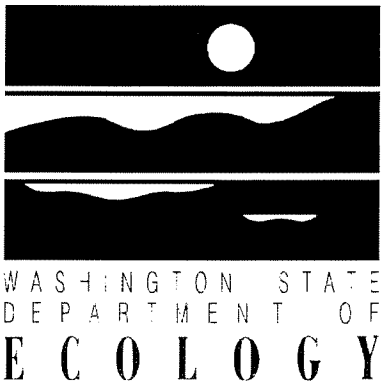


# Puyallup Basin Treatment Plant Metals Survey

*by*
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Olympia, Washington 98504-7710

April 1997

Water Body Numbers (see Abstract)

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# Abstract

A one-year survey of effluent metal concentrations and associated general chemistry parameters was conducted on four wastewater treatment plants (WWTPs) and their receiving waters, all located within the Puyallup River drainage basin. The facilities include: the Orting WWTP on the lower Carbonado River, the Buckley WWTP on the White River, the Wilkeson WWTP on Wilkeson Creek, and the Carbonado WWTP on the upper Carbonado. Samples were take bimonthly at the Orting and Buckley facilities, and once every four months at the Wilkeson and Carbonado facilities.

Statistical analysis of parameter data sets indicates that copper and zinc concentrations were associated with total suspended solids (TSS) concentrations, and reducing TSS may be a means of controlling metal loads to the receiving water. Orting, Buckley, and Wilkeson 24-hour sample effluent TSS loads were greater than NPDES permitted monthly average limits during one or more sampling events. Buckley exceeded the permit instantaneous peak flow for two events. Orting, Buckley, and Wilkeson flows were greater than the NPDES permitted maximum monthly average influent flow limit during one or more sampling events. With the exception of Buckley's May 1996 dry weather flow, these excursions occurred during extreme flood events. Most effluent metal concentrations were within both permit interim and final maximum daily limits, with a few exceptions. The Buckley February 1996 effluent mercury concentration exceeded both the permitted interim and final maximum daily limit. The Carbonado effluent copper concentrations exceeded the final maximum daily limits during all sampling events.

Buckley and Wilkeson effluent concentrations for copper at the edge of the acute dilution zone boundary were found to have exceeded water quality criteria during a number of individual sampling events. The Buckley mercury concentration at the edge of the chronic dilution zone boundary exceeded water quality criteria during the February and March 1996 sample events. It was recommended that the facilities take steps to control effluent TSS loads, high influent flows, and effluent metal concentrations, particularly by reducing inflow and infiltration into their respective collection systems. Changes to the permit metals limits may be needed to reflect the lower receiving water hardnesses detected during the inspection.

Water Body Numbers:

| | |
|---|---|
| Buckley: | WA-10-1040 |
| Carbonado: | WA-10-1050 |
| Orting: | WA-10-1080 |
| Wilkeson: | WA-10-1060 |

# Summary

## Flow Measurements

Independent verification of the accuracy of flow measurement devices was not performed; but each configuration was examined and, with one exception, all appeared to be functioning properly. Wilkeson's effluent V-notched weir displayed a pronounced bow and this might produce inaccuracies in effluent flow measurements. Flows during several sampling events were influenced by record precipitation that created flooding conditions in the area.

## General Effluent Results

Considerable variability was found for most parameter concentrations, both between treatment facilities and across sampling events. Variability across all sample events was less pronounced for copper and mercury. Despite periods of flooding, high flows account for little of the overall variability in concentrations, with most parameters retaining similar concentrations during flood events as during normal hydraulic loading. Decreased in-plant sedimentation due to hydraulic overloading may increase effluent metals loads. Re-entrainment of the clarifier sludge blanket may also contribute. Another explanation for these observations may be increased loads to the influent caused by contaminated inflow and infiltration into the collection system, which would offset the increased dilution. Controlling inflow and infiltration into the collection system may be a means of directly reducing effluent metals loads. Statistical analysis of parameter data sets also indicates that copper and zinc concentrations are associated with total suspended solids (TSS) concentrations. More efficient TSS removal may be a means of controlling these metal loads to the receiving water during more typical flow regimes.

## NPDES Permit Comparisons

Most effluent metal concentrations were within permitted interim and final maximum daily limits, with a few exceptions. Buckley's February 1996 mercury concentration exceeded the permit interim and final maximum daily limit. The Carbonado effluent copper results for August 1995, November 1995, and March 1996 exceeded the final maximum daily limit. The Orting and Buckley effluent TSS loads were greater than respective NPDES permitted monthly average limits for 24-hour sampling events during November 1995 and February 1996. The Wilkeson TSS result was greater than the effluent TSS load limit during the 24-hour composite sampling event in November 1995. Buckley plant flows during the November 1995 and February 1996 sampling events exceeded the permit

instantaneous peak flow limits. Orting and Buckley flows during those same sampling events were greater than the permit maximum monthly average influent flow. The Wilkeson flow during the November 1995 sampling event was also greater than the permit maximum month influent flow limit.

## Comparison of Detected Priority Pollutant Metals with Water Quality Criteria

### Orting Treatment Plant

Copper and mercury concentrations were within water quality criteria during all sample events, at both the acute and chronic dilution zone boundaries.

### Buckley Treatment Plant

Buckley's copper concentrations at the edge of the acute dilution boundary exceeded water quality criteria for all sample events, except for the September and November 1995 events. Mercury concentrations at the chronic dilution zone boundary exceeded the water quality criteria during February 1996 and March 1996. The February 1996 mercury sample result, with full chronic dilution, exceeds the water quality criteria by a factor of eight. Zinc concentrations at the edge of the acute and chronic dilution zone boundaries were within water quality criteria for all sample events.

### Wilkeson Treatment Plant

Copper concentrations at the edge of the acute dilution zone during the November sampling event exceeded water quality criteria by a factor of 1.8.

### Carbonado Treatment Plant

Dilution is projected to reduce all concentrations at the edge of both the acute and chronic boundaries to within applicable water quality criteria.

# Recommendations

## General Effluent Results

- The WWTPs should control inflow and infiltration to the collection system to decrease influent hydraulic loads and collateral effluent metals concentrations.

- The WWTPs should determine if increased TSS removal could reduce effluent metals concentrations during typical flow regimes.

## NPDES Permit Comparisons

- Orting WWTP should take steps to prevent excursions of TSS permit load limits and plant influent overload limits, with the focus on controlling infiltration into the collection system during high flow events.

- Buckley WWTP should investigate the treatment plant's potential for exceeding the copper and mercury permit limits. The WWTP should also take steps to prevent excursions of TSS permit load limits and plant influent overload limits, with the focus on controlling infiltration into the collection system during high flow events.

- Wilkeson WWTP should ensure that TSS concentrations and loads do not exceed the respective limits. The facility should also prevent excursions of plant influent overload limits, with the focus on controlling infiltration into the collection system during high flow events.

- Carbonado WWTP should ensure that copper concentrations do not exceed the daily final limits.

## Detected Priority Pollutant Metals

- Ecology should determine if permit metals limits need adjustments to reflect the lower receiving water harness concentrations reported during the survey, in order to ensure that metal concentrations remain within the water quality criteria at all dilutions during all seasons.

# Introduction

An effluent metals survey was conducted at the four municipal Wastewater Treatment Plants (WWTP) located on tributaries of the Puyallup River over a period of 10 months from August 1995 through May 1996. Samples were taken from WWTP effluents at the cities of Buckley, Carbonado, Orting, and Wilkeson. Copper and mercury analyses were performed at all plants. A zinc analysis was also performed on the Buckley and Carbonado plant effluents. Orting and Buckley were sampled approximately every two months, while Wilkeson and Carbonado were sampled approximately every four months.

Guy Hoyle-Dodson, environmental engineer for the Washington State Department of Ecology, Environmental Investigations and Laboratory Services Program, Toxics Investigations Section, conducted the survey. Steve Golding, environmental engineer (Toxic Investigation Section) and Dale Clark, environmental specialist (Ambient Monitoring Section) assisted in the field. Cathy Kupps, Ecology Southwest Regional Office permit manager, provided background information for the survey. Allen Wolfe, plant operator for the Buckley WWTP; Dean Kaelin, Orting city mayor and supervisor of the Orting WWTP; Jim Tharldson, operator at the Wilkeson WWTP; and Bob White, operator at the Carbonado WWTP, all provided information on individual facility operations and assistance on site.

## Background

The following is general information on the WWTPs included in the study:

### Orting

The Orting Wastewater Treatment Plant (Orting) is regulated under NPDES Permit No. WA-002030-3 (expiration date: June 30, 1999). Areas of regulation include effluent limitations, influent design criteria, and whole effluent toxicity testing. NPDES permit effluent metal limits include copper and mercury. The facility currently serves a population of approximately 2,300 individuals, with a design limit of 3,000. The wastestream is generated primarily from residential hookups, but also includes a nursing facility (State Soldiers Home) with approximately 180 users. Contributions from other small commercial or industrial sources are likely, but have not been specifically identified. Flows are seasonal, with high flows during the wet season likely attributed to infiltration into portions of the collection system constructed more than 40 years ago. These flows have been known to exceed the EPA recommended 275 gallon per capita per day limit (Ecology, 1994). A 1991 Ecology Class II Inspection detected copper in the effluent, but at a concentration below water quality criteria.

### Buckley

The Buckley Wastewater Treatment Plant (Buckley) is regulated under NPDES Permit No. WA-002336-1 (expiration date: August 28, 1999). Areas of regulation include effluent limitations, influent design criteria, and whole effluent toxicity testing. NPDES permit effluent metal limits include copper, mercury, and zinc. The facility's population design limit is 3,700 people. The wastestream is generated primarily from residential sewage, with a small number of commercial and industrial hookups. Variations in average seasonal flows allowed by the design criteria range from 0.39 MGD to 1.0 MGD.

### Wilkeson

The Wilkeson Wastewater Treatment Plant (Wilkeson) is regulated under NPDES Permit No. WA-002328-1 (expiration date: June 30, 1999). Areas of regulation include effluent limitations and influent design criteria. NPDES permit effluent metal limits include copper, mercury, and zinc. The facility serves a population of approximately 367 individuals and has a population design limit of 367. The wastestream is predominately residential sewage, with a small commercial contribution. The collection system experiences high infiltration and inflow during the wet season. Influent flow throughout the day is intermittent. The facility is restricted to a monthly average design flow of 0.07 MGD.

### Carbonado

The Carbonado Wastewater Treatment Plant (Carbonado) is regulated under NPDES Permit No. WA-002083-4 (expiration date: June 30, 1999). Areas of regulation include effluent limitations and influent design criteria. NPDES permit effluent metal limits include copper and mercury. The facility serves a population of approximately 500 individuals and has a population design limit of 800. The wastestream is predominately residential sewage, with a small commercial contribution. Flows to the treatment system from the collection system are gravity fed and vary with seasonal precipitation. Monthly average design flow is 0.1 MGD.

## Objectives

The survey was initiated by the Washington State Department of Ecology (Ecology) to evaluate permit compliance with metals limits and to provide information to fulfill established NPDES permit compliance and monitoring requirements. The inspection also focused on plant flow, the concentrations of TSS and hardness in whole effluent, and the concentrations of TSS and hardness in the receiving waters upstream of each plant's discharge. Specific objectives of the inspection included:

1. Evaluate NPDES permit compliance with metals limits by analysis of effluent to determine concentrations and loads;

2. Evaluate wastewater toxicity by comparing priority pollutant metals scan results to Washington State acute and chronic water quality criteria;

3. Evaluate the effect of receiving water hardness on effluent metals toxicity;

4. Provide long-term data to fulfill established NPDES permit compliance and monitoring requirements; and

5. Review operator metals sampling techniques and provide training as needed to improve sampling accuracy.

# Setting

The following includes specifics about plant design and discharge characteristics for each facility:

## Orting

The Orting facility is located northwest of the city of Orting in Pierce County (Figure 1). The Orting system consists of influent headworks with a bar screen and a comminutor, two aerated complete mix cells, one partially mixed facultative cell, a final polishing pond, and a chlorine contact chamber (Figure 4). The first three cells are created by a floating partition and act in series. The aeration cells are each aerated by a single 25-Hp aerator. The final cell is partially aerated by three 10-Hp aerators. Flow is measured at the influent by an electromagnetic flowmeter. Discharge is via a 21-inch diameter pipe that extends 300 feet into the Carbon River. The discharge port is approximately eight feet above the river bottom. During high flows the port is submerged, but during low flows the port is exposed and effluent cascades onto a concrete pad before trickling into the river. A mixing zone has been established for the Orting discharge, with acute and chronic annual dilution factors of 3.8 and 15 respectively. The 7Q10 for the Carbon River at the Orting outfall is approximately 148 cfs. Ambient dissolved copper and mercury concentrations reported in the Puyallup River basin 1993 TMDL (Pelletier, 1993) were below detection limits.

## Buckley

The Buckley facility is located on the northwest side of the city of Buckley in Pierce County (Figure 2). Buckley consists of influent headworks incorporating a bar screen, grit chamber, and comminutor; two aerated complete mix cells, each with a clarifier; an effluent Parshall flume situated prior to the chlorine contact chamber; a chlorine contact chamber with optional dechlorination; and a sludge removal system (Figure 5). Discharge is to a small channel of the White River, a tributary of the Puyallup River. A mixing zone has been established for the Buckley discharge, with acute and chronic annual dilution factors of 1.2 and 5.9 respectively. A more restrictive seasonal chronic dilution factor of 3.9 is enforced from December through April.

## Wilkeson

The Wilkeson facility is located on the north side of the city of Wilkeson in Pierce County (Figure 3). The Wilkeson system consists of influent headworks with a manually cleaned bar screen, two 90 foot diameter aeration lagoons, a chlorine contact chamber, and discharge line (Figure 6). Influent flow discharge is to the bank of Wilkeson Creek, a tributary of South Prairie Creek, which in turn is a tributary of the Carbon River and within the Puyallup River Basin. A mixing zone has been established for the Orting

discharge, with acute and chronic annual dilution factors of 3.2 and 28.5 respectively. More restrictive seasonal acute dilution factors of 3.1 for May through November and 2.6 for December through April also exist. A more restrictive chronic dilution factor of 25.8 is stipulated for May through November. A less restrictive chronic dilution factor of 30.2 is allowed for December through April. The 7Q10 for Wilkeson Creek at the Wilkeson outfall is approximately 8.9 cfs. The ambient dissolved copper and mercury concentrations reported in the TMDL were below detection limits. The ambient zinc concentration was 5.5 µg/L.

