Selah Ditch Multiparameter Total Maximum Daily Load

Technical Assessment

January 2005
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Water Quality Program

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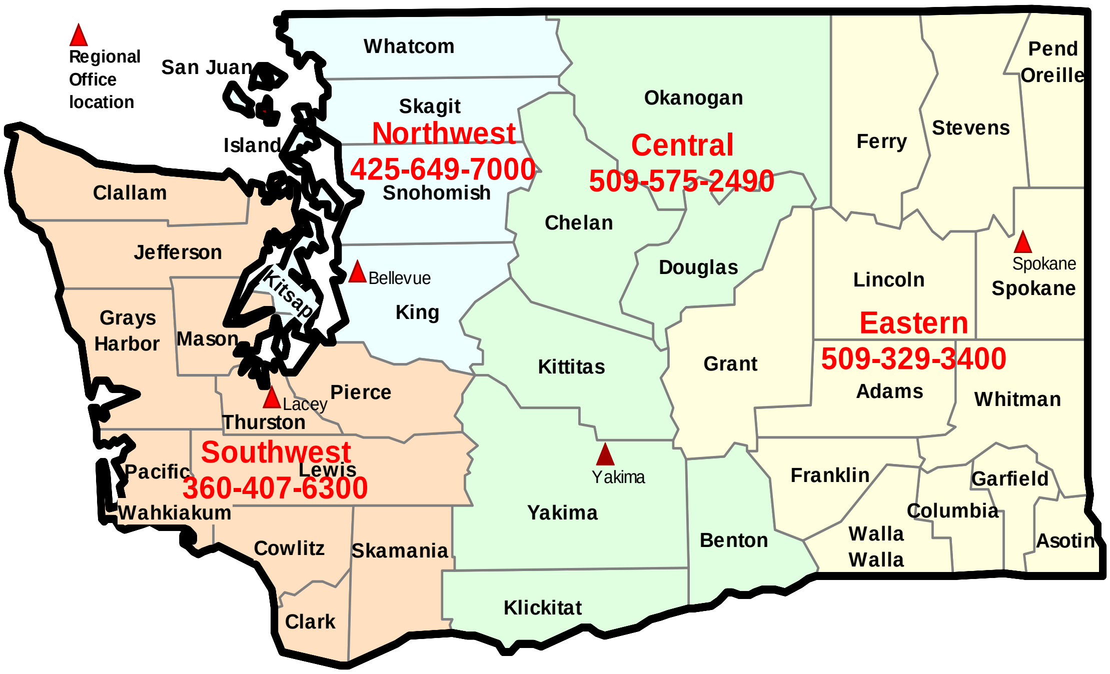

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Table of Contents

List of Tables

List of Figures

Abstract

Section 303(d) of the federal Clean Water Act requires states to identify surface water bodies where technology-based point-source controls have been insufficient to meet applicable water quality standards or to support beneficial uses. Selah Ditch was included in the state of Washington's (state's) 1996 and 1998-303(d) listings of impaired water bodies for the parameters of ammonia, chlorine, and dissolved oxygen (DO).

Ammonia was placed on the 1996 and 1998 303(d) lists, but this parameter was never found in Selah Ditch at concentrations greater than the state's surface water criterion. In order to continue to comply with the water quality chronic ammonia criterion, the ammonia wasteload allocation (WLA) for the publicly owned treatment works (POTW) is set to a daily maximum of 2.5 mg/L and the stormwater ammonia WLA is set to a daily maximum of 0.18 mg/L. The load allocation (LA) for ammonia is set to 0.02 mg/L.

Chlorine has historically exceeded water quality standards. However, during October 2003 there were no excessive concentrations of that parameter discharged, nor were there excessive concentrations in Selah Ditch. This corresponds to the conversion and start-up of an ultraviolet (UV) disinfection system at the city of Selah POTW. The UV disinfection system was installed in response to the requirements of the NPDES permit, which contained an effluent limitation of 0.02 mg/L. In order to continue to comply with the Class A water quality chronic chlorine criterion of 0.011 mg/L, the chlorine WLA for the POTW effluent is set to a daily maximum of 0.011 mg/L; while, the WLA for the stormwater discharges is set to a daily maximum of 0.015 mg/L. The LA for chlorine is set to zero.

DO concentrations in discharges to Selah Ditch have historically been lower than water quality standards. The lowest DO concentrations occur in the POTW effluent; while the greatest occur in the stormwater sewer system discharges and in the lower reach of Selah Ditch. In order to comply with the Class A water quality standards, interim DO WLAs are set to a daily minimum of 8.4 mg/L for both the POTW and stormwater discharges. The interim POTW biochemical oxygen demand (BOD_5) WLA is set to 10.0 mg/L; while the interim stormwater BOD_5 WLA is set to 2.0 mg/L. A minor monitoring study in 2008, after improved aeration best management practices (BMPs) have been implemented, will be conducted to address future Selah Ditch DO compliance with water quality standards. If needed, a TMDL modification will be made to include all new BOD_5 and DO WLAs in order to ensure that the Class A water quality DO criterion is complied with throughout the entire ditch. The LA for DO is set to 8.0 mg/L. The LA for BOD_5 is set to 2.0 m/L.

Excessive fecal coliform (FC) densities occur throughout the entire year, even though such parameter has never been included in prior 303(d) listings. The lowest FC densities occur in the POTW effluent; while, the greatest densities occur in the stormwater discharges. The FC WLA for the POTW is set to a geometric mean of 10 cfu/100 mL; while, the stormwater FC WLA is set to a geometric mean of 186 cfu/100 mL. Such WLAs will be protective of the Class A water quality geometric mean criterion of 100 cfu/100mL within Selah Ditch. The LA for FC is set to a geometric mean of 24 cfu/100mL.

High instream temperatures (exceeding standards) are presently considered the most important pollution parameter for aquatic life in Selah Ditch and have occurred often. The “natural condition” temperature of the ditch is inapplicable since it is a man-made water body. However, a surrogate “natural condition” temperature is assumed to be equal to the Class A water quality temperature criterion of 18.0°C due to the ditch’s physical conditions and the very sparse natural condition amount of vegetation caused by the semi-arid climate of eastern Washington, even though the “natural condition” temperature of the nearby Yakima River was found to be 17.8°C.

Upper reach temperatures in Selah Ditch are predominantly influenced by discharges from the stormwater sewer system and the municipal wastewater treatment plant. Whereas, the water temperatures in the lower reach are predominantly influenced by solar radiation. The temperature WLAs for both the POTW and stormwater discharges are set to a daily maximum of 18.0°C during the critical condition period of April 1 through October 31; however during the non-critical condition period, the WLAs for the POTW and stormwater discharges at 18.0°C and 25.0°C, respectively. Such WLAs will be protective of the Class A water quality criterion within Selah Ditch. The LA for temperature is set to a minimum of 90 percent effective shade.

Acknowledgments

The completion of the technical assessment for the *Selah Ditch Multiparameter TMDL* would not have been possible without the help of the following people and agencies.

- *Laurie Mann*, Environmental Protection Agency, for her valuable cooperation, editorial comments, and technical analysis skills.

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Executive Summary

Selah Ditch was included in the state of Washington's (State's) 1996 and 1998 303(d) listings of impaired water bodies for the parameters of ammonia, chlorine, and dissolved oxygen due to the results of water quality sampling conducted during October 1988 and reported by Joy (1990). In addition to the above parameters, the same sampling identified fecal coliform (FC) bacteria densities and temperatures as exceeding their respective criteria. However, for some unknown reason the latter two parameters were never included in the 303(d) listings for Selah Ditch.

Ammonia: The original 303(d) listing of Selah Ditch as being impaired for ammonia was a result of the 303(d) listing policy in effect at that time; however, no ammonia impairment of Selah Ditch has actually ever occurred. A daily maximum effluent limitation for ammonia of 2.9 mg/L (48.4 lbs/day) was included in the present NPDES permit issued to the city of Selah Publicly-Owned Treatment Works (POTW) on July 19, 2001. In order to meet the calculated chronic ammonia water quality criterion (0.915 mg/L) in Selah Ditch, the TMDL sets an ammonia WLA for the city of Selah POTW to a daily maximum of 2.5 mg/L (21.1 lbs/day) and an ammonia WLA for stormwater to a daily maximum of 0.18 mg/L (2.3 lbs/day). The TMDL's more stringent ammonia limitation (WLA) for the POTW is based on that facility's actual average discharge rate of 1.0 mgd, not on its design capacity that is typically used in calculating NPDES effluent limitations. In addition, a non-point load allocation (LA) of 0.02 mg/L has been set for ammonia. No critical condition period for ammonia has been determined.

Chlorine: The city of Selah POTW has historically been the greatest source of chlorine discharging into Selah Ditch. The 24" stormwater sewer also appears to contain, at times, substantial chlorine residuals. The most recent water quality monitoring has determined that the past instream Selah Ditch problems with chlorine have been mitigated since the POTW's conversion to ultraviolet (UV) disinfection during the summer of 2003. The POTW was converted to UV disinfection in response to the past 303(d) listings and had an effluent limitation of 0.02 mg/L that was contained within the facility's present NPDES permit issued on July 19, 2001. However, in order to meet the more stringent chronic chlorine water quality criterion (0.011 mg/L), the TMDL sets a chlorine WLA for the city of Selah POTW to a daily maximum of 0.011 mg/L (0.09 lbs/day), and a stormwater discharge WLA to a daily maximum of 0.015 mg/L (0.28 lbs/day). The WLA for the POTW is more stringent than the facility's NPDES permit limitation. In addition, an LA of 0 has been set for chlorine, as there are no known non-point sources of chlorine in the watershed. No critical condition period for chlorine has been determined.

Dissolved oxygen: There have been historical problems of low dissolved oxygen (DO) throughout Selah Ditch, which were attributed to industrial discharges of high oxygen demand wastewaters into the stormwater sewer system. In the 1990s, Tree Top, Inc. located and corrected a cross-contamination problem inside their facility, which resulted in substantial improvement in DO concentrations contained within both the stormwater sewer effluent and the Selah Ditch. The most recent water quality monitoring has determined that DO concentrations in the ditch still remain just below the State's Class A water quality criterion of 8.0 mg/L.

A statistical analysis of the DO concentrations determined that the lowest DO concentrations occur in the POTW effluent; while the greatest DO concentrations occur in the stormwater sewer system outfalls and in the lower reach of Selah Ditch. A DO critical condition period was determined to be from April 1 through October 31, which is the same as for temperature.

In order to raise the historically low DO levels in its effluent, the POTW has been required to submit, to Ecology by December 30, 2004, a *Plan to Increase Dissolved Oxygen in Effluent Discharge*. The plan will describe BMP implementation that must substantially increase DO concentrations within the POTW effluent, and consequently the upper reach of Selah Ditch. The facility has never had a specific DO NPDES effluent limitation, even though its effluent has been known to be deficient in oxygen. The TMDL sets interim DO WLAs for both the city of Selah POTW and the stormwater discharges to a daily minimum of 8.4 mg/L. In addition, a non-point LA of 8.0 mg/L has been set for DO. WLAs for BOD_5 are also calculated for point sources when there are problems with DO impairment. The TMDL sets interim BOD_5 WLAs for the POTW and stormwater discharges of 10 mg/L and 2.0 mg/L, respectfully. The LA for BOD_5 is set to 2.0 mg/L.

Additional DO monitoring in Selah Ditch will be necessary after the implementation of the additional aeration required by the above plan in order to determine if the Selah Ditch will comply with the Class A water quality DO criterion. Ecology will conduct a minor DO monitoring study of the ditch after the additional aeration BMPs, required by the above plan, have been installed, operated, and equilibrated (est. in 2008). The additional monitoring will allow for new BOD_5 and DO WLAs to be calculated, if needed. A TMDL modification would then be made to incorporate the new WLAs into the *Selah Ditch Multiparameter TMDL*.