## Carbonado

The Carbonado facility is located south of the city of Carbonado in Pierce County (Figure 3). The Carbonado system consists of influent headworks with a manually cleaned bar screen, a single cell aeration lagoon, a chlorine contact chamber with a solids screen, an effluent weir, and discharge line (Figure 7). Discharge is to the Carbon River, a tributary of the Puyallup River. The receiving water is located approximately 500 below the treatment plant. Effluent first flows through a 4-inch diameter pipe that extends about 250 feet down a steep embankment, ending in a metal deflector that allows effluent to spray out over the canyon. The effluent then trickles the remaining 250 feet into the Carbon River. A mixing zone has been established for the Carbonado discharge, with acute and chronic annual dilution factors of 36.7 and 501 respectively. The 7Q10 for the Carbon River at the Orting outfall is approximately 107 cfs. Ambient dissolved copper and mercury concentrations reported in the TMDL were 2.1 µg/L and 0.08 µg/L respectively.

# Procedure

Composite samples from Buckley and Orting effluents were collected on August 28-29, 1995; October 26-27, 1995; November 28-29, 1995; February 6-7, 1996; March 26-27, 1996,; and May 28-29, 1996 (Figure 4, Figure 5, & Appendix A). Composite samples were collected from Wilkeson and Carbonado effluents on August 28-29, 1995; November 28-29, 1995; and March 26-27, 1996. Zinc, copper, and mercury analyses were performed on the Buckley and Wilkeson treatment plant effluent samples, while only copper and mercury analyses were performed on Orting and Carbonado effluent samples. All samples were analyzed for total suspended solids (TSS) and hardness. Samples were collected from the Buckley, Wilkeson, and Carbonado WWTP effluents just above the weir at the end of each plant's chlorination chamber. Samples were collected from the Orting WWTP effluent after chlorination, just prior to the flow entering the discharge pipe. Hoses with strainers were submerged approximately 12 inches below the surface of the flow and positioned to prevent entrainment of sediments.

All composite samples were collected using Ecology ISCO composite samplers with equal volumes of the sample collected every 30 minutes over a 24-hour period. Transfer blanks were collected prior to each sampling event for each compositor by running deionized (DI) water through the compositor and collecting the sample from the compositor's glass carboy.

Ambient hardness and TSS grab samples were collected from each receiving water above the plant outfall. The Orting Carbon River ambient sample location was approximately 200 feet above the Orting plant outfall. The Buckley White River ambient sample location was in the main stem of the river approximately 100 meters NNW the plant outfall and approximately 1200 feet north of the treatment plant. The Wilkeson WWTP Wilkeson Creek ambient sample location was about 100 feet north of the treatment plant approximately 20 feet above the plant outfall. Due to steepness of the river's canyon walls near the Carbonado outfall, the ambient sample location was approximately 6 miles above the plant outfall. This later ambient sample location was necessitated by the inaccessibility of the Carbon River near the treatment plant outfall.

Parameters analyzed, samples collected, and the sampling schedule appear in Appendix B. Samples for Ecology analysis were put in appropriate containers and preserved as necessary. Samples were packed in ice for delivery to the Ecology Manchester Environmental Laboratory. Holding time restrictions were observed for all samples. Analytical methods and laboratories performing the analyses are summarized in Appendix C.

## Specific QA/QC Discussions

Transfer blanks were submitted for analysis to establish baseline sampling conditions. Sampling quality assurance included ultra cleaning (priority pollutant cleaning) of sampling equipment to remove trace priority pollutant contaminate (Appendix D). A glossary of terms appears in Appendix E. Protocols for holding times, preservation, and chain-of-custody set forth in the Manchester Environmental Laboratory Lab Users Manual (Ecology, 1994) were followed.

Laboratory QA/QC -- including holding times, Laboratory Control Sample (LCS) analysis, matrix spike and duplicate spike sample analyses, surrogate recoveries, and precision data -- were within appropriate ranges, with a few exceptions. Initial calibration verification standards and continuing calibration standards were within relevant USEPA (CLP) control limits. Procedural blanks were predominantly free from contamination. Qualifiers are included in the data table where appropriate. The following are specific concerns:

1. General Chemistry - Several ambient hardness results had to be qualified with an "E" qualifier, denoting that the result was an estimate due to matrix interference which would not allow a clear end point. This occurred most often during periods of high flow, particularly during the flooding events in November 1995 and February 1996.

2. Metals - One effluent mercury result was qualified with the "J" qualifier indicating that the value is an estimate (but it has been positively identified) due to low spike recovery.

Two transfer blanks taken during the first sample event in August 1995 indicated some contamination of those samples with copper. Subsequent investigations indicated the contamination may have originated at the laboratory during analysis. The original sample contamination was relatively minor and samples subsequent to the August sampling showed no contamination in transfer blanks. The copper data are of acceptable quality for the purposes of this report. Several other metal values derived from samples take in August 1995 have been qualified with a "P" qualifier, indicating that the reported value is above analytic detection levels, but below analytic quantitation levels

# Results And Discussion

## Flow Measurements

Individual plant flow measurements were collected from effluent totalizer flow measurement devices. Independent verification of device accuracy was not performed; but each configuration was examined and, with one exception, all appeared to be functioning properly. Wilkeson's effluent V-notched weir displayed a pronounced bow and this might produce inaccuracies in effluent flow measurements. Wilkeson should replace the defective weir to ensure accuracy of their flow measurement device. The following is a summary of the 24-hour effluent totalized flows for all sample dates recorded at each facility during the survey:

**Orting**

| Date | Flow (MGD) |
|---|---|
| 8/28-29/95 | 0.213 |
| 9/26-27/95 | 0.238 |
| 11/28-29/95 | 1.47 |
| 2/6-7/96 | 1.78 |
| 3/26-27/96 | 0.408 |
| 5/28-29/96 | 0.487 |

**Wilkeson**

| Date | Flow (MGD) |
|---|---|
| 8/28-29/95 | 0.015 |
| 11/28-29/95 | 0.192 |
| 3/26-27/96 | 0.019 |

**Buckley**

| Date | Flow (MGD) |
|---|---|
| 8/28-29/95 | 0.293 |
| 9/26-27/95 | 0.367 |
| 11/28-29/95 | 2.71 |
| 2/6-7/96 | 2.65 |
| 3/26-27/96 | 0.323 |
| 5/28-29/96 | 0.503 |

**Carbonado**

| Date | Flow (MGD) |
|---|---|
| 8/28-29/95 | 0.031 |
| 11/28-29/95 | 0.07 |
| 3/26-27/96 | 0.029 |

It should be noted that the flows for November 1995 and February 1996 were recorded during flood events and approached or exceeded peak flows through the treatment plants.

## General Effluent Results

A summary of effluent sample results for each facility during all sample periods is presented in Table 1. With two exceptions, considerable variability was found for most

parameter concentrations, both between treatment facilities and across sampling events. Variability across all sample events for copper and mercury was less pronounced. The consistency of mercury concentrations is likely due to the predominance of non-detections. The event which showed the most overall variability from other sample events was in March, with general increases in mercury and general decreases in both zinc and total suspended solids (TSS). The copper variability was greatest in August and May.

Samples from November 28-29, 1995 and February 6-7, 1996 were both collected during unprecedented flood events. Heavy rains produced high flows through all plants that approached or exceeded peak design flows. All WWTP effluent discharges were believed to be highly impacted by massive infiltration into plant collection systems and it is likely that most treatment systems were short-circuited. Measured flows were extremely high, hydraulic overloading was plainly evident, and the effluent was visibly murky. Interestingly, these high flows account for little of the overall variability in metals concentrations, with most parameters retaining similar concentrations (in mg/L) during flood events as during normal hydraulic loading (but with corresponding large increases in loads {in lbs/day} discharged during the high flow periods).

Hypothesized decreases in sedimentation due to rapid flows through the treatment plants may be a source for a portion of the increased metal loads in the effluent, but it would also be expected that the increased hydraulic loading from rainfall would substantially increase dilution. Re-entrainment from the clarifier sludge blanket may also contribute, although the decreased detention time may quickly flush these solids through the system. Another explanation may be increased influent metal loads during high flows, resulting from contaminated inflow and infiltration (I&I) into the collection system which would offset the increased dilution. Reducing I&I to the collection system would likely decrease all these sources of effluent metals loading, and the WWTPs should implement strategies for achieving this goal.

Statistical analysis suggests that effluent metal concentrations could be linked to the effectiveness of solids removal. Distribution analysis of individual effluent parameters in combined sets derived from all treatment facilities determined that hardness, TSS, copper, and zinc were log-normally distributed. These distributions can be explained by the difference in flow regimes, both between plants and between sample events. Mercury displayed no discernible distribution pattern. Linear regression analysis of transformed parameter results revealed that copper and zinc concentrations were likely influenced by the TSS concentration and more moderately by hardness (Table 2). The coefficient of determination ($r^2$), as a measure of the percent of variability for a dependent variable (copper and zinc) that can be attributed to the independent variable (TSS), was found to be approximately 50% for copper and 33% for zinc. Pearson's r correlation coefficient, as a measure of the mutual movement of data sets, approached 0.8 for copper to TSS and 0.9 for zinc to TSS, indicating high positive correlations. Covariance analysis provided corresponding correlations.

Metal ions are known to be adsorbed by or chemically bind to solid constituents (APHA, 1992). The total recoverable analytic technique will include a portion of these bound metals in its results. Higher effluent TSS and corresponding metals concentrations could result from decreased in-plant sedimentation during high flows. Controlling infiltration would have the added benefit of reducing flow velocities through the plant and improving sedimentation. The WWTPs might also employ an overall strategy of improved in-plant TSS removal to reduce effluent metal concentrations during more normal flow regimes.

## NPDES Permit Comparisons

Table 3 compares inspection results to NPDES permit limits. It should be noted that permit load limits are assumed to encompass the extreme loading conditions experienced during the survey, and that permit comparisons are strictly interpreted. It should also be noted that excursions from permit limits during extreme loading conditions may be ameliorated by controlling inflow and infiltration into the facility's collection system. Following is a summary of NPDES comparisons for each facility:

### Orting

Copper and mercury concentrations were all within maximum daily interim and final limits. The Orting 24-hour composite effluent TSS concentrations were all within permit monthly and weekly average limits. All but two results were within permit load limits. The TSS load determined for the February 24-hour composite sample (193 lbs/day) was greater than the monthly and weekly average limit by approximately 61% and 7% respectively. The TSS load for the November 24-hour composite sample (172 lbs/day) was greater than the monthly average limit by 43%. Plant flow during the inspections in November and February (1.47 MGD & 1.78 MGD respectively) were greater than the permit maximum month limit, but were within the instantaneous peak flow limit.

The Orting WWTP should ensure that excursions of monthly average TSS permit load limits do not occur. They should also ensure that hydraulic loads are maintained below plant influent overload limits. Orting is advised to determine whether controlling inflow and infiltration to the collection system will safeguard against influent flows and effluent TSS loads from exceeding permit limits.

### Buckley

Most metal concentrations were within permit limits, with one exception. The February 1996 24-hour composite effluent mercury concentration (0.38 µg/L) exceeded the permit interim maximum daily effluent limit by 12% and was 4.75 times the final maximum daily limit. Of note, was a corresponding mercury load of 3.8 grams/day discharged to the White River during the February 1996 sampling event.

The Buckley effluent TSS concentrations were all within permit monthly and weekly average limits. All but two results were within permit load limits. The 24-hour composite effluent TSS loads for the months of November (362 lbs/day) and February (486 lbs/day) were greater than the monthly average by factors of 3.8 and 5.1 respectively. These loads were greater than the weekly average by factors of 2.2 and 2.9 respectively. November and February plant flows recorded during the 24-hour inspections (2.71 MGD and 2.65 MGD, respectively) exceeded the instantaneous peak flow influent limit and were greater than the permit maximum month overload limit. The May inspection plant flow (0.503 MGD) exceeded the permit dry weather flow (May - November) influent overloading limit by 29%.

The Buckley WWTP should constrain effluent mercury concentrations from exceeding permit limits during all flow regimes. The facility should ensure that excursions of monthly and weekly average TSS permit load limits do not occur. The facility should also prevent excursions of plant influent overload limits. Buckley is advised to determine whether controlling inflow and infiltration to the collection system will prevent exceedences of permitted limits.

## Wilkeson

All effluent metals concentrations were within permit limits. The Wilkeson August 24-hour composite effluent TSS concentration (60 mg/L) was greater than the permitted monthly average limit by 9.1%. The November 24-hour composite effluent TSS load (80 lbs/day) was greater than the permit monthly and weekly load limit by 150% and 67% respectively. The flow recorded during the November inspection (0.192 MGD) exceeded the permit maximum month overload limits by a factor of 2.7.

The Wilkeson WWTP should ensure that average TSS concentrations and loads do not exceed the permit limits. The facility should also prevent excursions of plant influent overload limits. Wilkeson is advised to determine whether controlling inflow and infiltration to the collection system will ensure that influent flows and effluent loads remain within permit limits.

## Carbonado

The Carbonado 24-hour composite effluent copper results in August (18.4 µg/L), November (16.3 µg/L), and March (13.4 µg/L) exceeded the permit final maximum daily limit by factors of 5.3, 4.7, and 3.8 respectively. These same copper results were within permit maximum interim limits. All other permit parameters were within pertinent permit limits.

The Carbonado WWTP should ensure that copper concentrations do not exceed the daily final limits.

## Comparison of Priority Pollutant Metals to Water Quality Criteria

Table 4 summarizes concentrations of detected priority pollutant metal parameters. Most chronic water quality criteria are adjusted by the receiving water hardness measured in receiving water during the 24-hour composite sampling period. These are appropriate values to use for comparisons at the edge of the chronic dilution zone. For the edge of the acute zone, receiving water hardness values will under most circumstances be increased due to mixing with the higher effluent hardness concentrations, which would have the effect of slightly raising the acute water quality criteria. A weighted average for acute hardness was calculated by weighting the receiving water hardness by the acute dilution factor, adding the effluent hardness, and dividing by the acute dilution factor plus one. Effluent results were all decreased by permitted dilution factors before comparisons to the criteria. The following is a summary of comparisons of detected metal results to hardness adjusted state water quality criteria:

### Orting

Whole effluent copper concentration results were greater than both acute and chronic state water quality criteria during all six sampling events. A chronic dilution factor of 15 specified in the permit would reduce concentrations at the edge of the chronic boundary to within chronic water quality criteria for all events. An acute dilution factor of 3.8 specified in the permit would reduce copper concentrations to within acute water quality criteria at the edge of the acute dilution zone for all sample events.

The mercury concentration were within water quality criteria during all sample events, at both acute and chronic dilutions.

### Buckley

Whole effluent copper concentrations were greater than acute state water quality criteria during several sampling events, and were greater than chronic criteria during all sampling events except the November 1995 inspection. The Buckley permit stipulates chronic dilution factors of 5.9 for May through November and 3.9 for December through April. The acute dilution factor is 1.2 year around. Dilution would reduced Buckley's copper concentrations at the edge of the chronic dilution zone boundary to within the water quality criteria during all sampling events. Buckley's copper concentrations at the edge of the acute boundary exceeded acute water quality criteria for all sample events, except the September 1995 and the November 1995 events.

Whole effluent zinc concentrations did not exceed acute water quality criteria during any sampling event. Zinc concentrations in the whole effluent exceeded chronic state water quality criteria during several events, however, dilution would reduce the Buckley zinc concentration at the edge of the chronic boundary to within chronic water quality standards during all sample events.

Whole effluent mercury concentrations were all less than the acute water quality criteria. Mercury concentrations in the whole effluent were greater than the chronic water quality criteria during the months of November 1995, February 1996, and March 1996. Dilution reduced concentrations at the edge of the chronic boundary to within chronic water quality standards for only the November 1995 result. The March 1996 result with dilution exceeds the chronic criteria by 50%. The February 1996 mercury result with dilution exceeds the chronic criteria by a factor of eight.

## Wilkeson

Whole effluent copper concentrations were greater than both acute and chronic state water quality criteria during all sampling events. Mercury concentrations were less than acute and chronic criteria during all sampling events, except during the November 1995 event. The Wilkeson permit stipulates chronic dilution factors of 25.8 for May through November and 30.2 for December through April. The acute dilution factor is 3.1 for May through November and 2.6 for December through April. With dilution at the edge of the chronic dilution zone boundary Wilkeson's copper, mercury, and zinc concentrations are reduced to within the water quality criteria during all sampling events. Dilution at the acute boundary would also have reduced Wilkeson's metal concentrations to within the acute water quality criteria during all sampling events, except the November 1995 event. The November copper concentration at the edge of the acute dilution zone exceeded the hardness adjusted acute water quality criteria by a factor of 1.8.

## Carbonado

Whole effluent copper concentrations were greater than both acute and chronic state water quality criteria during all sampling events. The whole effluent mercury concentration during the March 1996 sampling event was within the acute criteria, but was greater than the chronic criteria for that same event The Carbonado permit stipulates a chronic dilution factor of 501 and an acute dilution factor of 36.7. With dilution all metals concentrations are reduced at the edge of both the acute and chronic boundaries to within water quality criteria.

It should be noted that several of the effluent metal concentrations which exceeded water quality criteria after dilution were within their respective permit limits. This discrepancy may be attributed to differences between hardness values used in

calculating the water quality criteria for the permit and those measured during the inspection. Ecology should determine if the permit metal limits for the affected facilities need adjustments to reflect the lower hardness concentrations found in the receiving waters during the inspection.

# References

APHA, AWWA, WPCF, 1992. Standard Methods for the Examination of Water and Wastewater, 17th edition. American Public Health Association. Washington DC.

Ecology, 1991. Manchester Environmental Laboratory, Laboratory Users Manual, Third Revision. Dickey Huntamer and Janet Hyre, Ed. Washington State Department of Ecology, 1991.

Ecology, 1994. Orting NPDES Permit Fact Sheet. Washington State Department of Ecology, 1994.

Pelletier, G., 1993. Puyallup River Total Maximum Daily Load for Biochemical Oxygen Demand, Ammonia, and Residual Chlorine. Ecology Report, 36 pp. + appendices.

WAC, 173-201A, 1992. Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC. Washington State Administrative Code, 1992.

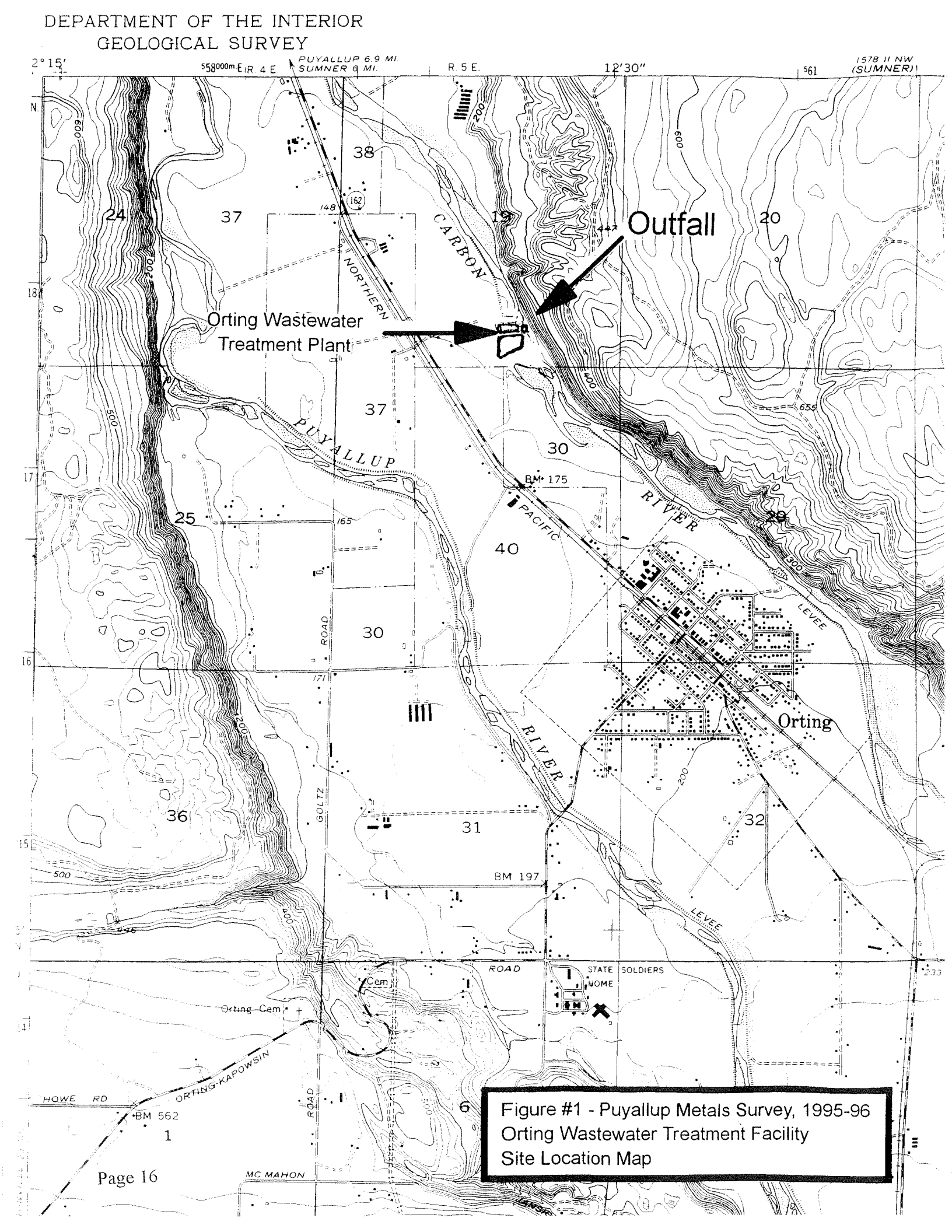


Figure #1 - Puyallup Metals Survey, 1995-96
Orting Wastewater Treatment Facility
Site Location Map

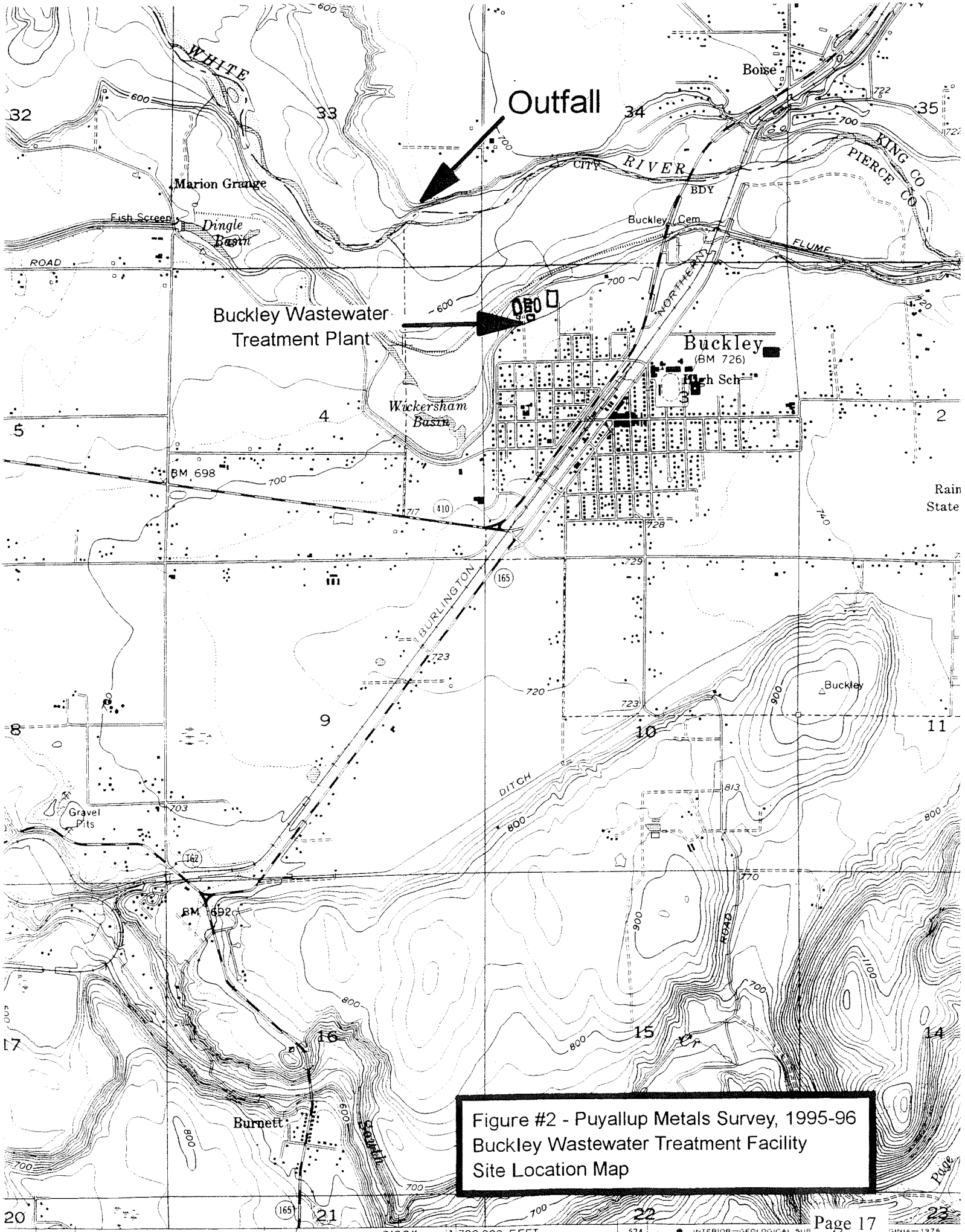


Figure #2 - Puyallup Metals Survey, 1995-96
Buckley Wastewater Treatment Facility
Site Location Map

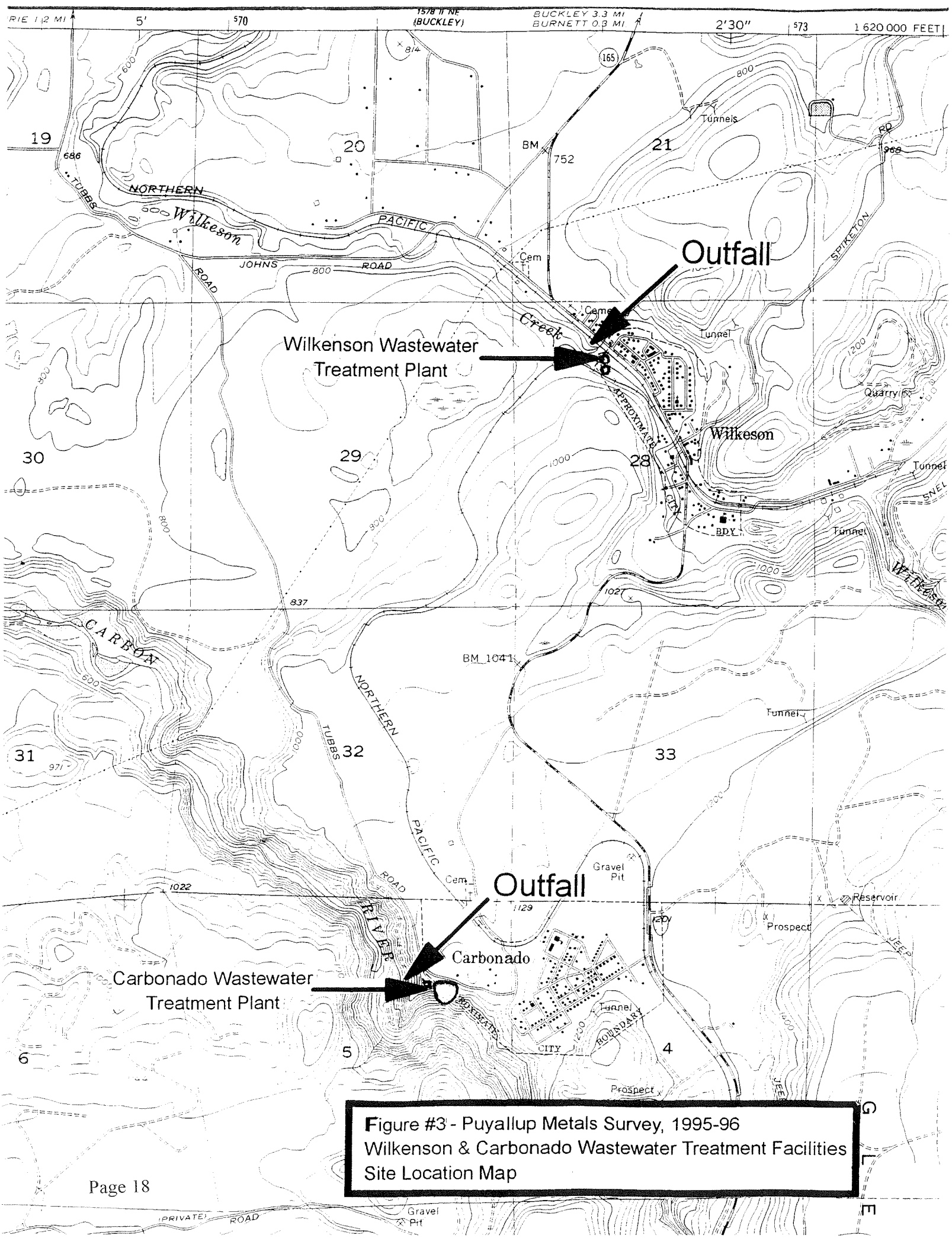


**Figure #3 - Puyallup Metals Survey, 1995-96**
**Wilkenson & Carbonado Wastewater Treatment Facilities**
**Site Location Map**