Fecal coliform bacteria: Historically, fecal coliform (FC) bacteria densities in Selah Ditch have been found in excess of the State's Class A two-tiered bacteria criteria. Therefore, Selah Ditch should have been included in the 1996 and 1998 303(d) listings of impaired water bodies but was not. During the latest water quality monitoring, FC densities were still excessive at various times. A statistical analysis of the $\log_{10}$ FC densities revealed no significant difference between the months. Another statistical analysis determined that the 18" stormwater sewer effluent had the greatest geometric mean FC densities. This suggests that the excessive FC densities in the upper reach of Selah Ditch are coming from upstream sources within the city's stormwater sewer system, but not associated with an industrial cross-connection of wastewaters as previously identified in the early 1990s.

Ecology recognizes that various sources of FC bacteria may affect storm water. City of Selah representatives have in fact indicated that illegal sanitary connections to the stormwater sewer system have previously been found. The FC WLA for the city of Selah POTW is set to a monthly geometric mean of 10 cfu/100 mL; while, the stormwater FC WLA is set to a monthly geometric mean of 186 cfu/100 mL. In comparison, the POTW's NPDES permit contains a monthly geometric mean effluent limitation of 100 cfu/100mL. In addition, a non-point LA for FC has been set to a geometric mean of 24 cfu/100mL. No critical condition period for FC has been determined.

Temperature: With respect to aquatic life, the predominant water quality problem occurring in Selah Ditch is high temperature. Within the lower reach of Selah Ditch, water temperature sampling conducted from August 2001 through November 2002 (*Selah Ditch Temperature Study*) indicated that the highest summer water temperatures surpassed the lethal temperature for salmonids (23°C). A thorough analysis of that study's temperature data has determined a temperature critical condition period of April 1 through October 31. Selah Ditch should have been previously 303(d)-listed due to excessive water temperatures but was not.

During the critical condition period, statistical analyses determined that the predominant source of heat within the upper reach of Selah Ditch was the municipal 24" stormwater sewer system that carries substantial volumes of background ground water, as well as hot contact cooling waters from Hi-Country Foods Corp., warm non-contact cooling water discharges from Larson Fruit Company, Matson Fruit Company, and Tree Top, Inc. The background flow in the municipal stormwater sewer system is composed of shallow ground water that infiltrates into the system. Such ground water is composed primarily of subsurface irrigation return flows and infiltration from the west fork of Taylor Ditch. Selah Ditch was designed to dewater the area's high water table resulting from irrigation, so that the city of Selah could be established.

The "natural condition" water temperature of Selah Ditch is impossible to determine, since it is a man-made water body. However, a surrogate "natural condition" temperature is assumed to be equal to the Class A water quality criterion of 18.0°C. This was concluded from the fact that the "natural condition" temperature of the nearby Yakima River was found to be 17.8°C (1891 data), and that the Selah Ditch is shallower and has slower flow than the substantially larger Yakima River. The shallower and slower flow allows a greater heat flux in Selah Ditch.

The upper reach of Selah Ditch is influenced predominantly by point sources, consequently, the TMDL has set temperature WLAs for both the city of Selah POTW and stormwater discharges to a daily maximum of 18.3°C during the critical condition period of April 1 through October 31. Such temperature represents the maximum allowable temperature of a receiving water due to point source contribution, when the "natural condition" water temperature of a receiving water exceeds the Class A water quality temperature criterion of 18.0°C. During the non-critical condition period (November 1 through March 31), the TMDL sets temperature WLAs of 18.0°C and 25.0°C for the POTW and stormwater sewer effluents, respectively.

The water temperatures in the lower reach of Selah Ditch, however, are influenced primarily by non-point thermal sources, particularly solar radiation. The net heat flux to Selah Ditch can therefore be managed by increasing the shade from riparian vegetation, as well as other methods. A maximum amount of mature riparian vegetation would effectively produce a maximum amount of shade (a maximum reduction of water temperature). The LA for temperature has been set to a minimum of 90 percent effective shade, which will be obtained through the implementation of the best management practice (BMP) of "maximum mature riparian vegetation." This is significantly more than the sparse natural condition shade (Figures 1 and 15).

Introduction

Description of Area

Selah Ditch (elevation = 1,120 ft.) is located in the southeast corner of the city of Selah, which lies on the east side of the Cascade Mountain range within Yakima County at the south end of the Selah Valley, approximately one mile north of the city of Yakima. The ditch is a short (0.83 mile long) straight man-made drainage canal that was originally constructed for the purpose of dewatering a high water table for the continued growth of the city of Selah. The ditch begins immediately south of Tree Top, Inc. packing facility, immediately east of the city of Selah wastewater treatment plant (POTW) that is located in the southern part of the city. The ditch runs from north-east to south-west and parallel to the Burlington Northern Santa Fe (BNSF) railroad line, on the latter's west side. The majority of the ditch is located on property belonging to the BNSF, with exception of the lower (downstream) 300-ft reach.

The climate of the Selah Valley is generally characterized as being mild and dry. Summers are sunny, while winters are generally cloudy with only a third of the possible sunshine. Daily temperatures for the summer months range from 65 to over 100°F (Fahrenheit). Precipitation in the area follows the typical West Coast marine climate regime, being greatest during the late fall, winter, and early spring. More than 50 percent of the annual precipitation occurs from October through February. Summer rainfall usually averages less than one inch.

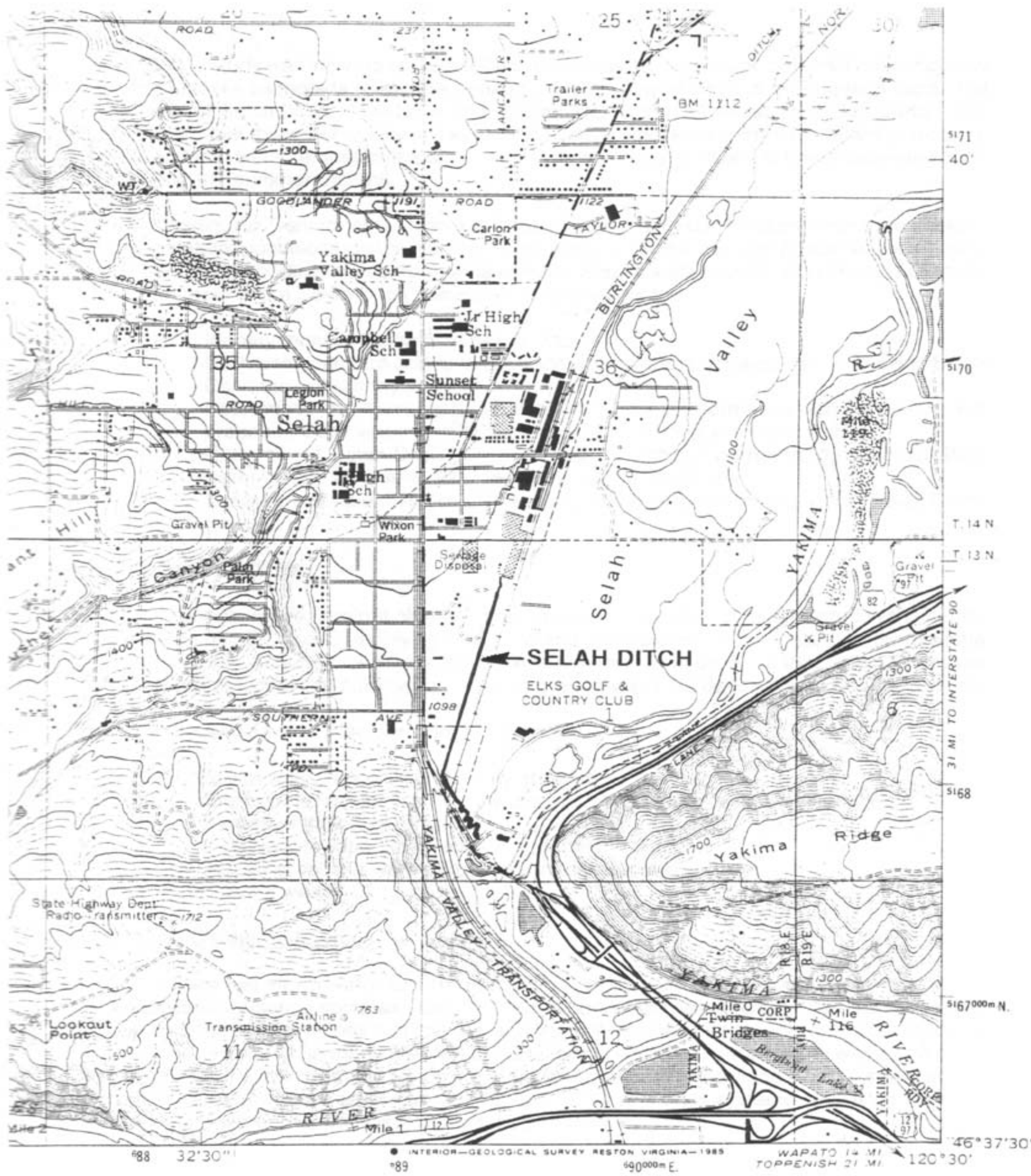
Hydrology

Selah Ditch (Figures 1 and 2) is a short (4,380 feet long; .83 mile) straight water body that collects irrigation supply water, irrigation runoff, urban storm water, and industrial/municipal discharges prior to its own discharge into the west side of the east fork of Taylor Ditch[1]. Selah Ditch is in reality an extension of the west fork of Taylor Ditch, which historically transported irrigation water through the city and into the limited rural areas located to the south. However, over time the west fork had to be piped underground to allow for additional residential growth in that area.

This underground west fork of Taylor Ditch resurfaces as a west-side tributary to Selah Ditch, approximately 2/3 of the distance downstream of Selah Ditch's headwaters. Selah Ditch ultimately discharges into the east fork of Taylor Ditch. After its discharge, the combined flow of the two ditches continues for another 0.1 mile prior to discharging into the Yakima River at River Mile 117.1.

[1] Taylor Ditch, which begins as an irrigation diversion of the Yakima River located approximately 5 miles north of Selah, is composed of two forks: east and west. The ditch was built to bring irrigation water to the Selah area. The east fork supplies the area to the east of the BNSF railroad tracks; while the west fork passes through the city and supplies the area west of the BNSF railroad tracks. The east fork ultimately drains the Elks Golf Course and low-lying areas between Selah and the Yakima River. In this area, Taylor Ditch is commonly referred to as Golf Club Creek. The west fork ultimately drains into Selah Ditch, which then drains back into the east fork just prior to the Taylor Ditch confluence with the Yakima River.

Figure 1: Selah Ditch - Looking Downstream to the Southwest from Upper Reach



LOCATION OF SELAH DITCH

WITHIN THE CITY OF SELAH

Figure 2: Location of Selah Ditch within the City of Selah

In the late 1990s, the lower reach of Selah Ditch was reconstructed to improve fish and wildlife habitat. The waterbody's direction of flow changed from moving directly south into the Yakima River, to moving south-easterly into the east fork of Taylor Ditch. Meanders were also constructed and woody debris added to enhance the stream characteristics.

Selah Ditch is located within the Water Resource Inventory Area (WRIA) 39. The water body is classified as Class A and must comply with specific water quality criteria listed in Table 1. However, according to the July 2003 amended state regulations (Chapter 173-201A WAC), the ditch is proposed to be reclassified as a *Salmon and Trout Spawning, Noncore Rearing, and Migration* aquatic life use category (Table 2) and a *Primary Contact Recreation* water contact recreation category water body. The *Selah Ditch Multiparameter TMDL* must comply with the Class A standards, as the newer standards have yet to be approved by EPA.