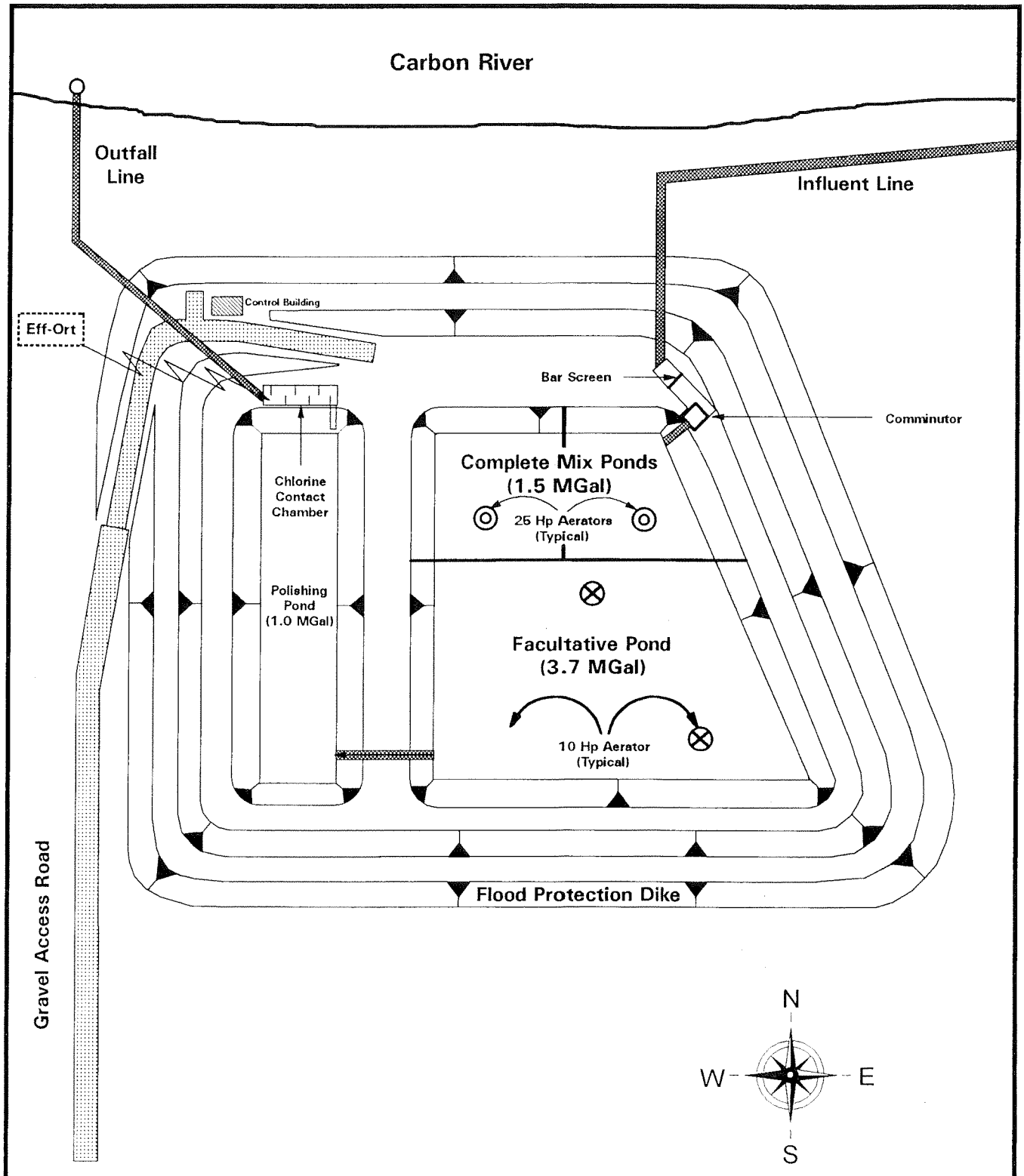


Figure # 4 - Plant Schematic
Orting Wastewater Treatment Plant
Puyallup Metals Survey, 1995 - 1996

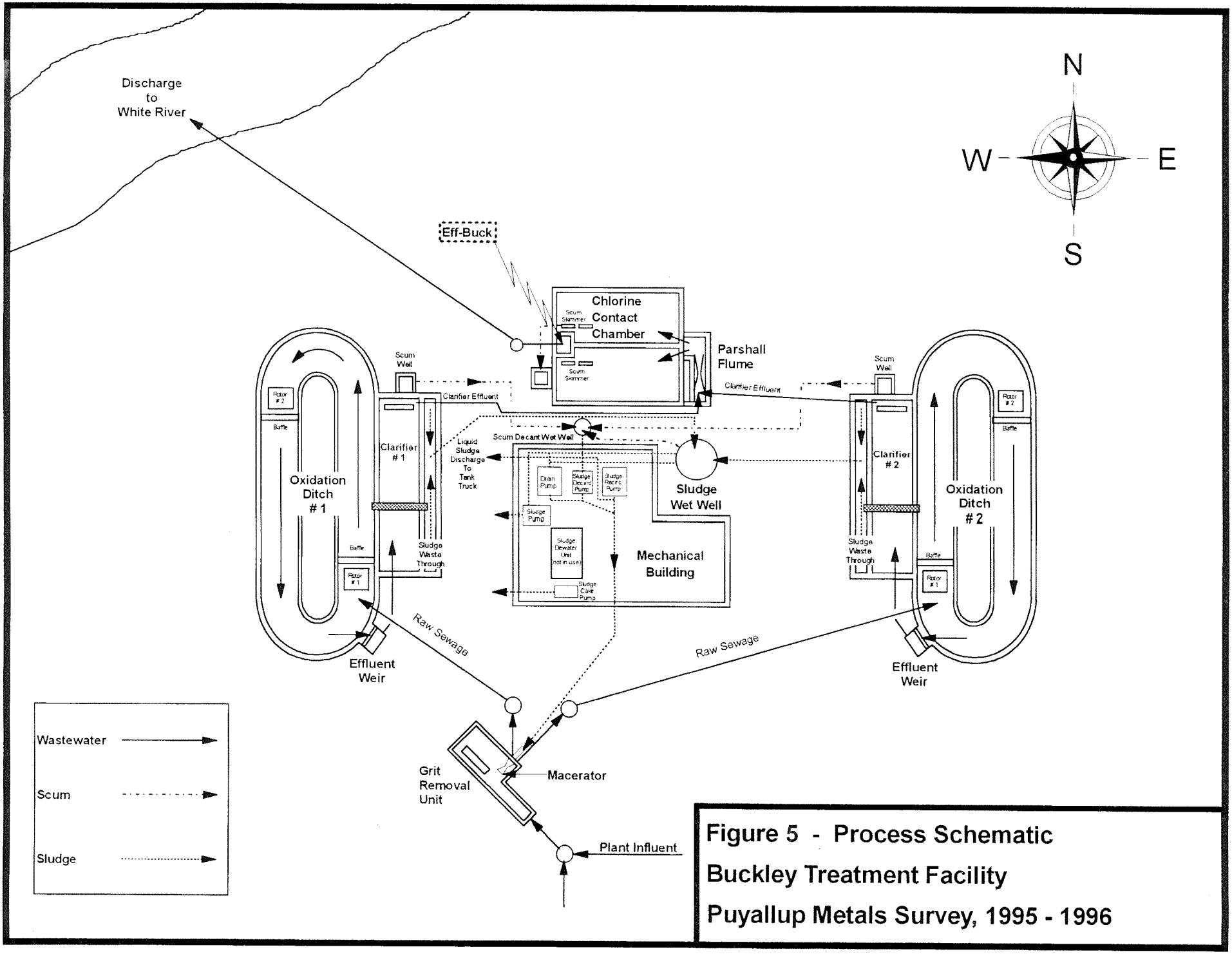


**Figure 5 - Process Schematic**

**Buckley Treatment Facility**

**Puyallup Metals Survey, 1995 - 1996**

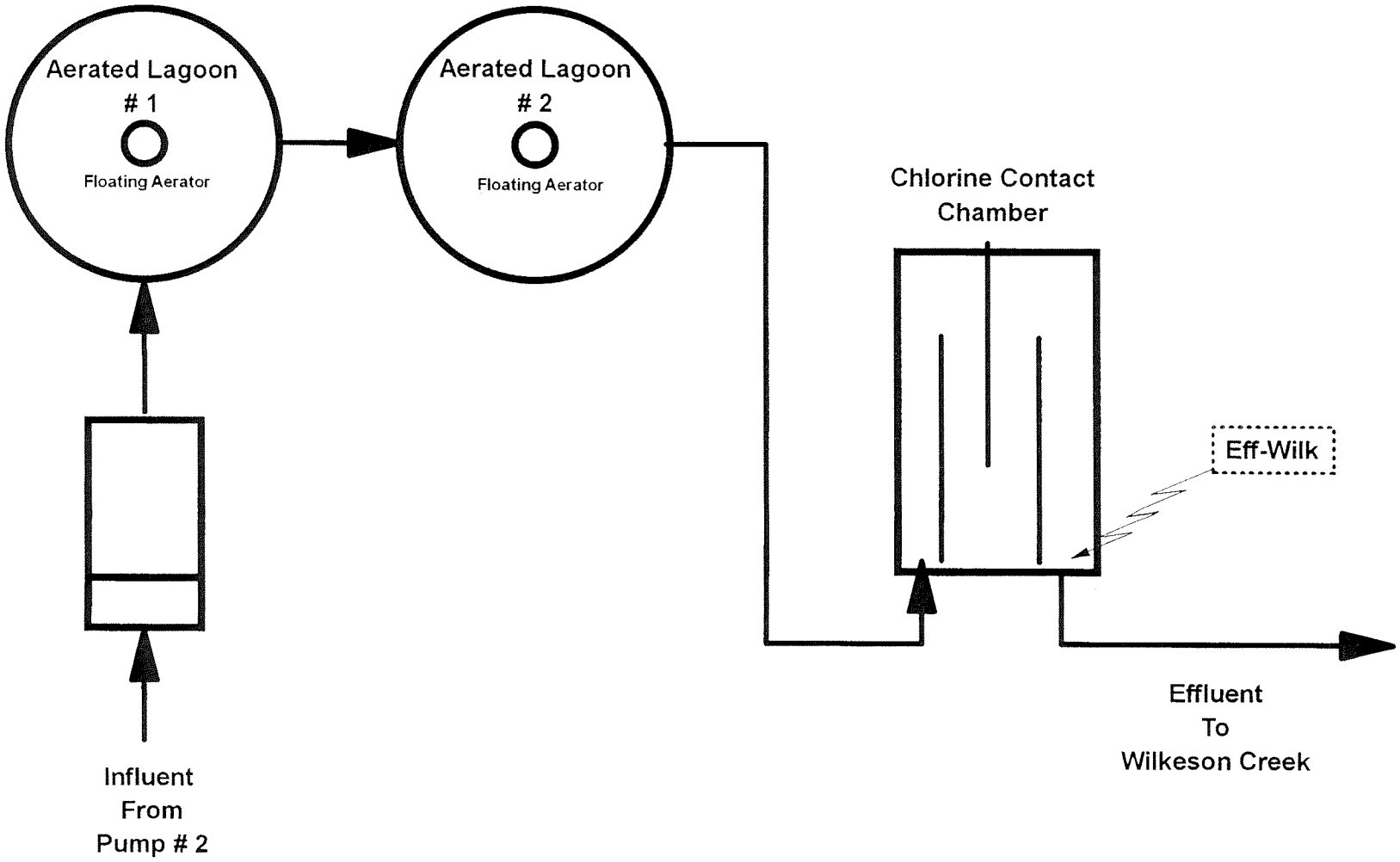


Figure # 6 - Plant Schematic

Wilkeson Wastewater Treatment Plant

Puyallup Metals Survey, 1995 - 1996

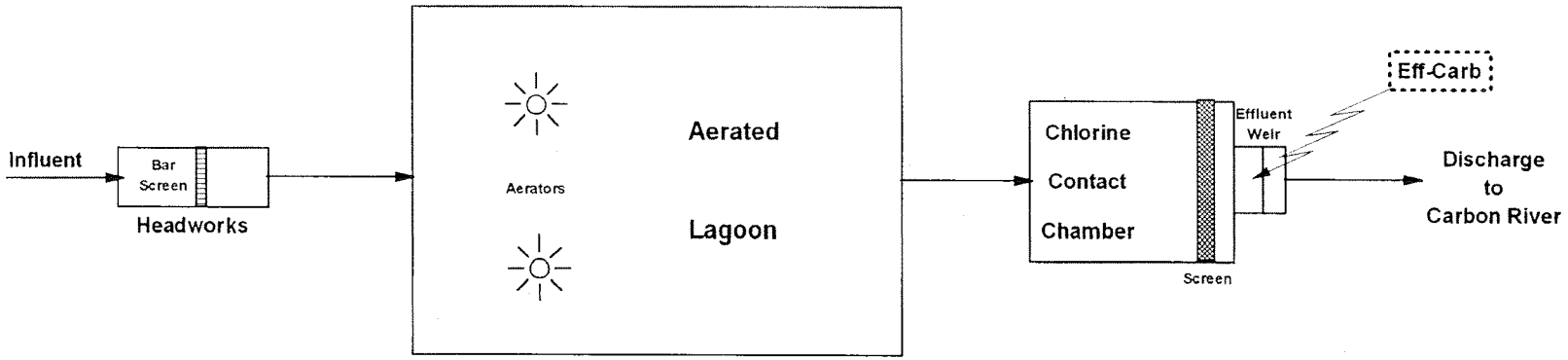


Figure # 7 - Plant Schematic

Carbonado Wastewater Treatment Plant

Puyallup Metals Survey, 1995 - 1996

# Table 1 - Inspection Results - Puyallup Metals Survey, 1995-96.



## September 1995 Inspection Results

| PARAMETER | Location: | Eff-Ort1 | Eff-Buck1 | Eff-Wilk1 | Eff-Carb1 | TranBlkO1 | TranBlkB1 | TranBlkW1 | TranBlkC1 | Amb-Carb-O1 | Amb-White-B1 | Amb-WilkCr-W1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | comp | comp | grab | grab | grab | grab | grab | grab | grab |
| | Date: | 8/28-29/95 | 8/28-29/95 | 8/28-29/95 | 8/28-29/95 | 8/28/95 | 8/28/95 | 8/28/95 | 8/28/95 | 8/29/95 | 8/29/95 | 8/29/95 |
| | Time: | 10:50-10:50 | 11:50-11:50 | 13:35-13:35 | 15:10-15:10 | 10:50 | 11:50 | 13:35 | 15:10 | 10:28 | 12:25 | 14:03 |
| | Lab Log #: | 358182 | 358180 | 358183 | 358181 | 358186 | 358184 | 358187 | 358185 | 358190 | 358188 | 358191 |
| **GENERAL CHEMISTRY** | | | | | | | | | | | | |
| Hardness (mg/L CaCO3) | | 99.8 | 40.3 | 113 | 47.9 | | | | | 26.4 | 24 | 62.4 |
| **SOLIDS** | | | | | | | | | | | | |
| TSS (mg/L) | | 22 | 2 | 60 | 10 | | | | | 17 | 24 | 1 U |
| **METALS** | | | | | | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | 36 P | 73.4 | | 4 U | 12 P | 4 U | 4 U | | | |
| Copper (ug/L - Total Rec, GFAA) | | 9.3 P | 5.5 P | 36.2 | 18.4 | 1 P | 5.2 P | 1 U | 1 U | | | |
| Mercury (ug/L - Total Rec, CVAA) | | 0.05 U | 0.05 U | 0.05 U | 0.05 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U | | | |
| **FIELD OBSERVATIONS** | | | | | | | | | | | | |
| Temperature (C) | | | | | | | | | | 13.1 | 16.5 | 14.2 |
| Temp-cooled (C) | | 5.8 | 7.1 | 3.9 | 3.8 | | | | | | | |
| pH | | 8.12 | 7.23 | 7.38 | 7.79 | | | | | 7.84 | 7.71 | 8.16 |
| Conductivity (umhos/cm) | | 661 | 359 | 579 | 743 | | | | | 66.5 | 66.7 | 152 |

## October 1995 Inspection Results

| PARAMETER | Location: | Eff-Ort2 | Eff-Buck2 | TranBlkO2 | TranBlkB2 | Amb-Carb-O2 | Amb-White-B2 |
|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | grab | grab | grab | grab |
| | Date: | 9/26-27/95 | 9/26-27/95 | 9/26/95 | 9/26/95 | 9/26/95 | 9/26/95 |
| | Time: | 11:04-11:04 | 13:30-13:30 | 11:04 | 13:30 | 1143 | 1410 |
| | Lab Log #: | 398005 | 398006 | 398007 | 398008 | 398009 | 398010 |
| **GENERAL CHEMISTRY** | | | | | | | |
| Hardness (mg/L CaCO3) | | 96.7 | 38.4 | | | 28.1 | 26.7 E |
| **SOLIDS** | | | | | | | |
| TSS (mg/L) | | 22 | 3 | | | 13 | 12 |
| **METALS** | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | 14 P | 39 P | 4 U | 4 U | | |
| Copper (ug/L - Total Rec, GFAA) | | 13.7 | 7 P | 1 P | 1 U | | |
| Mercury (ug/L - Total Rec, CVAA) | | 0.05 U | 0.05 U | 0.1 U | 0.1 U | | |
| **FIELD OBSERVATIONS** | | | | | | | |
| Temperature (C) | | | | | | 14.3 | 17.7 |
| Temp-cooled (C) | | 4.9 | 4.4 | | | | |
| pH | | 8.33 | 7.98 | | | 8.39 | 8.29 |
| Conductivity (umhos/cm) | | 697 | 407 | | | 75.2 | 96.1 |

| | |
|---|---|
| Eff | Effluent |
| Buck | Buckly Treatment Plant |
| Carb | Carbonado Treatment Plant |
| Ort | Orting Treatment Plant |
| Wilk | Wilkeson Treatment Plant |
| TranBlk | Transfer Blank |

| | |
|---|---|
| ICP | Inductively Coupled Plasma analysis |
| GFAA | Graphite Furnace Atomic Adsorption |
| CVAA | Cold Vapor Atomic Adsorption |
| comp | Composite sample |
| grab | Grab sample |

| | |
|---|---|
| Amb-White-B | White River ambient sample for Buckley WWTP |
| Amb-Carb-O | Carbonado River ambient sample for Orting WWTP |
| Amb-WilkCr-W | Wilkenson Creek ambient sample for Wilkenson WWTP |
| Amb-Carb-C | Carbonado River ambient sample for Carbonado WWTP |
| E | The reported result is an estimate because of the presence of interference. |
| P | The analyte was detected above the instrument detection |
| U | The analyte was not detect at or above the reported result. |

# Table 1 - Inspection Results - Puyallup Metals Survey, 1995-96.



## November 1995 Inspection Results

| PARAMETER | Location: | Eff-Ort3 | Eff-Buck3 | Eff-Wilk3 | Eff-Carb3 | TranBlkO3 | TranBlkB3 | TranBlkW3 | TranBlkC3 | Amb-Carb-O3 | Amb-White-B3 | Amb-WilkCr-W3 | Amb-Carb-C3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | comp | comp | grab | grab | grab | grab | grab | grab | grab | grab |
| | Date: | 11/28-29/95 | 11/28-29/95 | 11/28-29/95 | 11/28-29/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 |
| | Time: | 10:46-10:46 | 15:30-15:30 | 14:49-14:49 | 16:25-16:25 | 10:46 | 12:21 | 14:49 | 16:25 | 11:11 | 14:05 | 15:00 | 17:28 |
| | Lab Log #: | 488182 | 488180 | 488183 | 488181 | 488184 | 488186 | 488188 | 488187 | 488191 | 488189 | 488192 | 488190 |
| **GENERAL CHEMISTRY** | | | | | | | | | | | | | |
| Hardness (mg/L CaCO3) | | 93.1 | 48.9 | 79.3 | 40.6 | | | | | 64.8 E | 82.8 E | 23.5 E | 45.4 E |
| **SOLIDS** | | | | | | | | | | | | | |
| TSS (mg/L) | | 14 | 16 | 50 | 33 | | | | | 2770 | 2170 | 526 | 1980 |
| **METALS** | | | | | | | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | 37 | 73.1 | | | 4 U | 4 U | | | | | |
| Copper (ug/L - Total Rec, GFAA) | | 14.3 | 8.7 | 37.1 | 16.3 | 1 U | 1 U | 1 U | 1 U | | | | |
| Mercury (ug/L - Total Rec, CVAA) | | 0.05 U | 0.06 | 0.12 | 0.05 U | 0.1 U | 0.1 U | 0.1 U | 0.1 U | | | | |
| **FIELD OBSERVATIONS** | | | | | | | | | | | | | |
| Temperature (C) | | | | | | | | | | 9.4 | 11.1 | 9.7 | 9.5 |
| Temp-cooled (C) | | 4.2 | 3.1 | 3.5 | 3.8 | | | | | | | | |
| pH | | 7.24 | 7.21 | 7.85 | 7.68 | | | | | 7.05 | 7.41 | 7.26 | 7.64 |
| Conductivity (umhos/cm) | | 444 | 163 | 366 | 601 | | | | | 25.1 | 47.1 | 38.5 | 19.9 |

## February 1996 Inspection Results

| PARAMETER | Location: | Eff-Ort4 | Eff-Buck4 | TranBlkO4 | TranBlkB4 | Amb-Carb-O4 | Amb-White-B4 |
|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | grab | grab | grab | grab |
| | Date: | 2/6-7/96 | 2/6-7/96 | 2/6/96 | 2/6/96 | 9/6/95 | 9/6/95 |
| | Time: | 10:15-10:15 | 11:18-11:18 | 10:15 | 11:18 | 10:30 | 13:40 |
| | Lab Log #: | 068131 | 068130 | 068133 | 068132 | 068135 | 068134 |
| **GENERAL CHEMISTRY** | | | | | | | |
| Hardness (mg/L CaCO3) | | 99.4 | 44.6 | | | 18.8 E | 22 E |
| **SOLIDS** | | | | | | | |
| TSS (mg/L) | | 13 | 22 | | | 51 | 140 |
| **METALS** | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | 43.1 | | 7.9 | | |
| Copper (ug/L - Total Rec, GFAA) | | 13.3 | 8.6 | 1 U | 1 U | | |
| Mercury (ug/L - Total Rec, CVAA) | | 0.05 UJ | 0.38 J | 0.1 UJ | 0.1 UJ | | |
| **FIELD OBSERVATIONS** | | | | | | | |
| Temperature (C) | | | | | | 6.0 | 9.5 |
| Temp-cooled (C) | | 3.3 | 3.4 | | | | |
| pH | | 7.66 | 6.93 | | | | 7.29 |
| Conductivity (umhos/cm) | | 228 | 82.0 | | | 28.4 | 41.8 |

| | |
|---|---|
| Eff | Effluent |
| Buck | Buckly Treatment Plant |
| Carb | Carbonado Treatment Plant |
| Ort | Orting Treatment Plant |
| Wilk | Wilkeson Treatment Plant |
| TranBlk | Transfer Blank |

| | |
|---|---|
| ICP | Inductively Coupled Plasma analysis |
| GFAA | Graphite Furnace Atomic Adsorption |
| CVAA | Cold Vapor Atomic Adsorption |
| comp | Composite sample |
| grab | Grab sample |

| | |
|---|---|
| Amb-White-B | White River ambient sample for Buckley WWTP |
| Amb-Carb-O | Carbonado River ambient sample for Orting WWTP |
| Amb-WilkCr-W | Wilkenson Creek ambient sample for Wilkenson WWTP |
| Amb-Carb-C | Carbonado River ambient sample for Carbonado WWTP |
| J | The analyte was positively identified. The associated numerical result is an estimate. |
| E | The reported result is an estimate because of the presence of interference. |
| U | The analyte was not detected at or above the reported result. |

# Table 1 - Inspection Results - Puyallup Metals Survey, 1995-96.



## March 1996 Inspection Results

| PARAMETER | Location: | Eff-Ort5 | Eff-Buck5 | Eff-Wilk5 | Eff-Carb5 | TranBlkO5 | TranBlkB5 | TranBlkW5 | TranBlkC5 | Amb-Carb-O5 | Amb-White-B5 | Amb-WilkCr-W5 | Amb-Carb-C5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | comp | comp | grab | grab | grab | grab | grab | grab | grab | grab |
| | Date: | 3/26-27/96 | 3/26-27/96 | 3/26-27/96 | 3/26-27/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 |
| | Time: | 10:05-10:05 | 11:15-11:15 | 14:07-14:07 | 14:50-14:50 | 10:05 | 11:15 | 14:07 | 14:50 | 10:40 | 12:40 | 14:23 | 16:00 |
| | Lab Log #: | 138207 | 138205 | 138208 | 138206 | 138209 | 138210 | 138211 | 138212 | 138215 | 138213 | 138216 | 138214 |
| **GENERAL CHEMISTRY** | | | | | | | | | | | | | |
| Hardness (mg/L CaCO3) | | 25.1 | 37.3 | 87.6 | 25 | | | | | 31.5 | 25.7 | 40.6 | 12.8 |
| **SOLIDS** | | | | | | | | | | | | | |
| TSS (mg/L) | | 18 | 7 | 10 | 43 | | | | | 4 | 23 | 1 | 1 |
| **METALS** | | | | | | | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | 29 | 18 | | | 4 U | 4 U | | | | | |
| Copper (ug/L - Total Rec, GFAA) | | 13.5 | 8.3 | 13 | 13.4 | 1 U | 1 U | 1 U | 1 U | | | | |
| Mercury (ug/L - Total Rec, CVAA) | | 0.075 | 0.068 | 0.05 U | 0.062 | 0.1 U | 0.1 U | 0.1 U | 0.1 | | | | |
| **FIELD OBSERVATIONS** | | | | | | | | | | | | | |
| Temperature (C) | | | | | | | | | | 7.3 | 9.0 | 7.3 | 9.6 |
| Temp-cooled (C) | | 3.0 | 3.7 | 2.8 | 4.0 | | | | | | | | |
| pH | | 7.48 | 7.36 | 7.70 | 7.81 | | | | | 7.64 | 7.09 | 7.18 | 7.24 |
| Conductivity (umhos/cm) | | 528 | 318 | 608 | 640 | | | | | 88.8 | 77.3 | 113 | 43.4 |

## May 1996 Inspection Results

| PARAMETER | Location: | Eff-Ort6 | Eff-Buck6 | TranBlkO6 | TranBlkB6 | Amb-Carb-O6 | Amb-White-B6 |
|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | grab | grab | grab | grab |
| | Date: | 5/28-29/96 | 5/28-29/96 | 5/28/96 | 5/28/96 | 5/28/96 | 5/28/96 |
| | Time: | 11:50-11:50 | 13:30-13:30 | 11:50 | 13:30 | 12:10 | 18:00 |
| | Lab Log #: | 228131 | 228130 | 068133 | 068132 | 228134 | 228135 |
| **GENERAL CHEMISTRY** | | | | | | | |
| Hardness (mg/L CaCO3) | | 109 | 41.6 | | | 21.6 | 20.1 |
| **SOLIDS** | | | | | | | |
| TSS (mg/L) | | 21 | 21 | | | 5 | 47 |
| **METALS** | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | 34 | | 4 U | | |
| Copper (ug/L - Total Rec, GFAA) | | 8.5 | 10.9 | 1 U | 1 U | | |
| Mercury (ug/L - Total Rec, CVAA) | | 0.05 U | 0.05 U | 0.1 U | 0.1 U | | |
| **FIELD OBSERVATIONS** | | | | | | | |
| Temperature (C) | | | | | | 11.4 | 14.1 |
| Temp-cooled (C) | | 3.7 | 3.5 | | | | |
| pH | | 7.70 | 7.47 | | | 817 | 8.30 |
| Conductivity (umhos/cm) | | 487 | 317 | | | 57.4 | 53.8 |

| | |
|---|---|
| Eff | Effluent |
| Buck | Buckly Treatment Plant |
| Carb | Carbonado Treatment Plant |
| Ort | Orting Treatment Plant |
| Wilk | Wilkeson Treatment Plant |
| TranBlk | Transfer Blank |

| | |
|---|---|
| ICP | Inductively Coupled Plasma analysis |
| GFAA | Graphite Furnace Atomic Adsorption |
| CVAA | Cold Vapor Atomic Adsorption |
| comp | Composite sample |
| grab | Grab sample |

| | |
|---|---|
| Amb-White-B | White River ambient sample for Buckley WWTP |
| Amb-Carb-O | Carbonado River ambient sample for Orting WWTP |
| Amb-WilkCr-W | Wilkenson Creek ambient sample for Wilkenson WWTP |
| Amb-Carb-C | Carbonado River ambient sample for Carbonado WWTP |
| J | The analyte was positively identified. The associated numerical result is an estimate. |
| E | The reported result is an estimate because of the presence of interference. |
| U | The analyte was not detected at or above the reported result. |