There are three sources of water that discharge into Selah Ditch. Two are classified as point sources: the effluent outfall from the city of Selah's wastewater treatment plant (POTW) and stormwater discharges from sub-systems #1, #3, and #4. The third source of water is the naturally-occurring flow in the west-side tributary that discharges into Selah Ditch 0.65 miles downstream of the POTW outfall. The tributary's flow (0.38 mgd) is considered primarily to be a combination of irrigation water diverted from the Yakima River upstream of the city of Selah, as well as irrigation return water. The city's stormwater sewer system outfalls are considered by Ecology to be point sources because the city is classified as a Phase-2 stormwater municipality according to EPA guidelines. The stormwater sub-systems that discharge into Selah Ditch are described later in this technical assessment.

The flow from the POTW represents approximately 33 percent of the total flow in the downstream ditch. Storm water represents approximately 55 percent; while, the west-side tributary represents approximately 12 percent. During the summer, the majority of the flow in the municipal stormwater sewer system results primarily from the inflow and infiltration of shallow groundwater composed primarily of subsurface irrigation return flows and naturally-occurring groundwater. Blakeney (2003) found through an isotope study that "a significant portion of the ground water is recharged by local runoff or local precipitation." It should be reiterated that the original purpose of the man-made Selah Ditch was to dewater surrounding wetlands, as well as to transport subsurface irrigation water that began as the west-fork of Taylor Ditch.

Storm Water

Selah Ditch itself actually begins as discharges from an 18" diameter stormwater outfall (sub-system #3) that enter at the head of the ditch, approximately 100 feet upstream of the POTW outfall. A 24" stormwater outfall (sub-system #4) is located approximately 10 feet downstream of the POTW outfall. A 36" stormwater outfall discharges into the west-side tributary near to its confluence with Selah Ditch. Below are descriptions of the three stormwater sewer sub-systems that, according to the city's 2001 Storm Water Management Plan, that typically discharge year-round into Selah Ditch. The descriptions below were taken from a *Selah Ditch Temperature Study* conducted by Huibregtse, Louman Associates, Inc. (2003).

Table 1: Specific Class A Water Quality Criteria for Freshwaters Related to the Selah Ditch Multiparameter TMDL

Ammonia:	Acute Criterion (1-hour average concentration not to be exceeded more than once every three years on the average.): Shall not exceed the numerical value given by: 0.52 ÷ (FT x FPH x 2), where: $FT = 10^{[0.03(20\text{-}TCAP)}$; TCAP ≤ T ≤ 30 $FT = 10^{[0.03(20\text{-}T)]}$; 0 ≤ T ≤ TCAP FPH = 1; 8 ≤ pH ≤ 9 $FPH = (1 + 10^{(7.4 - pH)}) \div 1.25$; 6.5 ≤ pH ≤ 8.0 TCAP = 20°C; Salmonids present TCAP = 25°C; Salmonids absent Chronic Criterion (4-day average concentration not to be exceeded more than once every three years on the average.): Shall not exceed the numerical value given by: 0.80 ÷ (FT x FPH x RATIO), where: RATIO = 13.5; 7.7 ≤ pH ≤ 9 $RATIO = (20.25 \times 10^{(7.7 - pH)}) \div (1 + 10^{(7.4\text{-} pH)})$; 6.5 ≤ pH ≤ 7.7 $FT = 10^{[0.03(20\text{-}TCAP)}$; TCAP ≤ T ≤ 30 $FT = 10^{[0.03(20\text{-}T)]}$; 0 ≤ T ≤ TCAP FPH = 1; 8 ≤ pH ≤ 9 $FPH = (1 + 10^{(7.4 - pH)}) \div 1.25$; 6.5 ≤ pH ≤ 8.0 TCAP = 15°C; Salmonids present TCAP = 20°C; Salmonids absent
Chlorine:	Acute Criterion (1-hour average concentration not to be exceeded more than once every three years on the average.): Shall not exceed 0.019 mg/L. Chronic Criterion (4-day average concentration not to be exceeded more than once every three years on the average.): Shall not exceed 0.011 mg/L.
Dissolved Oxygen:	Shall exceed 8.0 mg/L.
Fecal Coliform:	Shall both not exceed a geometric mean value of 100 cfu/100mL and not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 200 cfu/100mL.
Temperature:	Shall not exceed 18°C due to human activities. When natural conditions exceed 18°C, no temperature increase will be allowed that will raise the receiving water temperature by greater than 0.3°C. Incremental temperature increases resulting from non-point activities shall not exceed 2.8°C. Incremental increases from point source activities shall not, at any time, exceed t=28/(T+7). ("T" represents the background temperature increase as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge. "t" represents the maximum permissible temperature increase measured at a mixing zone boundary.)

Table 2: Salmon and Trout Spawning, Noncore Rearing, and Migration Aquatic Life Use and Primary Contact Water Quality Standards

Characteristic Uses:	Shall include the protection of spawning, noncore rearing, and migration of salmon and trout, and other associated aquatic life; primary contact recreation; water supply uses (domestic, agricultural, industrial, and stock watering); and miscellaneous uses (wildlife habitat; harvesting; commerce and navigation; boating; and aesthetics).
Fecal Coliform:	Must not exceed a geometric mean value of 100 colonies/100mL, with not more than 10% of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100mL.
Dissolved Oxygen:	1-DMin shall not be less than 8.0 mg/L.
Total Dissolved Gas:	Shall not exceed 110% of saturation at any point of sample collection.
Temperature:	7-DADMax is not to exceed 17.5°C (63.5°F) at a probability frequency of more than once every ten years. When natural conditions exceed 17.5°C, no temperature increase will be allowed which will raise the receiving water's 7-DADMax temperature by greater than 0.3°C (0.54°F). When receiving water is cooler than 17.5°C: (A) incremental temperature increases resulting from individual non-point activities must not, at any time, exceed 2.8/(T-5)°C as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge), and (B) incremental temperature increases resulting from the combined effect of all nonpoint source activities in the water body must not, at any time, exceed 2.8°C (5.04°F).
pH:	Shall be within the range of 6.5 to 8.5, with a human–caused variation within the above range of less than 0.5 units.
Turbidity:	Shall not exceed 5 NTU over background when the background is 50 NTU or less; or have more than a 10% increase in turbidity when the background turbidity is more then 50 NTU.
Toxic, radioactive, or deleterious material:	Must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon the those waters, or adversely affect public health.
Aesthetic Values:	Must not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

1. Sub-system #1: Discharges enter Selah Ditch through the west-side tributary, which includes a 36″ outfall located at the east end of 10th Avenue. Storm water comes from the South First Street commercial area, West Selah Avenue residential area, and portions of the residential area between West Freemont Avenue and Speyers Road. Irrigation return waters enter from roadside ditches along Crusher Canyon Road, through a gully off Pleasant Hill Road, and through a gully and culvert flowing under Speyers Road.

2. Sub-systems #3 and #4: Discharges enter Selah Ditch through both the 18″ and 24″ stormwater sewer outfalls located at the head end of the ditch and just downstream of the POTW outfall, respectively. The systems carry storm water from a portion of the city's industrial/commercial area in the north part of the city, North Wenas Road, North First Street, as well as some residential areas in the northwest portion of the city. Irrigation return waters that are discharged come from an area near the south end of Terry Lane.

   Storm water sub-systems #3 and #4 are actually connected together upstream of the Tree Top, Inc. facility and are divided later into the two separate stormwater sewer outfalls, which both enter the upper reach of Selah Ditch. According to an Ecology flow analysis of October 1988, the 24″ outfall primarily contains non-contact cooling[2] discharges from Tree Top, Inc. combined with substantial volumes of ground water. The 18″ outfall contains primarily upstream municipal stormwater sewer flow that contains both residential and industrial discharges, as well as substantial volumes of ground water.

Problem Statement

Selah Ditch was placed on both the State's 1996 and 1998 303(d) lists of impaired water bodies due to three water quality parameters having previously exceeded the State's Class A water quality standards. Selah Ditch is required to comply with the Class A water quality standards listed in Table 1, above. Table 3 details all of the 1996 and 1998 303(d) listings for Selah Ditch.

Table 3: Selah Ditch - 1996 and 1998 303(d) Listings

303(d) Year	Water body Name	WRIA	Water body Old #	Water body New #	T/R/S	Parameter
1996	Selah Ditch	39	WA-39-1110	UNK000	13N/18E/01	Ammonia
″	″ ″	″	″	“	“	Chlorine
″	″ ″	″	″	“	“	Dissolved Oxygen
1998	Selah Ditch	39	WA-39-1110	UNK000	13N/18E/01	Ammonia
″	″ ″	″	″	″	″	Chlorine
″	″ ″	″	″	″	″	Dissolved Oxygen

2 The general term of "non-contact cooling" is a misnomer, since the actual discharges are a combination of both hot "container cooling" water and cooler "non-contact cooling" water. Water that is used to cool Tree Top, Inc.'s final products (bottles and cans) should actually be labeled "contact cooling" since such water actually contacts the final product. This technical assessment uses container cooling water and contact cooling water, interchangeably; whereas, other cooling waters are referred to as non-contact cooling water.

All of the above listings were determined from water quality data collected during October 25-26, 1988 and published by Ecology *Selah Wastewater Treatment Plant Receiving Water Survey October 1988* (Joy, 1990). The listing of Selah Ditch as being "impaired" indicates that such water body poses a health hazard to in-stream aquatic life. Ecology must conduct a TMDL assessment for all impaired, 303(d)-listed water bodies. TMDLs are defined in 40 CFR Part 130 as the determination of maximum allowable individual point source wasteload allocations and non-point source load allocations. Table 4 details all of the proposed (January 2004) impaired listings for Selah Ditch.

Table 4: Selah Ditch – Proposed 2004 Listings

Water body Name	WRIA	Water body New #	T/R/S	Parameter	Category
Selah Ditch	39	UNK000	13N/18E/01	Ammonia	2
Selah Ditch	39	UNK000	13N/18E/01	Chlorine	2
Selah Ditch	39	UNK000	13N/18E/01	Dissolved Oxygen	2
Selah Ditch	39	UNK000	13N/18E/01	Fecal Coliform Bacteria	5*
Selah Ditch	39	UNK000	13N/18E/01	Temperature	5*

* A TMDL is required to be conducted.

Objectives

The main objectives of the *Selah Ditch Multiparameter TMDL* technical assessment are to:

1. Illustrate:
   A. How divergent the surface water in Selah Ditch is from meeting the State's water quality standards for the parameters of ammonia, chlorine, dissolved oxygen, fecal coliform bacteria and temperature; and
   B. The pollution impact of past and present anthropogenic activities in the ditch.
2. Determine which of the above water quality parameters require mitigation through a TMDL analysis and process.
3. Estimate the site potential temperatures for both the upper and lower reaches of Selah Ditch.
4. Calculate ammonia, chlorine, dissolved oxygen, fecal coliform bacteria, and temperature wasteload allocations (WLAs) for point sources (POTW and stormwater discharges) and load allocations (LAs) for non-point sources to meet the state's water quality standards.
5. Calculate appropriate TMDL milestones for Selah Ditch in order to ultimately comply with the State's water quality standards.