## TABLE 2 - Summary Output of Linear Regression and Correlation Analysis, Puyallup Metals Survey, 1995-96

**Linear Regression Analysis of Individual Parameters for All Sample Stations and Events**

| Cu to TSS | | Cu to Hardness | | Cu to Hg | |
|---|---|---|---|---|---|
| *Regression Statistics* | | *Regression Statistics* | | *Regression Statistics* | |
| Multiple R | 0.712 | Multiple R | 0.332 | Multiple R | 0.012 |
| R Square | 0.507 | R Square | 0.110 | R Square | 0.000 |
| Adjusted R S | 0.476 | Adjusted R S | 0.054 | Adjusted R S | -0.062 |
| Standard Err | 0.158 | Standard Err | 0.212 | Standard Err | 0.225 |
| Observations | 18.000 | Observations | 18.000 | Observations | 18.000 |

| Hardness to TSS | | Hardness to Cu | | Hardness to Hg | |
|---|---|---|---|---|---|
| *Regression Statistics* | | *Regression Statistics* | | *Regression Statistics* | |
| Multiple R | 0.248 | Multiple R | 0.332 | Multiple R | 0.211 |
| R Square | 0.062 | R Square | 0.110 | R Square | 0.044 |
| Adjusted R S | 0.003 | Adjusted R S | 0.054 | Adjusted R S | -0.015 |
| Standard Err | 0.222 | Standard Err | 0.216 | Standard Err | 0.224 |
| Observations | 18.000 | Observations | 18.000 | Observations | 18.000 |

| Zn to TSS | | Zn to Hardness | | Zn to Cu | | Zn to Hg | |
|---|---|---|---|---|---|---|---|
| *Regression Statistics* | | *Regression Statistics* | | *Regression Statistics* | | *Regression Statistics* | |
| Multiple R | 0.574 | Multiple R | 0.338 | Multiple R | 0.027 | Multiple R | 0.550 |
| R Square | 0.330 | R Square | 0.114 | R Square | 0.001 | R Square | 0.303 |
| Adjusted R S | 0.234 | Adjusted R S | -0.012 | Adjusted R S | -0.142 | Adjusted R S | 0.203 |
| Standard Err | 0.166 | Standard Err | 0.190 | Standard Err | 0.202 | Standard Err | 0.169 |
| Observations | 9.000 | Observations | 9.000 | Observations | 9.000 | Observations | 9.000 |

**Pearson's r**

| | *HARDNESS* | *TSS* | *Zn* | *Cu* | *Hg* |
|---|---|---|---|---|---|
| HARDNESS | 1.000 | | | | |
| TSS | 0.258 | 1.000 | | | |
| Zn | 0.551 | 0.893 | 1.000 | | |
| Cu | 0.361 | 0.799 | 0.868 | 1.000 | |
| Hg | -0.190 | 0.096 | 0.124 | -0.040 | 1.000 |

**Covariance**

| | *HARDNESS* | *TSS* | *Zn* | *Cu* | *Hg* |
|---|---|---|---|---|---|
| HARDNESS | 972.440 | | | | |
| TSS | 127.347 | 250.500 | | | |
| Zn | 283.811 | 345.697 | 353.879 | | |
| Cu | 99.256 | 111.721 | 191.317 | 77.953 | |
| Hg | -0.461 | 0.118 | 0.238 | -0.027 | 0.006 |

# Table 3 - NPDES Comparison Results - Puyallup Metals Survey, 1996.



## Orting Permit Comparisons

| Parameter | Permit Limits | | Ecology Composite Results | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Location: | Eff-Ort1 | Eff-Ort2 | Eff-Ort3 | Eff-Ort4 | Eff-Ort5 | Eff-Ort6 |
| | | | Type: | comp | comp | comp | comp | comp | comp |
| | Monthly Average | Weekly Average | Date: | 8/28-29/95 | 9/26-27/95 | 11/28-29/95 | 2/6-7/96 | 3/26-27/96 | 5/28-29/96 |
| | | | Time: | 10:50-10:50 | 11:04-11:04 | 10:46-10:46 | 10:15-10:15 | 10:05-10:05 | 11:50-11:50 |
| | | | Lab Log #: | 358182 | 398005 | 488182 | 068131 | 138207 | 228131 |
| **Effluent TSS** | | | | | | | | | |
| Concentration (mg/L) | 30 | 45 | | 22 | 22 | 14 | 13 | 18 | 21 |
| Loading: (lbs/day) | 120 | 180 | | 39 | 44 | 172 | 193 | 61 | 85 |
| **Effluent pH** | | | | | | | | | |
| (S.U.) | 6 < pH < 9 | | | 8.12 | 8.33 | 7.24 | 7.66 | 7.48 | 7.70 |
| **Plant Flow (MGD)** | | | | 0.213 | 0.238 | 1.47 | 1.78 | 0.408 | 0.487 |
| **Influent Flow Overloading Limits** | | | | | | | | | |
| Dry weather Flow (MGD) | 0.55 | | | | | | | | |
| Maximum Month (MGD) | 0.85 | | | | | | | | |
| Instantaneous Peak Flow (MGD) | 2.10 | | | | | | | | |
| **Total Recoverable Copper (µg/L)** | | | | 9.3 P | 13.7 | 14.3 | 13.3 | 13.5 | 8.5 |
| | Maximum Daily | | | | | | | | |
| | Interim | Final | | | | | | | |
| Limit (µg/L) | 106 | 52 | | | | | | | |
| **Total Recoverable Mercury (µg/L)** | | | | 0.05 U | 0.05 U | 0.05 U | 0.05 U | 0.075 | 0.05 U |
| | Maximum Daily | | | | | | | | |
| | Interim | Final | | | | | | | |
| Limit (µg/L) | 0.76 | 0.30 | | | | | | | |

## Buckley Permit Comparisons

| Parameter | Permit Limits | | Ecology Composite Results | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Location: | Eff-Buck1 | Eff-Buck2 | Eff-Buck3 | Eff-Buck4 | Eff-Buck5 | Eff-Buck6 |
| | | | Type: | comp | comp | comp | comp | comp | comp |
| | Monthly Average | Weekly Average | Date: | 8/28-29/95 | 9/26-27/95 | 11/28-29/95 | 2/6-7/96 | 3/26-27/96 | 5/28-29/96 |
| | | | Time: | 11:50-11:50 | 13:30-13:30 | 15:30-15:30 | 11:18-11:18 | 11:15-11:15 | 13:30-13:30 |
| | | | Lab Log #: | 358180 | 398006 | 488180 | 068130 | 138205 | 228130 |
| **Effluent TSS** | | | | | | | | | |
| Concentration (mg/L) | 30 | 45 | | 2 | 3 | 16 | 22 | 7 | 21 |
| Loading: (lbs/day) | 95 | 167 | | 5 | 9 | 362 | 486 | 19 | 88 |
| **Effluent pH** | | | | | | | | | |
| (S.U.) | 6 < pH < 9 | | | 7.23 | 7.98 | 7.21 | 6.93 | 7.36 | 7.47 |
| **Plant Flow (MGD)** | | | | 0.293 | 0.367 | 2.71 | 2.65 | 0.323 | 0.503 |
| **Influent Flow Overloading Limits** | | | | | | | | | |
| Dry weather Flow (MGD) | 0.390 | | | | | | | | |
| Maximum Month (MGD) | 1.00 | | | | | | | | |
| Instantaneous Peak Flow (MGD) | 1.65 | | | | | | | | |
| **Total Recoverable Copper (µg/L)** | | | | 5.5 P | 7 P | 8.7 | 8.6 | 8.3 | 10.9 |
| | Maximum Daily | | | | | | | | |
| | Interim | Final | | | | | | | |
| Limit (µg/L) | 15 | 14 | | | | | | | |
| **Total Recoverable Mercury (µg/L)** | | | | 0.05 U | 0.05 U | 0.06 | 0.38 J | 0.068 | 0.05 U |
| | Maximum Daily | | | | | | | | |
| | Interim | Final | | | | | | | |
| Limit (µg/L) | 0.34 | 0.08 | | | | | | | |
| **Total Recoverable Zinc (µg/L)** | | | | 36 P | 39 P | 37 | 43.1 | 29 | 34 |
| | Maximum Daily | | | | | | | | |
| | Interim | Final | | | | | | | |
| Limit (µg/L) | 102 | 66.5 | | | | | | | |

| | | | |
|---|---|---|---|
| Eff | Effluent | U | The analyte was not detected at or above the reported result. |
| Buck | Buckly Treatment Plant | U J | The analyte was not detected at or above the reported estimated result. |
| Ort | Orting Treatment Plant | P | The analyte was detected above the instrument detection |
| comp | Composite sample | | |

# Table 3 - NPDES Comparison Results - Puyallup Metals Survey, 1996.

## Wilkeson Permit Comparisons

| Parameter | Permit Limits | | | Ecology Composite Results | | |
|---|---|---|---|---|---|---|
| | | | Location: | Eff-Wilk1 | Eff-Wilk3 | Eff-Wilk5 |
| | | | Type: | comp | comp | comp |
| | Monthly Average | Weekly Average | Date: | 8/28-29/95 | 11/28-29/95 | 3/26-27/96 |
| | | | Time: | 13:35-13:35 | 14:49-14:49 | 14:07-14:07 |
| | | | Lab Log #: | 358183 | 488183 | 138208 |
| **Effluent TSS** | | | | | | |
| Concentration (mg/L) | 55 | 70 | | 60 | 50 | 10 |
| Loading: (lbs/day) | 32 | 48 | | 7.5 | 80 | 2 |
| **Effluent pH** (S.U.) | 6 < pH < 9 | | | 7.38 | 7.85 | 7.70 |
| **Plant Flow (MGD)** | | | | 0.015 | 0.192 | 0.019 |
| **Influent Flow Overloading Limits** | | | | | | |
| Maximum Month (MGD) | 0.07 | | | | | |
| **Total Recoverable Copper (µg/L)** | | | | 36.2 | 37.1 | 13 |
| | Maximum Daily | | | | | |
| | Interim | Final | | | | |
| Limit (µg/L) | 126 | 42.5 | | | | |
| **Total Recoverable Mercury (µg/L)** | | | | 0.05 U | 0.12 | 0.05 U |
| | Maximum Daily | | | | | |
| | Interim | Final | | | | |
| Limit (µg/L) | 1.8 | 0.6 | | | | |
| **Total Recoverable Zinc (µg/L)** | | | | 73.4 | 73.1 | 18 |
| | Maximum Daily | | | | | |
| | Interim | Final | | | | |
| Limit (µg/L) | 309 | 276.5 | | | | |

## Carbonado Permit Comparisons

| Parameter | Permit Limits | | | Ecology Composite Results | | |
|---|---|---|---|---|---|---|
| | | | Location: | Eff-Carb1 | Eff-Carb3 | Eff-Carb5 |
| | | | Type: | comp | comp | comp |
| | Monthly Average | Weekly Average | Date: | 8/28-29/95 | 11/28-29/95 | 3/26-27/96 |
| | | | Time: | 15:10-15:10 | 16:25-16:25 | 14:50-14:50 |
| | | | Lab Log #: | 358181 | 488181 | 138206 |
| **Effluent TSS** | | | | | | |
| Concentration (mg/L) | 65 | 95 | | 10 | 33 | 43 |
| Loading: (lbs/day) | 54 | 81.5 | | 3 | 20 | 10 |
| **Effluent pH** (S.U.) | 6 < pH < 9 | | | 7.79 | 7.68 | 7.81 |
| **Plant Flow (MGD)** | | | | 0.031 | 0.07 | 0.029 |
| **Influent Flow Overloading Limits** | | | | | | |
| Maximum Month (MGD) | 0.10 | | | | | |
| **Total Recoverable Copper (µg/L)** | | | | 18.4 | 16.3 | 13.4 |
| | Maximum Daily | | | | | |
| | Interim | Final | | | | |
| Limit (µg/L) | 50 | 3.5 | | | | |
| **Total Recoverable Mercury (µg/L)** | | | | 0.05 U | 0.05 U | 0.062 |
| | Maximum Daily | | | | | |
| | Interim | Final | | | | |
| Limit (µg/L) | 0.46 | 0.13 | | | | |

Eff Effluent
Wilk Wilkeson Treatment Plant
Carb Carbonado Treatment Plant
comp Composite sample

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

# Table 4 - Detected Metals Results - Puyallup Metals Survey, 1995-96.



## September 1995 Inspection Results

| PARAMETER | Location: | Eff-Ort1 | Ecology Water Quality Criteria Summary | | Eff-Buck1 | Ecology Water Quality Criteria Summary | | Eff-Wilk1 | Ecology Water Quality Criteria Summary | | Eff-Carb1 | Ecology Water Quality Criteria Summary | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | | | comp | | | comp | | | comp | | |
| | Date: | 8/28-29/95 | Acute Fresh | Chronic Fresh | 8/28-29/95 | Acute Fresh | Chronic Fresh | 8/28-29/95 | Acute Fresh | Chronic Fresh | 8/28-29/95 | Acute Fresh | Chronic Fresh |
| | Time: | 10:50-10:5 | | | 11:50-11:50 | | | 13:35-13:3 | | | 15:10-15:1 | | |
| | Lab Log #: | 358182 | | | 358180 | | | 358183 | | | 358181 | | |
| **METALS** | | | µg/L | µg/L | | µg/L | µg/L | | µg/L | µg/L | | µg/L | µg/L |
| Zinc (ug/L - Total Rec, ICP) | | | | | **36 P** | 42.4 *(c) | 31.2 *(d) | **73.4** | 89.7 *(c) | 70.1 *(d) | | | |
| Copper (ug/L - Total Rec, GFAA) | | **9.3 P** | 7.5 *(c) | 3.6 *(d) | **5.5 P** | 5.6 *(c) | 3.4 *(d) | **36** | 13.0 *(c) | 7.6 *(d) | **18** | 8.5 +(c) | 6.1 +(d) |
| Chronic (Acute) Hardness (mg/L $CaCo_3$) | | **26** ( 42 ) | | | **24** ( 31 ) | | | **62** ( 75 ) | | | **48** ( NA ) | | |

## October 1995 Inspection Results

| PARAMETER | Location: | Eff-Ort2 | Ecology Water Quality Criteria Summary | | Eff-Buck2 | Ecology Water Quality Criteria Summary | |
|---|---|---|---|---|---|---|---|
| | Type: | comp | | | comp | | |
| | Date: | 9/26-27/95 | Acute Fresh | Chronic Fresh | 9/26-27/95 | Acute Fresh | Chronic Fresh |
| | Time: | 11:04-11:0 | | | 13:30-13:30 | | |
| | Lab Log #: | 398005 | | | 398006 | | |
| **METALS** | | | µg/L | µg/L | | µg/L | µg/L |
| Zinc (ug/L - Total Rec, ICP) | | | | | **39 P** | 43.6 *(c) | 34.1 *(d) |
| Copper (ug/L - Total Rec, GFAA) | | **13.7 P** | 7.5 *(c) | 3.8 *(d) | **7 P** | 5.8 *(c) | 3.7 *(d) |
| Chronic (Acute) Hardness (mg/L $CaCo_3$) | | **28** ( 42 ) | | | **27** ( 32 ) | | |

## November 1995 Inspection Results

| PARAMETER | Location: | Eff-Ort3 | Ecology Water Quality Criteria Summary | | Eff-Buck3 | Ecology Water Quality Criteria Summary | | Eff-Wilk3 | Ecology Water Quality Criteria Summary | | Eff-Carb3 | Ecology Water Quality Criteria Summary | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | | | comp | | | comp | | | comp | | |
| | Date: | 11/28-29/9 | Acute Fresh | Chronic Fresh | 11/28-29/95 | Acute Fresh | Chronic Fresh | 11/28-29/9 | Acute Fresh | Chronic Fresh | 11/28-29/9 | Acute Fresh | Chronic Fresh |
| | Time: | 10:46-10:4 | | | 15:30-15:30 | | | 14:49-14:4 | | | 16:25-16:2 | | |
| | Lab Log #: | 488182 | | | 488180 | | | 488183 | | | 488181 | | |
| **METALS** | | | µg/L | µg/L | | µg/L | µg/L | | µg/L | µg/L | | µg/L | µg/L |
| Zinc (ug/L - Total Rec, ICP) | | | | | **37** | 81.5 *(c) | 89.1 *(d) | **73.1** | 49.3 *(c) | 30.6 *(d) | | | |
| Copper (ug/L - Total Rec, GFAA) | | **14.3** | 12.3 *(c) | 7.8 *(d) | **8.7** | 11.7 *(c) | 9.7 *(d) | **37.1** | 6.7 *(c) | 3.3 *(d) | **16.3** | 8.0 *(c) | 5.8 *(d) |
| Mercury (ug/L - Total Rec, CVAA) | | | | | **0.06** | 2.4 (c) | 0.012 (d) | **0.12** | 2.4 (c) | 0.012 (d) | | | |
| Chronic (Acute) Hardness (mg/L $CaCo_3$) | | **65** ( 71 ) | | | **83** ( 67 ) | | | **24** ( 37 ) | | | **45** ( 45 ) | | |

| | |
|---|---|
| Eff | Effluent |
| Buck | Buckley Treatment Plant |
| Carb | Carbonado Treatment Plant |
| Ort | Orting Treatment Plant |
| Wilk | Wilkeson Treatment Plant |
| ICP | Inductively Coupled Plasma |
| GFAA | Graphite Furnace Atomic Adsorption |
| CVAA | Cold Vapor Atomic Adsorption |
| **Bold =** | Sample results |

| | |
|---|---|
| J | The analyte was positively identified. The associated numerical result is an estimate. |
| P | The analyte was detected above the instrument detection limit, but below minimum quantitation limit. |
| U | The analyte was not detected at or above the reported result. |
| + | Hardness dependent criteria (Effluent hardness used). |
| c | A 1-hour average concentration not to be exceeded more than once every three years on the average. |
| d | A 4-day average concentration not to be exceeded more than once every three years on the average. |

| | |
|---|---|
| * | Hardness dependent criteria. Receiving water hardness is used for the chronic criteria. A weighted value is used for the acute criteria [$H_{wt} = (H_{RW}*d + H_{Eff})/(d+1)$] Where: d=acute dilution factor; $H_{RW}$ =receiving water hardness; $H_{Eff}$ = effluent hardness. |
| ** | Effluent hardness |
| comp | Composite sample |

# Table 4 - Detected Metals Results - Puyallup Metals Survey, 1995-96.



## February 1996 Inspection Results

| PARAMETER | Location: | Eff-Ort4 | Ecology Water Quality Criteria Summary | | Eff-Buck4 | Ecology Water Quality Criteria Summary | |
|---|---|---|---|---|---|---|---|
| | Type: | comp | | | comp | | |
| | Date: | 2/6-7/96 | Acute Fresh | Chronic Fresh | 2/6-7/96 | Acute Fresh | Chronic Fresh |
| | Time: | 10:15-10:1 | | | 11:18-11:18 | | |
| | Lab Log #: | 068131 | | | 068130 | | |
| **METALS** | | | µg/L | µg/L | | µg/L | µg/L |
| Zinc (ug/L - Total Rec, ICP) | | | | | **43.1** | 43.6 *(c) | 29.0 *(d) |
| Copper (ug/L - Total Rec, GFAA) | | **13.3** | 6.5 *(c) | 2.7 *(d) | **8.6** | 5.8 *(c) | 3.1 *(d) |
| Mercury (ug/L - Total Rec, CVAA) | | | | | **0.38** J | 2.4 (c) | 0.012 (d) |
| Chronic (Acute) Hardness (mg/L $CaCo_3$) | | **19** ( 36 ) | | | **22** ( 32 ) | | |

## March 1996 Inspection Results

| PARAMETER | Location: | Eff-Ort5 | Ecology Water Quality Criteria Summary | | Eff-Buck5 | Ecology Water Quality Criteria Summary | | Eff-Wilk5 | Ecology Water Quality Criteria Summary | | Eff-Carb5 | Ecology Water Quality Criteria Summary | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | | | comp | | | comp | | | comp | | |
| | Date: | 3/26-27/96 | Acute Fresh | Chronic Fresh | 3/26-27/96 | Acute Fresh | Chronic Fresh | 3/26-27/96 | Acute Fresh | Chronic Fresh | 3/26-27/96 | Acute Fresh | Chronic Fresh |
| | Time: | 10:05-10:0 | | | 11:15-11:15 | | | 14:07-14:0 | | | 14:50-14:5 | | |
| | Lab Log #: | 138207 | | | 138205 | | | 138208 | | | 138206 | | |
| **METALS** | | | µg/L | µg/L | | µg/L | µg/L | | µg/L | µg/L | | µg/L | µg/L |
| Zinc (ug/L - Total Rec, ICP) | | | | | **29** | 42.4 *(c) | 33.1 *(d) | **18** | 67.9 *(c) | 48.7 *(d) | | | |
| Copper (ug/L - Total Rec, GFAA) | | **13.5** | 5.5 *(c) | 4.2 *(d) | **8.3** | 5.6 *(c) | 3.6 *(d) | **13** | 9.5 *(c) | 5.3 *(d) | **13.4** | 2.5 *(c) | 2.0 *(d) |
| Mercury (ug/L - Total Rec, CVAA) | | **0.08** | 2.4 (c) | 0.01 (d) | **0.07** | 2.4 (c) | 0.012 (d) | | | | **0.06** | 2.4 (c) | 0.012 (d) |
| Chronic (Acute) Hardness (mg/L $CaCo_3$) | | **32** ( 30 ) | | | **26** ( 31 ) | | | **41** ( 54 ) | | | **13** ( 13 ) | | |

## May 1996 Inspection Results

| PARAMETER | Location: | Eff-Ort6 | Ecology Water Quality Criteria Summary | | Eff-Buck6 | Ecology Water Quality Criteria Summary | |
|---|---|---|---|---|---|---|---|
| | Type: | comp | | | comp | | |
| | Date: | 5/28-29/96 | Acute Fresh | Chronic Fresh | 5/28-29/96 | Acute Fresh | Chronic Fresh |
| | Time: | 11:50-11:5 | | | 13:30-13:30 | | |
| | Lab Log #: | 228131 | | | 228130 | | |
| **METALS** | | | µg/L | µg/L | | µg/L | µg/L |
| Zinc (ug/L - Total Rec, ICP) | | | | | **34** | 41.3 *(c) | 26.8 *(d) |
| Copper (ug/L - Total Rec, GFAA) | | **9** | 7.2 *(c) | 3.1 *(d) | **11** | 5.5 *(c) | 2.9 *(d) |
| Chronic (Acute) Hardness (mg/L $CaCo_3$) | | **22** ( 40 ) | | | **20** ( 30 ) | | |

| | |
|---|---|
| Eff | Effluent |
| Buck | Buckley Treatment Plant |
| Carb | Carbonado Treatment Plant |
| Ort | Orting Treatment Plant |
| Wilk | Wilkeson Treatment Plant |
| TranBlk | Transfer Blank |
| ICP | Inductively Coupled Plasma |
| GFAA | Graphite Furnace Atomic Adsorption |
| CVAA | Cold Vapor Atomic Adsorption |

| | |
|---|---|
| J | The analyte was positively identified. The associated numerical result is an estimate. |
| P | The analyte was detected above the instrument detection limit, but below minimum quantitation limit. |
| U | The analyte was not detected at or above the reported result. |
| c | A 1-hour average concentration not to be exceeded more than once every three years on the average. |
| d | A 4-day average concentration not to be exceeded more than once every three years on the average. |
| **Bold =** | Sample results |
| * | Hardness dependent criteria. Receiving water hardness is used for the chronic criteria. A weighted value is used for the acute criteria [$H_{wt} = (H_{RW}*d + H_{Eff})/(d+1)$] Where: d=acute dilution factor; $H_{RW}$ =receiving water hardness; $H_{Eff}$ = effluent hardness. |
| comp | Composite sample |

# Appendices

## Appendix A - Sampling Stations Descriptions - Puyallup Metals Survey, 1996

**EFF-Ort-#:** Ecology 24-hour composite sample of Orting WWTP effluent wastewater collected at the end of the chlorine contact chamber, just prior to final discharge. Collected 08/28-29/95, 09/26-27/95, 11/28-29/95, 02/6-7/96, 03/26-27/96, and 05/28-29/96.

**EFF-Buck-#:** Ecology 24-hour composite sample of Buckley WWTP effluent wastewater collected above the weir at the end of the chlorine contact chamber, just prior to final discharge. Collected 08/28-29/95, 09/26-27/95, 11/28-29/95, 02/6-7/96, 03/26-27/96, and 05/28-29/96.

**EFF-Wilk-#:** Ecology 24-hour composite sample of Wilkeson WWTP effluent wastewater collected above the weir at the end of the chlorine contact chamber, just prior to final discharge. Collected 08/28-29/95, 11/28-29/95, and 03/26-27/96.

**EFF-Carb-#:** Ecology 24-hour composite sample of Carbonado WWTP effluent wastewater collected above the weir at the end of the chlorine contact chamber, just prior to final discharge. Collected 08/28-29/95, 11/28-29/95, and 03/26-27/96.

**TrnBlkO#:** Ecology transfer blank sample taken by running D.I. water through the Orting effluent compositor prior to initiating sampling. Collected 08/28/95, 09/26/95, 11/28/95, 02/6/96, 03/26/96, and 05/28/96.

**TrnBlkB#:** Ecology transfer blank sample taken by running D.I. water through the Buckley effluent compositor prior to initiating sampling. Collected 08/28/95, 09/26/95, 11/28/95, 02/6/96, 03/26/96, and 05/28/96.

**TrnBlkW#:** Ecology transfer blank sample taken by running D.I. water through the Wilkenson effluent compositor prior to initiating sampling. Collected 08/28/95, 11/28/95, and 03/26/96.

**TrnBlkC#:** Ecology transfer blank sample taken by running D.I. water through the Carbonado effluent compositor prior to initiating sampling. Collected 08/28/95, 11/28/95, and 03/26/96.

**Amb-Carb-O#:** Ambient receiving water sample taken from the Carbonado river approximately 200 meters upstream of the Orting WWTP outfall. Approximate Lat/Long: 47°06.458 N/122°12.783 W. Collected 08/28/95, 09/26/95, 11/28/95, 02/6/96, 03/26/96, and 05/28/96.

**Amb-White-B#:** Ambient receiving water sample taken from the main channel of the White river approximately 100 meters upstream of the Buckley WWTP outfall. Approximate Lat/Long: 47°10.384 N/122°02.247 W. Collected 08/28/95, 09/26/95, 11/28/95, 02/6/96, 03/26/96, and 05/28/96.

**Amb-WilkCr-W#:** Ambient receiving water sample taken from Wilkeson Creek approximately 20 meters upstream of the Wilkeson WWTP outfall. Collected 08/28/95, 11/28/95, and 03/26/96.

**Amb-Carb-C#:** Ambient receiving water sample taken from the Carbonado river approximately 6 miles upstream of the Carbonado WWTP outfall. Approximate Lat/Long: 47°00.725 N/122°00.751 W. Collected 11/28/95 and 03/26/96.