Ecology's Water Quality Program wrote Policy 1-11, *Assessment of Water Quality for the Section 303(d) List*, which became effective in August 1993. The policy was later revised in September 2002 in order to coordinate with later changes the EPA had made to regulations concerning the Federal Clean Water Act. Ecology's revised policy states "Whenever possible, the [TMDL] assessment will be based on data collected in the previous ten years." As the majority of the data utilized for the 1996 and 1998 303(d)-listings of Selah Ditch were collected in excess of ten years ago (October 1988), it was suggested that all interested parties (Ecology, city of Selah, Hi-Country Foods Corp., Larson Fruit, Matson Fruit, and Tree Top, Inc.) arrange for the collection of more recent water quality data.

A meeting was held at Selah City Hall on March 13, 2003 with representatives of all of the above interested parties. At that meeting, a decision was made to conduct water quality sampling once every two weeks during the individual months of April, July, and October of the year 2003 at the same sites used by the *Selah Wastewater Treatment Plant Receiving Water Survey,* October 1988. This sampling was designed to include high stormwater/low industrial flows during April; high irrigation/low industrial flows during July; and, low stormwater/high industrial flows during October of the year 2003. Such data will be evaluated to identify if the parameters of chlorine, dissolved oxygen, fecal coliform bacteria and temperature are continuing to impair the water quality within Selah Ditch, or if they have improved sufficiently over the past years to where no water quality impairment now exists.

Background

Significance of Ammonia, Chlorine, Dissolved Oxygen, Fecal Coliform Bacteria, and Temperature Parameters

1. **Ammonia**

   The toxic form of ammonia is un-ionized ammonia (NH_3-N), not the ammonium ion (NH_4^+). Concentrations of ammonia that are acutely toxic to aquatic life may cause loss of equilibrium, hyperexcitability, increased breathing, cardiac output and oxygen uptake, and, in extreme cases, convulsions, coma, and death. At lower concentrations, ammonia has many effects on fishes including a reduction in hatching success, reduction in growth rate and morphological development, and pathologic changes in tissues of gills, livers, and kidneys. Ammonia toxicity tests have indicated that freshwater phytoplankton and vascular plants are appreciably more tolerant than are invertebrates or fishes. The concentration of ammonia is affected by the temperature and pH of the receiving water, and increases as either, or both, temperature and pH increase. Therefore, the state water quality standards include a complex formula for calculating appropriate acute and chronic criteria for each individual site-specific set of water quality conditions.

2. Chlorine

Chlorine is the most widely used disinfectant for municipal wastewater because it destroys target organisms by oxidizing cellular material. However, even at extremely low concentrations, chlorine causes stress and toxicity of aquatic life. Chlorine is extremely caustic and causes irritation of the mucous membranes of fish, as well as on the skin itself. The chemical destroys gill tissue (necrosis) and causes respiratory difficulty and ultimately asphyxiation. Chloramines (chlorine combined with ammonia) pass through the gills and enter the bloodstream, binding to iron in the red blood cells, which prevents oxygen from entering the blood and likewise results in suffocation.

3. Dissolved Oxygen

The level of dissolved oxygen (DO) present in streams is commonly used as an indicator of water quality. Maintaining adequate concentrations of DO is vitally important for supporting fish, invertebrates and other aquatic life since all such life needs oxygen to live. As air or water moves past an animal's breathing apparatus (gills or lungs), oxygen is transferred to their blood. It is more difficult to transfer oxygen from water to blood than it is to transfer oxygen from air to blood.

DO concentrations are affected by water temperatures, photosynthesis and respiration of bottom algae and phytoplankton, and sediment oxygen demand. In addition, the discharge of wastewaters containing high BOD_5 concentrations will decrease the DO content in receiving waters, as a secondary effect, further downstream than the actual discharge point of such wastewater.

4. Fecal Coliform Bacteria

There are more than 100 different waterborne enteric pathogens known to be related to the feces of warm-blooded animals, including man. Many diseases/pathogens can be transmitted to humans from animal manure, including: cryptosporidiosis, giardiasis, salmonellosis, *Campylobacter jujuni*, and *Escherichia coli* (*E. coli*) O157:H7. Due to the diversity and unpredictability of individual pathogens, water quality testing for each individual pathogen would be very time-consuming, technically intensive, and prohibitively costly. Fortunately, testing for an indicator organism is much easier and has been utilized during the past 100 years. Fecal coliform (FC) is currently the water quality parameter for determining microbial contamination in freshwaters of the state of Washington.

The presence of FC indicator organisms in a water sample does not necessarily mean that pathogenic organisms are present. However, excessive FC densities in a water body represent a statistically significant potential health risk for human beings and could result in the loss of beneficial uses like swimming, fishing, boating, incidental contact, and water sports. Beneficial uses of water bodies are required to be protected by both the federal Clean Water Act (CWA) and the state's own surface water quality standards. However, the majority of the beneficial uses listed above infrequently exist in the sub-basin's surface waters.

5. **Temperature**

Temperature is one of the most important water quality parameters that affect the physiological functions of aquatic life. Affected physiological functions include growth, food consumption, metabolism, reproduction, activity, and survival. In the wild, fish appear to select temperatures that maximize the amount of energy available for metabolic activities. For most salmonids, the optimal temperature range for metabolism occurs between 10ºC and 17ºC. Temperatures that occur outside of such optimal range will begin to degrade the physiological functions of salmonids. The temperature at which fish succumb to thermal stress depends on the temperature to which it was acclimatized and on its developmental stage (e.g., embryo, fry, juvenile, adult). Hot water temperatures also allow for the development of diseases.

With specific application to the beneficial use of fish, Hicks (2002) indicated that water temperatures in excess of 23°C (73°F) should be considered lethal to salmonids, and that water temperatures greater than 22°C (71.6°F) should be assumed to be a barrier to salmonid migration. All of the foregoing information supports the state's establishment of a Class A temperature criterion of 18.0°C, as well as the proposed *Salmon and Trout Spawning, Noncore Rearing, and Migration* aquatic life temperature criterion of 17.5°C, as reasonable maximum temperature limitations for beneficial use.

Land-use Inventory and Water Sources

A detailed land-use inventory surrounding the very short Selah Ditch is not warranted since all point and non-point sources of pollution are easily identified. The areas surrounding the ditch are principally urban and industrial in the upper reach with open non-agricultural fields in the lower reaches.

Selah Ditch has three point source discharges: the POTW outfall and the 18″ and 24″ stormwater sewer discharges (Selah is classified as a Phase-2 stormwater municipality, therefore its stormwater sewer outfalls are now considered point sources). Discharges from the stormwater sub-systems, detailed previously in the Hydrology section, and contain a mix of ground water, urban runoff, and industrial discharges from Larson Fruit Company, Matson Fruit Company and Tree Top, Inc. [Hi-Country Foods Corporation, a historical industrial discharger of high temperature discharges has recently been sold to Yakama Juice.]

Selah Ditch also has one non-point discharge, which is the west-side tributary (upstream of the municipal stormwater outfall) and has an average critical condition flow of 0.38 mgd. The area surrounding the tributary is, for the most part, in a semi-natural state except for the 36″ concrete stormwater sewer pipeline that enters near the tributary near its confluence with Selah Ditch. The area's vegetation is semi-natural in that it has been significantly degraded by anthropogenic activities.

The west-side tributary is actually an extension of the west fork of Taylor Ditch, which was in later years placed subsurface in order to allow for additional residential expansion in the area south of the city.

Historical Information

There has been sparse historical information collected on the water quality parameters of Selah Ditch. Initial information was collected as part of a receiving water study by Ecology related to the city of Selah POTW during October, 1988. Selah Ditch was again sampled in 2000, 2001, 2002 and 2003 for various water quality parameters.

1. **1988 Selah Wastewater Treatment Plant Receiving Water Survey**

   WDOE (1990) reported the results of an October 1988 receiving water survey of Selah Ditch, into which discharges the city of Selah POTW effluent. The survey consisted of both chemical parameter analyses and biotic surveys. Table 5 details the results of water quality analyses that are considered the most important for the *Selah Ditch Multiparameter TMDL* assessment.

Table 5: Selah Ditch - Water Quality Data Collected on October 25 & 26, 1988

Parameter	Head of ditch, at 18″ culvert (RM=0.98)	City of Selah POTW effluent (RM=0.96)	24″ stormwater effluent (RM=0.95)	Ditch behind trailer fabrication plant (RM=0.85)	Right Bank Tributary to Selah Ditch (RM=0.33)*	Ditch 100′ above Golf Club Creek (RM=0.15)
Alkalinity (mg/L)	250 240	- 260	- -	240 -	- -	- 230
Ammonia (mg/L)	0.03 0.02	 0.05	0.04 0.02	0.08 0.04	0.02 0.02	0.03 0.03
BOD_5 (mg/L)	<3 <3	<3 <3	120 63	- -	- -	17 -
Chlorine (mg/L)	<0.1 <0.1	1.5 1.5	<0.1 <0.1	0.1 0.1	- -	- -
COD (mg/L)	6 -	- 35	160 -	- -	- -	42 -
Dissolved Oxygen (mg/L)	8.45 7.40	6.00 5.85	1.90 4.85	3.10 3.65	6.50 6.25	2.70 2.90
Fecal Coliform (cfu/100mL)	15,000 1,100	3 3	8,000 1,300	6,600 970	21 28	930 740
Flow (cfs)	0.7 0.8	2.83 2.30	2.9 3.5	6.4 6.6	0.6 0.6	7.8 7.6
Nitrate/Nitrite (mg/L)	3.1 3.0	- 0.70	2.1 2.2	1.5 1.4	1.7 1.7	0.9 1.0
pH	7.13 7.75	7.83 7.62	7.95 7.70	7.83 7.58	7.57 7.54	7.58 7.52
Specific Conductivity (Φmhos/cm)	535 530	970 945	480 455	640 610	490 490	600 580
Temperature (°C)	18.7 19.4	15.4 17.7	23.8 21.2	20.1 18.6	13.7 13.5	19.1 17.2
TSS (mg/L)	4 4	- 4	6 4	6 10	- 2	25 9

* This site is considered by the *Selah Ditch Multiparameter TMDL* to be representative of load allocations (LAs).
Shaded cells indicate sampling sites in Selah Ditch.

Ammonia: The actual ammonia concentrations in Selah Ditch never exceeded 0.08 mg/L. The decision to place ammonia on the 1996 and 1998 303(d) lists was based on potential ammonia concentrations that could have been discharged by the POTW, rather than on actual instream ditch concentrations. In addition, the report specifically stated that: "Toxic un-ionized ammonia concentrations were not present [in Selah Ditch] according to calculations made …" Finally, a limitation of 5 mg/L was recommended.

Chlorine: The state's acute and chronic chlorine criteria are 0.019 and 0.011 mg/L, respectively. From Table 5, above, the maximum instream Selah Ditch chlorine concentrations were found to be 0.1 mg/L, which exceeded both criteria. The source of the excessive instream chlorine concentrations was attributed to the effluent discharged by the POTW. The industrial dischargers to the city's stormwater sewer system may also be discharging minor residual chlorine due to their use of the municipal chlorinated potable water supply.

Dissolved Oxygen: Selah Ditch DO concentrations as low as 2.7 mg/L were found during the 1988 sampling. This concentration is well below the state's Class A water quality minimum criterion of 8.0 mg/L. The low DO concentrations were attributed to the storm water discharged from the 24" diameter outfall, which also contained industrial discharges from Tree Top, Inc. In addition to the extremely low DO (1.9 mg/L), the highest BOD_5 concentration (120 mg/L) was found in the 24" stormwater outfall. The combination of high oxygen demand and low DO concentrations suggested that industrial process wastewater was being discharged to the stormwater sewer, not just non-contact cooling water. The report stipulated that an NPDES permit effluent limitation of 10 mg/L BOD_5 would be needed in order to maintain sufficient DO in Selah Ditch.

In addition to the above parameters of ammonia, chlorine and DO, which were included in the 1996 and 1998 303(d) lists of impaired water bodies, the data presented in the original 1988 report indicated that two other parameters consistently violated the state's Class A water quality standards. These additional parameters were FC bacteria and temperature. Such parameters should have been included in both the 1996 and 1998 303(d) listings of impaired water bodies, but for some reason were not.

Fecal Coliform Bacteria: The maximum fecal coliform (FC) density found within Selah Ditch was 6,600 cfu/100ml. FC in such high densities usually suggest a direct connection of sanitary wastes; thus, more physical testing of the stormwater sewer system was recommended in the future to track for all direct connections, such as smoke and/or dye testing. A more probable source of the high instream FC densities would be the greater upstream FC densities of 15,000 cfu/100ml and 8,000 cfu/100ml being discharged through the 18" and 24" stormwater sewer outfalls, respectively. The source of the excessive bacterial densities in the stormwater sewer was characterized as "puzzling."

Temperature: Table 5 indicates that instream Selah Ditch water temperatures continually exceed the state's Class A temperature criterion of 18.0°C. The source of the highest water temperatures (averaging 22.5°C) was found associated with the 24" stormwater sewer system outfall, which contained the hot contact cooling (container cooling water) industrial wastewater discharges from Tree Top, Inc.

On the other hand, the 18" stormwater sewer outfall had water temperatures averaging 19.1°C, which contained upstream municipal storm water, and both industrial contact and non-contact cooling waters. The POTW discharges, through a separate outfall, were substantially cooler than the stormwater effluent and averaged 16.6°C

2. November 2000 Water Quality Survey of Selah Ditch

The city of Selah collected water quality samples from Selah Ditch during November, 2000 in order to replicate Ecology's October 1988 sampling. Table 6 details the maximum values for various water quality parameters from the November, 2000 sampling.

Table 6: Selah Ditch - Water Quality Data Collected in November, 2000

Parameter	Head of ditch, at 18" stormwater sewer effluent (RM=0.98)	City of Selah POTW effluent (RM=0.96)	24" stormwater sewer effluent (RM=0.95)	Behind Owens Warehouse building (RM=0.85)	100' upstream of confluence with Taylor Ditch (RM=0.15)
BOD_5 (mg/L)	6.2	3.0	2.0	2.5	2.3
Dissolved Oxygen* (mg/L)	7.2	5.5	7.4	4.9	6.8
Fecal Coliform (cfu/100mL)	TNTC**	3	350	TNTC	1,460
pH	6.89	7.06	6.84	7.05	6.92
Temperature(°C)	17.9	15.3	19.1	16.7	14.8

* Minimum concentrations rather than maximum concentrations.
** TNTC means "Too Numerous to Count."
Shaded cells indicate Selah Ditch mainstem sampling sites.

The data above indicate that the water quality in Selah Ditch has improved substantially since October 1988. The greatest improvements were associated with the effluent discharged from the 24" stormwater outfall and the downstream Selah Ditch. Specifically, the only parameters exceeding their respective Class A water quality criteria, during November, 2000, were FC bacteria and DO.

The industrial wastewater pollution found in the 24" stormwater effluent has substantially been mitigated, as evidenced by significant decreases in BOD_5 concentrations, FC densities, and temperature, as well as a significant increase in daily maximum DO concentrations (from 3.6 mg/L to 7.4 mg/L). The decrease in pollution is not considered to be an artifact of intermittent discharges, since both the 1988 and 2000 sampling were conducted during the active fruit processing season. In fact, Tree Top, Inc. discovered that high-BOD_5 "waters of evaporation" were being discharged accidentally to the stormwater sewer system via a plumbing cross-connection and were subsequently corrected in 1991.

The city of Selah's consultants indicated that although most parameters have greatly improved since October 1988, FC densities measured in Selah Ditch during November 2000 "remain high." The report stated that: "The large number of ducks observed to be present within Selah Ditch during the 2000 sampling, as well as muskrat and beaver, may be a source of the high fecal coliform counts within Selah Ditch."

The decrease in the FC densities in the 24” stormwater sewer since the 1988 sampling was most probably associated with the decrease of the BOD_5 content of the previous “waters of evaporation”. Such highly contaminated industrial wastewaters provide a rich nutrient, which is theorized as producing the subsequent explosion in bacterial populations. However, the reason for the continued high FC densities remaining in the 18” stormwater outfall is still unknown, but may be related to illegal sanitary discharges or urban runoff containing pet wastes.

3. August 2001 – November 2002, Selah Ditch Temperature Study

Huibregtse Louman Associates, Inc. published a report on intensive water temperature sampling throughout Selah Ditch and the city of Selah’s stormwater sewer system that was collected at 15-minute intervals during the entire period of August 2001 through November 2002 (16 months). In total, 14 sampling stations were established in order to determine the amounts of temperature discharged by various sources.

Table 7 details the quantity of the 15-minute temperature readings that exceeded to state’s Class A temperature water quality criterion of 18.0°C (64.4°F) at the four sampling stations located along Selah Ditch. Analysis of the data indicates that a critical condition period exists during the months of April through October.

Table 8 details the monthly maximum water temperatures at the same four sampling stations. The monthly maximum temperatures throughout Selah Ditch exceeded the Class A temperature criterion of 18.0°C (64.4°F) during the months of April through October, which supports the determination of the critical condition period.

The *Selah Ditch Temperature Study* made the following conclusions:

A. The discharges of warm water to the stormwater sewer system, during spring, fall and winter months, have the effect of raising the overall water temperature of Selah Ditch above what would be expected without those discharges.

B. Temperature of the water in Selah Ditch cools as it travels down the ditch during the spring, fall and winter months.

C. The water in the lower portion of Selah Ditch increases in temperature during the summer months, resulting in higher water temperatures at the lower end of the ditch than temperatures observed at the upper end of the ditch.

D. The temperature of water discharged to Selah Ditch, and water within Selah Ditch do, at various times of the year, exceed the current Class A and proposed water quality criteria for temperature.

E. Results of the study show that daily maximum and 7-DADMax water temperatures at the lower end of Selah Ditch exceed the state’s water quality temperature criteria during the months of May through October [actually April through October].

Table 7: Selah Ditch – Quantity of 15-minute Temperature Readings that Exceed 18°C from August 2001 – November 2002

Site Location	Station #	Aug. 2001	Sep. 2001	Oct. 2001	Nov. 2001	Dec. 2001	Jan. 2002	Feb. 2002	Mar. 2002	Apr. 2002	May 2002	Jun. 2002	Jul. 2002	Aug. 2002	Sep. 2002	Oct. 2002	Nov. 2002
Upper Reach of Selah Ditch (just below all municipal discharges)	**8**	2,447	1,542	199	5	0	0	0	0	-	0	79	2,088	2,362	1,775	**64**	0
Selah Ditch (just upstream of confluence of west-side channel)	**9**	2,342	914	0	0	0	0	0	0	-	57	1	954	-	914	63	0
Selah Ditch (just upstream of the railroad culvert)	**11**	2,149	1	66	0	0	0	0	0	3	20	49	1,141	89	1	36	0
Lower Reach of Selah Ditch (just upstream of Taylor Ditch)	**12**	2,052	491	27	0	0	0	0	0	35	64	78	1,749	1,674	634	97	0

Shaded cells indicate that no temperature readings were collected.

Table 8: Selah Ditch - Monthly Maximum Water Temperatures (°F) from August 2001 – November 2002

Site Location	Station #	Aug. 2001	Sep. 2001	Oct. 2001	Nov. 2001	Dec. 2001	Jan. 2002	Feb. 2002	Mar. 2002	Apr. 2002	May 2002	Jun. 2002	Jul. 2002	Aug. 2002	Sep. 2002	Oct. 2002	Nov. 2002
Upper Reach of Selah Ditch (just below all municipal discharges)	**8**	68.5	68.8	65.0	65.6	61.5	62.4	64.4	63.0	-	64.1	66.7	70.3	70.0	69.1	**66.1**	**-**
Selah Ditch (just upstream of confluence of west-side channel)	**9**	71.7	71.1	63.2	62.0	57.8	58.6	64.0	63.5	-	66.7	63.2	65.5	-	71.1	66.4	59.2
Selah Ditch (just upstream of the railroad culvert)	**11**	71.5	63.9	66.5	61.3	58.2	57.6	62.2	61.9	64.5	66.2	65.1	67.7	64.8	63.9	66.2	61.6
Lower Reach of Selah Ditch (just upstream of Taylor Ditch)	**12**	72.3	69.6	66.1	61.5	57.6	58.4	61.8	63.5	65.3	66.7	67.3	75.1	73.2	69.9	66.7	61.5

Shaded cells indicate a temperature in excess of the State's Class A water quality standard of 64.4°F (18°C).

F. Both the storm water and the intercepted ground water have a moderating effect on the overall water temperature within Selah Ditch. Discharges of storm and ground waters appear to raise the overall water temperature within Selah Ditch during the fall and winter months, and lower the overall water temperature during the summer months. Without the contributions of both storm and ground waters, temperatures would exhibit greater seasonal variations than is currently the case. If no municipal or industrial discharges were present, the flow in Selah Ditch would be initially limited to the temperature of the surrounding area's ground water, which is the background flow in the ditch.

G. Summertime cooling of the waters in Selah Ditch can best be accomplished through the development of vegetative cover. While cooling of the warm water discharges from Hi-Country, Tree Top, and the Selah WWTP [POTW] would lower the temperature in the upper end of the ditch, solar radiation and air temperatures would negate most [of those] cooling efforts by the time waters reach the lower end of the ditch.

4. City of Selah Water Quality Monitoring during April, July and October, 2003

In response to a meeting held at the Selah City Hall on March 13, 2003 by Ecology with the *Selah Ditch Multiparameter TMDL* technical advisory workgroup[3], a decision was made to conduct additional water quality sampling during the months of April, July, and October 2003 at sites similar to those used by the *Selah Wastewater Treatment Plant Receiving Water Survey October 1988*. Table 9 gives the details of the year-2003 water quality monitoring.

A. BOD_5: A statistical analysis of the BOD_5 concentrations for each sampling month, irrespective of sampling station, determined that April had the highest BOD_5 concentrations; while, October had the lowest BOD_5 concentrations. Figure 3 illustrates those results.

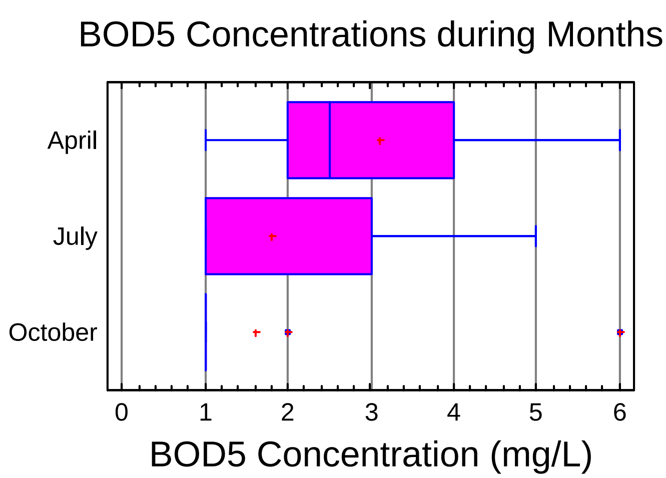


Figure 3: BOD_5 Concentrations during Months

[3] The TMDL workgroup consists of representatives from Ecology; City of Selah; Huibregtse, Louman Associates, Inc.; Hi-Country Foods Corporation; Larson Fruit Company; Matson Fruit Company; and Tree Top, Inc.