# Appendix B - Inspection Sampling Schedule - Puyallup Metals Survey, 1995-96.



## September 95 Inspection Sampling Schedule

| PARAMETER | Location: | Eff-Ort1 | Eff-Buck1 | Eff-Wilk1 | Eff-Carb1 | TranBlkO1 | TranBlkB1 | TranBlkW1 | TranBlkC1 | Amb-Carb-O1 | Amb-White-B1 | Amb-WilkCr-W1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | comp | comp | grab | grab | grab | grab | grab | grab | grab |
| | Date: | 8/28-29/95 | 8/28-29/95 | 8/28-29/95 | 8/28-29/95 | 8/28/95 | 8/28/95 | 8/28/95 | 8/28/95 | 8/29/95 | 8/29/95 | 8/29/95 |
| | Time: | 10:50-10:50 | 11:50-11:50 | 13:35-13:35 | 15:10-15:10 | 10:50 | 11:50 | 13:35 | 15:10 | 10:28 | 12:25 | 14:03 |
| | Lab Log #: | 358182 | 358180 | 358183 | 358181 | 358186 | 358184 | 358187 | 358185 | 358190 | 358188 | 358191 |
| GENERAL CHEMISTRY | | | | | | | | | | | | |
| Hardness (mg/L CaCO3) | | E | E | E | E | | | | | E | E | E |
| SOLIDS | | | | | | | | | | | | |
| TSS (mg/L) | | E | E | E | E | | | | | E | E | E |
| METALS | | | | | | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | E | E | | E | E | E | E | | | |
| Copper (ug/L - Total Rec, GFAA) | | E | E | E | E | E | E | E | E | | | |
| Mercury (ug/L - Total Rec, CVAA) | | E | E | E | E | E | E | E | E | | | |
| FIELD OBSERVATIONS | | | | | | | | | | | | |
| Temperature (C) | | | | | | | | | | E | E | E |
| Temp-cooled (C) | | E | E | E | E | | | | | | | |
| pH | | E | E | E | E | | | | | E | E | E |
| Conductivity (umhos/cm) | | E | E | E | E | | | | | E | E | E |

## October 95 Inspection Sampling Schedule

| PARAMETER | Location: | Eff-Ort2 | Eff-Buck2 | TranBlkO2 | TranBlkB2 | Amb-Carb-O2 | Amb-White-B2 |
|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | grab | grab | grab | grab |
| | Date: | 9/26-27/95 | 9/26-27/95 | 9/26/95 | 9/26/95 | 9/26/95 | 9/26/95 |
| | Time: | 11:04-11:04 | 13:30-13:30 | 11:04 | 13:30 | 1143 | 1410 |
| | Lab Log #: | 398005 | 398006 | 398007 | 398008 | 398009 | 398010 |
| GENERAL CHEMISTRY | | | | | | | |
| Hardness (mg/L CaCO3) | | E | E | | | E | E |
| SOLIDS | | | | | | | |
| TSS (mg/L) | | E | E | | | E | E |
| METALS | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | E | E | E | | |
| Copper (ug/L - Total Rec, GFAA) | | E | E | E | E | | |
| Mercury (ug/L - Total Rec, CVAA) | | E | E | E | E | | |
| FIELD OBSERVATIONS | | | | | | | |
| Temperature (C) | | | | | | E | E |
| Temp-cooled (C) | | E | E | | | | |
| pH | | E | E | | | E | E |
| Conductivity (umhos/cm) | | E | E | | | E | E |

| | |
|---|---|
| Eff | Effluent |
| Buck | Buckly Treatment Plant |
| Carb | Carbonado Treatment Plant |
| Ort | Orting Treatment Plant |
| Wilk | Wilkeson Treatment Plant |
| TranBlk | Transfer Blank |
| Amb-White-B | White River ambient sample for Buckley WWTP |
| Amb-Carb-O | Carbonado River ambient sample for Orting WWTP |
| Amb-WilkCr-W | Wilkenson Creek ambient sample for Wilkenson WWTP |
| Amb-Carb-C | Carbonado River ambient sample for Carbonado WWTP |
| E | Ecology sampls and analysis |
| comp | Composite sample |
| grab | Grab sample |

# Appendix B - Inspection Sampling Schedule - Puyallup Metals Survey, 1995-96.



## November 95 Inspection Sampling Schedule

| PARAMETER | Location: | Eff-Ort3 | Eff-Buck3 | Eff-Wilk3 | Eff-Carb3 | TranBlkO3 | TranBlkB3 | TranBlkW3 | TranBlkC3 | Amb-Carb-O3 | Amb-White-B3 | Amb-WilkCr-W3 | Amb-Carb-C3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | comp | comp | grab | grab | grab | grab | grab | grab | grab | grab |
| | Date: | 11/28-29/95 | 11/28-29/95 | 11/28-29/95 | 11/28-29/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 | 11/28/95 |
| | Time: | 10:46-10:46 | 15:30-15:30 | 14:49-14:49 | 16:25-16:25 | 10:46 | 12:21 | 14:49 | 16:25 | 11:11 | 14:05 | 15:00 | 17:28 |
| | Lab Log #: | 488182 | 488180 | 488183 | 488181 | 488184 | 488186 | 488188 | 488187 | 488191 | 488189 | 488192 | 488190 |
| **GENERAL CHEMISTRY** | | | | | | | | | | | | | |
| Hardness (mg/L CaCO3) | | E | E | E | E | | | | | E | E | E | E |
| **SOLIDS** | | | | | | | | | | | | | |
| TSS (mg/L) | | E | E | E | E | | | | | E | E | E | E |
| **METALS** | | | | | | | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | E | E | | | E | E | | | | | |
| Copper (ug/L - Total Rec, GFAA) | | E | E | E | E | E | E | E | E | | | | |
| Mercury (ug/L - Total Rec, CVAA) | | E | E | E | E | E | E | E | E | | | | |
| **FIELD OBSERVATIONS** | | | | | | | | | | | | | |
| Temperature (C) | | | | | | | | | | E | E | E | E |
| Temp-cooled (C) | | E | E | E | E | | | | | | | | |
| pH | | E | E | E | E | | | | | E | E | E | E |
| Conductivity (umhos/cm) | | E | E | E | E | | | | | E | E | E | E |

## February 96 Inspection Sampling Schedule

| PARAMETER | Location: | Eff-Ort4 | Eff-Buck4 | TranBlkO4 | TranBlkB4 | Amb-Carb-O4 | Amb-White-B4 |
|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | grab | grab | grab | grab |
| | Date: | 2/6-7/96 | 2/6-7/96 | 2/6/96 | 2/6/96 | 9/6/95 | 9/6/95 |
| | Time: | 10:15-10:15 | 11:18-11:18 | 10:15 | 11:18 | 10:30 | 13:40 |
| | Lab Log #: | 068131 | 068130 | 068133 | 068132 | 068135 | 068134 |
| **GENERAL CHEMISTRY** | | | | | | | |
| Hardness (mg/L CaCO3) | | E | E | | | E | E |
| **SOLIDS** | | | | | | | |
| TSS (mg/L) | | E | E | | | E | E |
| **METALS** | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | E | | E | | |
| Copper (ug/L - Total Rec, GFAA) | | E | E | E | E | | |
| Mercury (ug/L - Total Rec, CVAA) | | E | E | E | E | | |
| **FIELD OBSERVATIONS** | | | | | | | |
| Temperature (C) | | | | | | E | E |
| Temp-cooled (C) | | E | E | | | | |
| pH | | E | E | | | | E |
| Conductivity (umhos/cm) | | E | E | | | E | E |

| | | | | | |
|---|---|---|---|---|---|
| Eff | Effluent | Amb-White-B | White River ambient sample for Buckley WWTP | comp | Composite sample |
| Buck | Buckly Treatment Plant | Amb-Carb-O | Carbonado River ambient sample for Orting WWTP | grab | Grab sample |
| Carb | Carbonado Treatment Plant | Amb-WilkCr-W | Wilkenson Creek ambient sample for Wilkenson WWTP | | |
| Ort | Orting Treatment Plant | Amb-Carb-C | Carbonado River ambient sample for Carbonado WWTP | | |
| Wilk | Wilkeson Treatment Plant | E | Ecology sampls and analysis | | |
| TranBlk | Transfer Blank | | | | |

# Appendix B - Inspection Schedule - Puyallup Metals Survey, 1995-96.



## March 96 Inspection Sampling Schedule

| PARAMETER | Location: | Eff-Ort5 | Eff-Buck5 | Eff-Wilk5 | Eff-Carb5 | TranBlkO5 | TranBlkB5 | TranBlkW5 | TranBlkC5 | Amb-Carb-O5 | Amb-White-B5 | Amb-WilkCr-W5 | Amb-Carb-C5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | comp | comp | grab | grab | grab | grab | grab | grab | grab | grab |
| | Date: | 3/26-27/96 | 3/26-27/96 | 3/26-27/96 | 3/26-27/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 | 3/26/96 |
| | Time: | 10:05-10:05 | 11:15-11:15 | 14:07-14:07 | 14:50-14:50 | 10:05 | 11:15 | 14:07 | 14:50 | 10:40 | 12:40 | 14:23 | 16:00 |
| | Lab Log #: | 138207 | 138205 | 138208 | 138206 | 138209 | 138210 | 138211 | 138212 | 138215 | 138213 | 138216 | 138214 |
| **GENERAL CHEMISTRY** | | | | | | | | | | | | | |
| Hardness (mg/L CaCO3) | | E | E | E | E | | | | | E | E | E | E |
| **SOLIDS** | | | | | | | | | | | | | |
| TSS (mg/L) | | E | E | E | E | | | | | E | E | E | E |
| **METALS** | | | | | | | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | E | E | | | E | E | | | | | |
| Copper (ug/L - Total Rec, GFAA) | | E | E | E | E | E | E | E | E | | | | |
| Mercury (ug/L - Total Rec, CVAA) | | E | E | E | E | E | E | E | E | | | | |
| **FIELD OBSERVATIONS** | | | | | | | | | | | | | |
| Temperature (C) | | | | | | | | | | E | E | E | E |
| Temp-cooled (C) | | E | E | E | E | | | | | | | | |
| pH | | E | E | E | E | | | | | E | E | E | E |
| Conductivity (umhos/cm) | | E | E | E | E | | | | | E | E | E | E |

## May 96 Inspection Sampling Schedule

| PARAMETER | Location: | Eff-Ort6 | Eff-Buck6 | TranBlkO6 | TranBlkB6 | Amb-Carb-O6 | Amb-White-B6 |
|---|---|---|---|---|---|---|---|
| | Type: | comp | comp | grab | grab | grab | grab |
| | Date: | 5/28-29/96 | 5/28-29/96 | 5/28/96 | 5/28/96 | 5/28/96 | 5/28/96 |
| | Time: | 11:50-11:50 | 13:30-13:30 | 11:50 | 13:30 | 12:10 | 18:00 |
| | Lab Log #: | 228131 | 228130 | 068133 | 068132 | 228134 | 228135 |
| **GENERAL CHEMISTRY** | | | | | | | |
| Hardness (mg/L CaCO3) | | E | E | | | E | E |
| **SOLIDS** | | | | | | | |
| TSS (mg/L) | | E | E | | | E | E |
| **METALS** | | | | | | | |
| Zinc (ug/L - Total Rec, ICP) | | | E | | E | | |
| Copper (ug/L - Total Rec, GFAA) | | E | E | E | E | | |
| Mercury (ug/L - Total Rec, CVAA) | | E | E | E | E | | |
| **FIELD OBSERVATIONS** | | | | | | | |
| Temperature (C) | | | | | | E | E |
| Temp-cooled (C) | | E | E | | | | |
| pH | | E | E | | | E | E |
| Conductivity (umhos/cm) | | E | E | | | E | E |

| | |
|---|---|
| Eff | Effluent |
| Buck | Buckly Treatment Plant |
| Carb | Carbonado Treatment Plant |
| Ort | Orting Treatment Plant |
| Wilk | Wilkeson Treatment Plant |
| TranBlk | Transfer Blank |
| Amb-White-B | White River ambient sample for Buckley WWTP |
| Amb-Carb-O | Carbonado River ambient sample for Orting WWTP |
| Amb-WilkCr-W | Wilkenson Creek ambient sample for Wilkenson WWTP |
| Amb-Carb-C | Carbonado River ambient sample for Carbonado WWTP |
| E | Ecology sampls and analysis |
| comp | Composite sample |
| grab | Grab sample |

## Appendix C - Analytical Methods - Puyallup Metals Survey, 1995-96

| Parameter | Manchester Methods | APHA Methods | Lab Used |
|---|---|---|---|
| **GENERAL CHEMISTRY** | | | |
| Hardness | EPA, Revised 1983: 130.2 | APHA, 1989: 2340C. | Manchester Lab |
| **SOLIDS** | | | |
| TSS | EPA, Revised 1983: 160.2 | APHA, 1989: 2540D. | Manchester Lab |
| **PP METALS ($H_2O$)** | | | |
| Zinc (ICP) | EPA, Revised 1983: 200-299 | APHA, 1989: 3500-Zn C. | Manchester Lab |
| Copper (GFAA) | EPA, Revised 1983: 200-299 | APHA, 1989: 3500-Cu B. | Manchester Lab |
| Mercury (CVAA) | EPA, Revised 1983: 200-299 | APHA, 1989: 3500-Hg B. | Manchester Lab |

### Bibliography


APHA-AWWA-WPCF, 1989. Standard Methods for the Exanination of Water and Wastewater, 17th 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 - Puyallup Metals Survey, 1996

**Priority Pollutant Metal Cleaning Procedures for Wastewater Collection Equipment.**

1. Wash with laboratory detergent
2. Rinse several times with tap water
3. Rinse with 10% $HNO_3$ solution
4. Rinse once with distilled/deionized water
5. Rinse with 10% $HNO_3$ solution
6. Rinse three (3) times with distilled/deionized water
7. Allow to dry and seal with aluminum foil

## Appendix E - GLOSSARY - Puyallup

| | |
|---|---|
| Covariance | A measure of the tendency of two independent variables to vary together. |
| CVAA | Cold Vapor Atomic Absorption |
| EPA | Environmental Protection Agency |
| GFAA | Graphite furnace atomic adsorption |
| ICP | Inductively Coupled Plasma |
| kg | kilogram ($1 \times 10^3$ grams) |
| L | Liter ($1 \times 10^3$ milliliters) |
| lbs/day | Pounds per Day |
| $m^3$ | Cubic meter ($1 \times 10^3$ liters) |
| mg | milligram ($1 \times 10^{-3}$ grams) |
| MGD | Million Gallons per Day |
| mL | Milliliter ($1 \times 10^{-3}$ liters) |
| Pearson's r | Correlation coefficient: the tendency of two random variables to vary together. |
| pH | $Log_{10}$ of Negative Hydrogen Ion Concentration |
| PP | Priority Pollutant |
| ppb | Parts per billion ($1 \times 10^{-9}$ kg/L, 1 μg/L, or 1 μg/kg) |
| ppm | Parts per million ($1 \times 10^{-6}$ kg/L, 1 mg/L, or 1 mg/kg) |
| QA/QC | Quality Assurance/Quality Control |
| $r^2$ | Coefficeint of multiple determination: proportion of variability of y attributed to x. |
| RPD | Relative Percent Difference |
| TMDL | Total Maximum Daily Load |
| TSS | Total Suspended Solids |
| ug | Microgram ($1 \times 10^{-6}$ grams) |
| ug/L | Micrograms per Liter |
| WWTP | Wastewater Treatment Plant |