Table 9: Selah Ditch - Water Quality Data Collected during 2003

Date	Parameter	Station 1 (18″ stormwater sewer outfall)	Station 2 (POTW outfall)	Station 3 (24″ stormwater sewer outfall)	Station 4 (downstream of west-side channel)	Station 5 (lower reach of Selah Ditch)
April 8	Flow (mgd)	0.067	0.975	1.520	4.490	5.750
"	Temp. (°C)	14.6	14.1	15.7	17.1	14.8
"	pH	6.8	7.2	7	7.2	7.3
"	DO (mg/L)	6.5	5.7	8	8.8	10.1
"	Cl_2 (mg/L)	0.01	0.09	0.34	0.21	0.05
"	BOD_5 (mg/L)	2	6	2	4	3
"	FC (cfu/100mL)	TNTC	2.5	1.4	15.5	9.1
April 22	Flow (mgd)	0.055	0.990	1.460	3.570	6.020
"	Temp. (°C)	14.5	15.7	16	16.1	14.4
"	pH	6.9	7.2	7	7.2	7.3
"	DO (mg/L)	6.1	5	8.1	8.5	10
"	Cl_2 (mg/L)	0.01	0.11	0.06	0.07	0.03
"	BOD_5 (mg/L)	1	6	1	4	2
"	FC (cfu/100mL)	TNTC	1.0	TNTC	TNTC	TNTC
July 22	Flow (mgd)	0.300	1.039	1.360	-	3.090
"	Temp. (°C)	18.4	21.5	18.7	18.2	19.2
"	pH	7	7.3	7.1	7	7.2
"	DO (mg/L)	7.7	5.5	7.7	4.6	6.1
"	Cl_2 (mg/L)	0.1	0.02	0.16	0	0
"	BOD_5 (mg/L)	1	1	5	1	1
"	FC (cfu/100mL)	34.7	1.2	33.8	235	110
July 29	Flow (mgd)	0.24	0.807	1.26	-	3.08
"	Temp. (°C)	18.4	21.3	18.4	19	19.2
"	pH	6.7	7.1	6.8	7	7.1
"	DO (mg/L)	7.8	5.3	7.8	5.4	6.8
"	Cl_2 (mg/L)	0.01	0.02	0.01	0.01	0.02
"	BOD_5 (mg/L)	1	3	3	1	1
"	FC (cfu/100mL)	TNTC	5	TNTC	248	104
Oct. 7	Flow (mgd)	0.42	1.169	1.13	-	5.850
"	Temp. (°C)	17.8	17.8	17.8	17.1	16.1
"	pH	7	7.3	7.1	7	7.1
"	DO (mg/L)	7.5	5.5	7.7	4.4	7.2
"	Cl_2 (mg/L)	0	0.01	0.11	0.01	0.01
"	BOD_5 (mg/L)	1	1	6	1	1
"	FC (cfu/100mL)	TNTC	29	4	TNTC	TNTC
Oct. 28	Flow (mgd)	0.44	1.03	1.12	-	3.83
"	Temp. (°C)	17.9	16.2	18.1	16.8	16.5
"	pH	7	7.2	7	6.9	7.1
"	DO (mg/L)	7.4	5.5	7.6	6.1	7.7
"	Cl_2 (mg/L)	0.01	0.01	0.02	0.02	0.01
"	BOD_5 (mg/L)	1	1	2	1	1
"	FC (cfu/100mL)	TNTC	35.5	1,080	340	97

Shaded cells indicate sampling sites in Selah Ditch.

A statistical analysis of the BOD_5 concentrations for each sampling station, irrespective of month, determined a significant difference between stations. Figure 4 details those results.

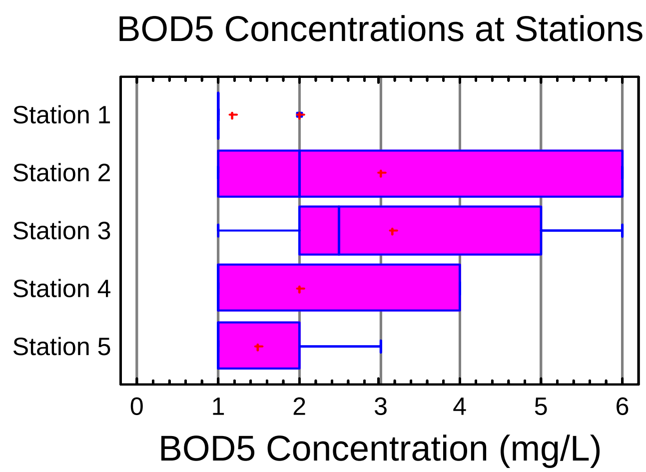


Figure 4: BOD_5 Concentrations at Stations

Analysis of Figure 4 indicates that Station 1 (18″ stormwater sewer outfall) had the lowest BOD_5 concentrations and that Station 3 (24″ stormwater sewer outfall) had the highest BOD_5 concentrations (maximum of 6 mg/L). This suggests that a minor amount of cross-connection between Tree Top, Inc. industrial waste water and storm water may still exist in the 24″ stormwater sewer, such as previously found in 1988.

B. **Chlorine:** A statistical analysis of residual chlorine concentrations for each sampling month, irrespective of sampling station, determined a significant difference between months. April had the greatest residual chlorine concentrations. Figure 5 details those results.

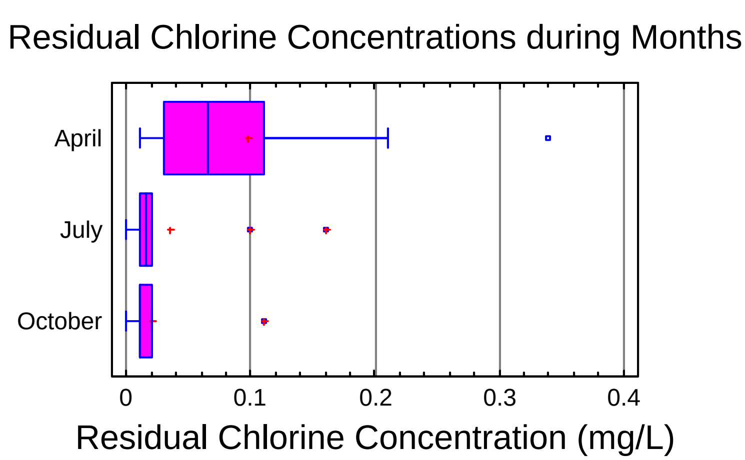


Figure 5: Residual Chlorine Concentrations during Months

A statistical analysis of the residual chlorine concentrations for each sampling station, irrespective of month, determined a significant difference between stations. Figure 6 details those results.

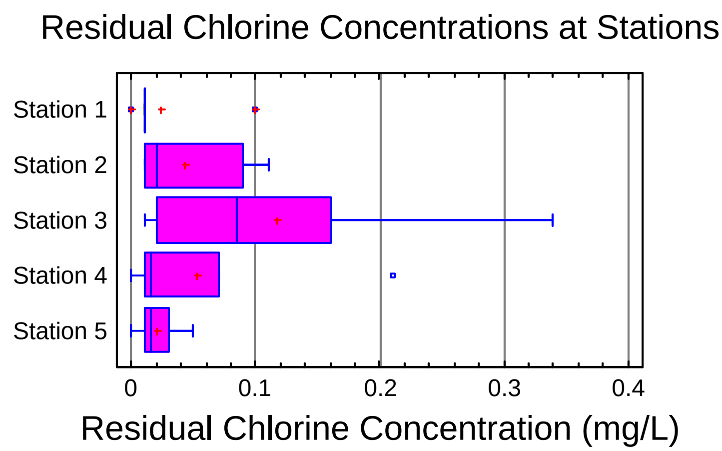


Figure 6: Residual Chlorine Concentrations at Stations

Stations 1 and 5 (lower reach of Selah Ditch) had the lowest residual chlorine concentrations; meanwhile, the highest concentrations (maximum of 0.34 mg/L) were found at Station 3. The combination of BOD_5 and chlorine pollution in the 24" stormwater sewer effluent supports the suggestion of a continued industrial wastewater cross-connection.

C. Dissolved Oxygen: A statistical analysis of the DO concentrations for each sampling month, irrespective of sampling station, determined no significant difference between months. Figure 7 details those results.

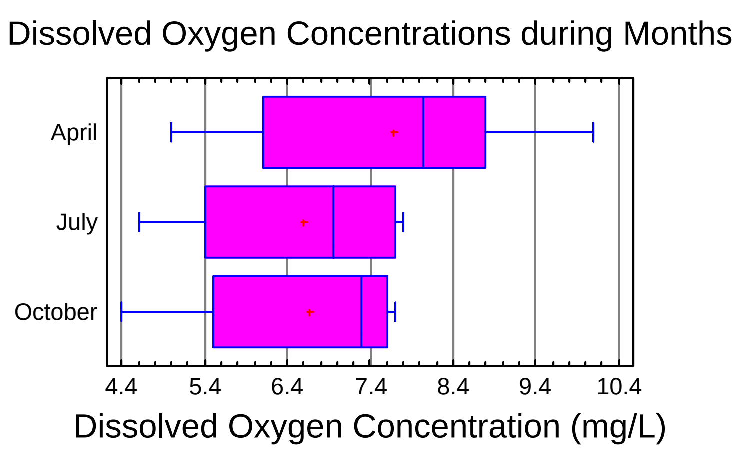


Figure 7: Dissolved Oxygen Concentrations during Months

A statistical analysis of the DO concentrations for each sampling station, irrespective of month, determined a significant difference between stations. Figure 8 details those results.

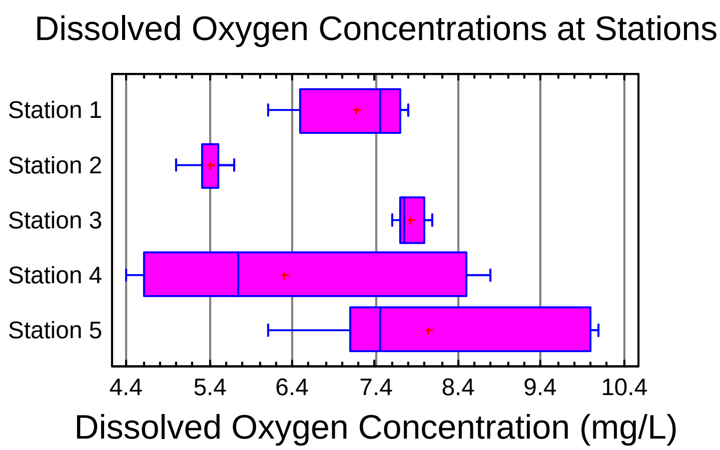


Figure 8: Dissolved Oxygen Concentrations at Stations

The lowest DO concentrations occurred at Station 2 (POTW outfall); while the greatest DO concentrations occurred at Stations 3 and 5.

D. **Fecal Coliform Bacteria:** A statistical analysis of the FC densities for each sampling month, irrespective of sampling station, determined no significant difference between months. Figure 9 details those results.

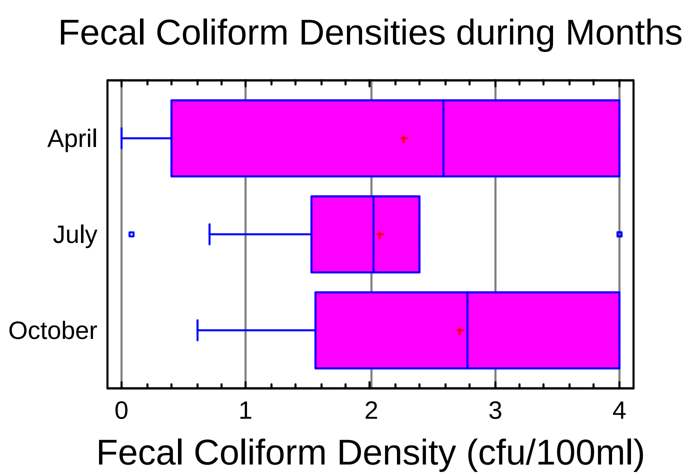


Figure 9: FC Densities during Months

A statistical analysis of the FC densities for each sampling station, irrespective of month, determined a significant difference between stations. Figure 10 details those results.

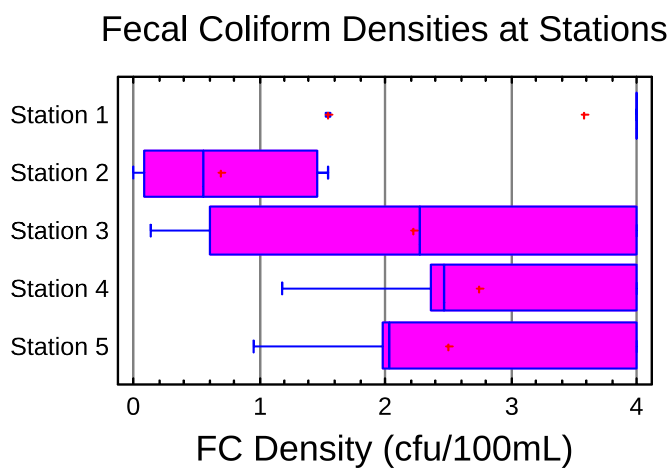


Figure 10: FC Densities at Stations

The lowest FC densities were found at Station 2, which is not unexpected since that facility actively disinfects its effluent. The highest FC densities were found at Station 1, which may indicate that the upstream municipal stormwater sewer has some unidentified source of bacteria, such as urban runoff, pet waste and/or illegal sanitary connections. The city of Selah has found some illegal connections in previous years.

E. **Flow:** A statistical analysis of flow for each sampling month, irrespective of sampling station, determined no significant difference between months. Figure 11 details those results.

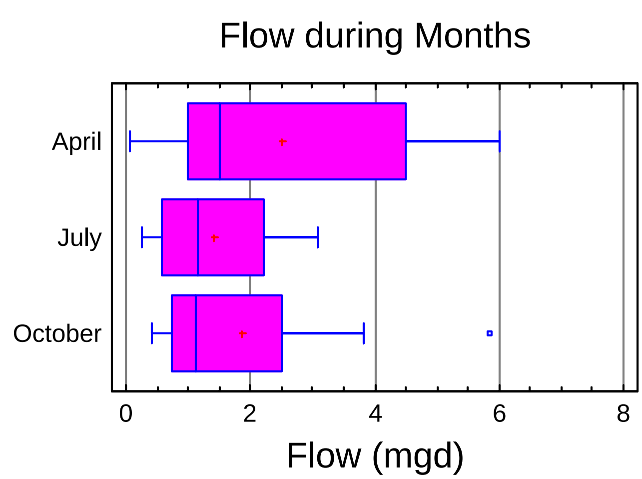


Figure 11: Flow during Months

A statistical analysis of flow at each sampling station, irrespective of month, determined a significant difference between stations. Figure 12 details those results.

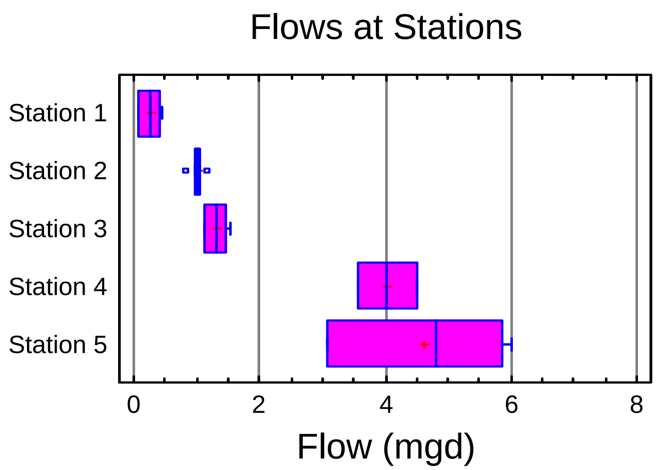


Figure 12: Flows at Stations

The lowest flows were found at Station 1; while, the greatest flows were found at Stations 4 (downstream of west-side channel) and 5. This is not unexpected, since the downstream reaches of Selah Ditch represent the cumulative effect of combining all of the upstream tributaries and discharges, and therefore should contain significantly more flow than the upstream sampling sites.

F. **Temperature:** A statistical analysis of the temperatures for each sampling month, irrespective of station, determined a significant difference between months. Figure 13 details those results.

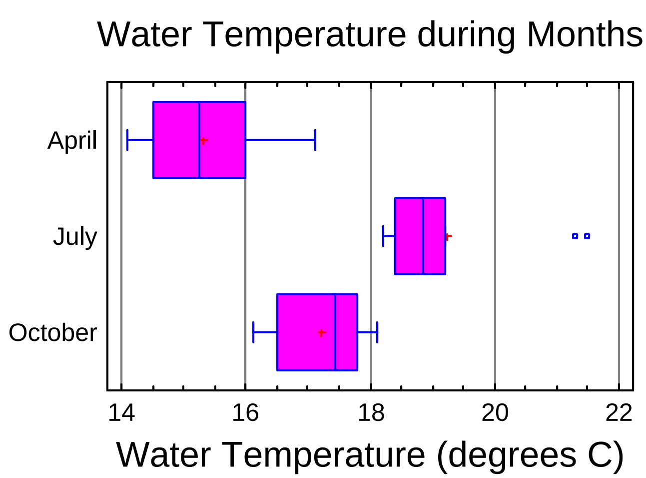


Figure 13: Water Temperature during Months

The temperatures in July were the highest; while the temperatures in April were the lowest. The temperatures in October were in between those of April and July. Only during July did the water temperatures consistently exceed the Class A water quality criterion of 18.0°C. Temperature variation between months is not unexpected due to normal seasonal changes.

A statistical analysis of the temperatures for each sampling station, irrespective of month, determined no significant difference between stations. Figure 14 details those results.

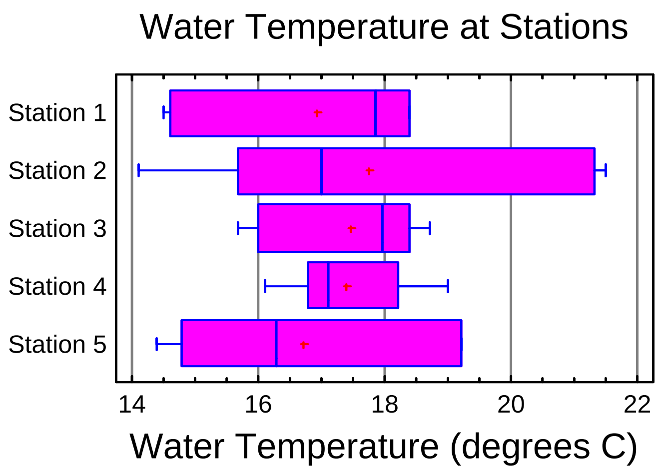


Figure 14: Water Temperature at Stations

Water Quality Technical Assessment

Selah Ditch was included in both the 1996 and 1998 303(d) listings as impaired because of three water quality parameters: ammonia, chlorine and DO. According to the historical data, two additional parameters (FC and temperature) should also have been listed as impaired, but were not. By utilizing all of the historical sampling data given in the previous sections, Ecology will make an assessment of each of the above parameters to determine if they presently impair Selah Ditch and thereby require load and wasteload allocations.

Ammonia

The original 303(d) listing of Selah Ditch as being impaired for ammonia was a result of the 303(d) listing policy in effect at that time. An effluent limitation for ammonia was included in the NPDES permit issued to the city of Selah POTW on July 19, 2001 of 2.9 mg/L. The actual instream concentrations (0.08 mg/L) have never exceeded either the state's acute or chronic water quality criteria of 5.667 mg/L and 0.915 mg/L, respectively, as calculated using receiving water data collected above in the 1988 *Selah Wastewater Treatment Plant Receiving Water Survey*.

Chlorine

The residual chlorine concentrations within Selah Ditch have at times exceeded both the state's water quality acute and chronic criteria of 0.019 mg/L and 0.011 mg/L, respectively. During the October 1988 sampling, the maximum in-stream chlorine concentration was 0.1 mg/L; while during 2003, it was 0.21 mg/L. However, the POTW was upgraded from chlorine to ultraviolet disinfection in the summer of 2003, as a result of a previous water quality-based effluent limitation of 0.02 mg/L in the NPDES permit issued to the POTW on July 19, 2001. Most recently, July and October 2003 samplings indicated a maximum chlorine residual of 0.02 mg/L. In order to measure compliance with the water quality criteria, the city of Selah may need to invest in improved chlorine measuring equipment.

Dissolved Oxygen

Selah Ditch has historically been plagued by low dissolved oxygen concentrations. The previous problem was the result of a combination of both low DO concentrations and high BOD_5 concentrations discharged via the 24" municipal stormwater sewer outfall. Both pollutants were later found to be attributed to an industrial cross-connection of wastewater discharged by Tree Top, Inc. to the stormwater sewer system. The cross-connection was repaired in September 1991; thereafter such wastewater was discharged to the POTW for treatment.

The latest (2003) Selah Ditch water quality monitoring found a minimum DO concentration of 4.4 mg/L, which is significantly higher than that of 1988 (2.7 mg/L) but still substantially lower than the Class A criterion of 8.0 mg/L. Statistically, the source of lowest DO concentrations is presently identified as the POTW effluent; while the greatest DO concentrations occur in the stormwater sewer effluents and in the lower reach of Selah Ditch. The POTW is already required by its NPDES permit to increase aeration of its effluent in an effort to substantially increase DO concentrations and to submit a plan by December 31, 2004.

The October 1988 *Selah Wastewater Treatment Plant Receiving Water Study* analyzed the potential for DO sag in Selah Ditch according to equations known as the Streeter-Phelps equations. The analysis calculated that at the downstream end of Selah Ditch there would be a total DO deficit of 1.58 mg/L when the POTW BOD_5, DO and ammonia effluent concentrations were 30 mg/L, 6.0 mg/L and 10.0 mg/L, respectively. A total DO deficit of 0.51 mg/L occurred with a POTW BOD_5, DO and ammonia effluent concentrations of 3.0 mg/L, 6.0 mg/L and 0.05 mg/L, respectively. The report concluded that a BOD_5 effluent limitation would need to be 10.0 mg/L in order to protect the state's water quality standards.

Fecal Coliform Bacteria

Historically, Selah Ditch has had numerous exceedances of the Class A two-tiered FC criteria: geometric mean of 100 cfu/100mL and a 90 percent value of 200 cfu/100mL. The maximum in-stream FC densities were determined as 6,600 cfu/100ml (1988), TNTC[4] (2000), and TNTC (2003). In 1988, the maximum FC densities in the 18″ and 24″ stormwater sewers were 15,000 cfu/100mL and 8,000 cfu/100mL, respectively. Twelve years later (2000), the same sampling sites produced FC densities of TNTC and 350 cfu/100mL, respectively. This suggests that the September 1991 mitigation of a cross-connection of high COD/BOD_5 industrial wastewater at the Tree Top facility resulted in a substantial reduction of FC densities in the 24″ stormwater sewer.

The latest (2003) water quality monitoring determined that there was still a significant difference in FC densities between sampling stations. The lowest FC densities were collected in the POTW effluent; while, the next lowest FC densities were collected in the 24″ stormwater sewer effluent. The greatest FC densities were found in the 18″ stormwater sewer effluent. The remaining stations (4 and 5) had statistically the same bacterial densities. The greatest FC densities being located in the 18″ stormwater sewer effluent, rather than in the 24″ stormwater sewer, suggests that such bacterial densities are probably not related to continued industrial wastewater cross-connections associated, but rather are more probably due to situations such as urban runoff, pet waste, and/or illegal direct sanitary connections to the stormwater sewer system. It should be noted that the city of Selah has found illegal sanitary connections to the stormwater sewer system in the past. No critical condition for FC was determined.

Temperature

The historical water temperatures in Selah Ditch have seasonally exceeded both the Class A water quality criterion of 18.0°C, as well as the proposed *Salmon and Trout Spawning, Noncore Rearing, and Migration* aquatic life temperature criterion of 17.5°C. The highest water temperatures in Selah Ditch coincide with the summer months. The highest daily maximum temperature recorded in the ditch was 23.9°C (July), which exceeds the lethal temperature of 23°C (73°F) for salmonids and the barrier to salmonid migration of 22°C (71.6°F) as indicated by Hicks (2002). The following sections will analyze the causes of excessive temperatures throughout the length of Selah Ditch. The surrogate "natural condition" temperature of Selah Ditch is assumed to be 18.0°C due to its hydrologic connectivity with the Yakima River, as well as its shallow and slow flow conditions. These conditions undoubtedly cause the water temperature of the ditch to be greater than the "natural condition" temperature in the Yakima River near Selah, which is 17.8°C as was measured in 1891 (Gilbert and Evermann, 1895).

[4] TNTC means "Too Numerous to Count".

1. Upper Reach of Selah Ditch

An intensive set of temperature data was collected for the *Selah Ditch Temperature Study* by Huibregtse Louman Associates, Inc. That data set contained continuous 15-minute temperature readings from August 2001 through November 2002 at various sites along Selah Ditch and Taylor Ditch. From that data, the quantity of 15-minute measurements that exceeded the Class A temperature criterion of 18.0°C and the maximum monthly temperatures were calculated by Ecology and detailed in Tables 7 and 8, respectively. Analysis of that data indicates that a critical condition period for temperature would be April 1 through October 31.

The next three sections of this technical assessment will discuss the three warmest point source discharges, in order of decreasing temperature, into the upper reach of Selah Ditch: Hi-Country Foods Corp. (indirectly through stormwater sewer system), POTW effluent (directly into Selah Ditch), and Tree Top, Inc. (indirectly through stormwater sewer system).

A. Hi-Country Foods Corp.

Hi-Country Foods Corp. (out of business, but recently reopened as Yakama Juice) had an NPDES permit (WA-005226-4), which became effective on July 1, 2001 and expires on June 30, 2006. The permit authorized the discharge of contact cooling water to Selah Ditch via the city of Selah's municipal stormwater sewer system, according to the effluent limitations given in Table 10.

Table 10: Hi-Country Foods Corp. - NPDES Effluent Limitations

Parameter	Limitation
pH	6.0 to 9.0
Temperature (°C)	34.4
Flow (mgd)	0.140

Hi-Country Foods Corp. had an NPDES temperature limitation of 34.4°C (94°F) according to Table 10. The derivation of such temperature limitation was based on a preliminary engineering report that determined that discharges below 35°C would eventually enter Selah Ditch at no greater than 20.5°C (69°F). [The 20.5°C temperature indicated above was incorrectly applied to Selah Ditch. The maximum allowable discharge temperature should have been stipulated as 25.6°C (78°F) in order to maintain compliance with the 18.3°C (65°F) stormwater sewer temperature limitation (WLA) as indicated later in this assessment.]

Ecology examined the monthly discharge monitoring reports (DMRs) submitted by Hi-Country Foods Corp., as well as the monthly maximum temperatures obtained from the *Selah Ditch Temperature Study* in order to determine past compliance with the temperature effluent limitation. Table 11 details the temperature data obtained from both of the sources.

Table 11: Hi-Country Foods Corp. - Monthly Maximum Water Temperatures (°C) of Contact Cooling Water According to DMRs and Selah Ditch Temperature Study

Month of Sampling	Monthly Maximum Temperature from DMR	Monthly Maximum Temperature from *Study*
Aug. 2001	29.44	38.25
Sep. 2001	25.56	38.25
Oct. 2001	28.89	38.25
Nov. 2001	27.78	38.25
Dec. 2001	27.78	38.25
Jan. 2002	31.11	38.25
Feb. 2002	28.89	38.25
Mar. 2002	26.67	38.25
Apr. 2002	25.56	-
May 2002	-	33.87
Jun. 2002	24.44	34.68
Jul. 2002	26.67	38.25
Aug. 2002	25.56	38.25
Sep. 2002	24.44	38.25
Oct. 2002	30.00	38.25
Nov. 2002	28.20	38.25

Shaded cells indicate temperatures exceeding facility's NPDES permit limitation of 34.4°C (94°F).

According to Table 11, the maximum temperature discharged by Hi-Country Foods Corp. was *at least* 38.25°C (100.83°F), since that was the instrumentation recording limit. Therefore, the facility's discharge temperatures actually exceeded that temperature on a regular basis. While in public notice period for Hi-County Foods Corp.'s present NPDES permit, the Washington Department of Fish and Wildlife (via Richard Visser in a March 22, 2001 letter) indicated that "…heated water needs to be recycled or cooled to ambient water temperatures prior to discharge to state waters." On May 10, 2001, a meeting was held with representatives of the Yakama Nation, WDFW and Ecology. It was agreed that a temperature study should be completed and that such data would determine appropriate temperature effluent limitations for the dischargers to Selah Ditch. The temperature study was conducted in 2001/2002 and published in March 2003 by Huibregtse, Louman Associates, Inc. as the *Selah Ditch Temperature Study* (HLA Job #01057). The results of that study have been previously described in this technical assessment.

B. City of Selah POTW

The city of Selah POTW has an NPDES permit (WA-002103-2) that became effective on September 1, 2001 and will expire on August 31, 2006. Although the permit does not specifically include an effluent limitation for temperature, the effluent must still comply with all of the state's water quality standards at end-of-pipe due to an express prohibition of a mixing zone. In other words, the NPDES permit indirectly establishes a maximum effluent temperature limitation of 18.0°C (equal to the Class A temperature criterion).

Table 12 details the monthly maximum water temperatures of the city of Selah POTW effluent as given in its submitted DMRs, and as determined by the 15-minute temperature data collected for the *Selah Ditch Temperature Study*.

Table 12: City of Selah POTW - Monthly Maximum Effluent Temperatures (°C) According to DMRs and Selah Ditch Temperature Study

Month of Sampling	Monthly Maximum Temperature from DMR	Monthly Maximum Temperature from *Study*
Aug. 2001	21.1	23.4
Sep. 2001	20.3	21.0
Oct. 2001	17.5	18.4
Nov. 2001	15.3	17.1
Dec. 2001	11.1	12.7
Jan. 2002	11.5	12.8
Feb. 2002	13.0	13.6
Mar. 2002	13.6	14.9
Apr. 2002	15.7	14.7
May 2002	18.5	19.3
Jun. 2002	21.5	22.1
Jul. 2002	22.2	23.8
Aug. 2002	21.5	22.1
Sep. 2002	21.0	21.4
Oct. 2002	17.8	18.4
Nov. 2002	14.5	14.9

Shaded cells indicate exceedances of the POTW's NPDES temperature limitation of 18°C.

Analysis of the data in Table 12 indicates that the POTW effluent exceeded the Class A temperature criterion during the critical condition period, according to the data collected for both the *Selah Ditch Temperature Study* and its own submitted DMRs.

C. Tree Top, Inc.

Tree Top, Inc. has an NPDES permit (WA-000243-7) that became effective on March 1, 2002 and will expire on February 28, 2007. The permit includes daily maximum effluent limitations of 29.4°C (85°F) and 0.5 mgd for discharges to Selah Ditch via the city of Selah municipal stormwater sewer system. Tree Top, Inc. discharges both hot contact cooling water and cooler non-contact cooling water. Both wastewaters are discharged primarily through the 24" stormwater sewer outfall (Joy, 1990). Specifically: "Downstream samples of both lines suggest there is little mixing of Tree Top, Inc. discharges with the municipal stormwater discharges [discharged through the 18" stormwater sewer outfall]."

The monthly maximum contact cooling water temperatures as reported on Tree Top, Inc.'s DMRs, as well as the temperatures determined from the *Selah Ditch Temperature Study* data, are listed in Table 13.

Table 13: Tree Top, Inc. - Monthly Maximum Water Temperatures (°C) of Contact Cooling Water According to DMRs and Selah Ditch Temperature Study

Month of Sampling	Monthly Maximum Temperature from DMRs	Monthly Maximum Temperature from *Study*
Aug. 2001	No Discharge	27.88
Sep. 2001	No Discharge	19.98
Oct. 2001	No Discharge	37.96
Nov. 2001	47.78	37.96
Dec. 2001	53.33	37.96
Jan. 2002	58.33	37.96
Feb. 2002	60.00	37.96
Mar. 2002	40.56	37.96
Apr. 2002	No Discharge	No Data
May 2002	No Discharge	23.46
Jun. 2002	No Discharge	19.18
Jul. 2002	No Discharge	18.69
Aug. 2002	No Discharge	19.50
Sep. 2002	No Discharge	19.66
Oct. 2002	No Discharge	31.74
Nov. 2002	No Discharge	37.96

Shaded cells indicate temperatures exceeding facility's NPDES permit limitation of 29.4°C.

Analysis of the data in Table 13, above, indicates that the monthly maximum temperature of the contact cooling water discharged by Tree Top, Inc. has regularly been in excess of its NPDES permit temperature effluent limitation during the non-critical condition months. The water temperatures reported by the *Selah Ditch Temperature Study* indicate that recorded temperatures were limited to 37.96°C due to the limitations of the temperature measurement devices.

Table 14 details the monthly maximum water temperatures of non-contact cooling water discharged by Tree Top, Inc. according to submitted DMRs and the *Selah Ditch Temperature Study*. Analysis of the data indicates that the non-contact cooling water discharged by Tree Top, Inc. has consistently complied with the facility's NPDES permit temperature effluent limitation of 29.4°C.

D. Interactions of the NPDES Dischargers

In order to determine the comparative influence of the above three NPDES dischargers to the water temperatures in the upper reach of Selah Ditch, a series of multiple regression correlation analyses were performed. For the correlations, Ecology utilized the 15-minute interval temperature data obtained from Huibregtse, Louman Associates, Inc. for the *Selah Ditch Temperature Study*. Since the monthly maximum water temperatures for both Hi-Country Foods Corp. and Tree Top, Inc. were limited by instrumentation issues, all of the data corresponding to those maximum temperatures were eliminated from the final data pool prior to analysis.

Table 14: Tree Top, Inc. - Monthly Maximum Water Temperatures (°C) of Non-contact Cooling Water According to DMRs and Selah Ditch Temperature Study

Month of Sampling	Monthly Maximum Temperature from DMRs	Monthly Maximum Temperature from *Study*
Aug. 2001	22.78	22.1
Sep. 2001	20.00	19.9
Oct. 2001	21.11	24.4
Nov. 2001	18.33	23.1
Dec. 2001	22.22	21.6
Jan. 2002	18.33	16.9
Feb. 2002	18.33	16.1
Mar. 2002	17.61	15.9
Apr. 2002	17.11	No data
May 2002	16.89	21.6
Jun. 2002	17.22	20.4
Jul. 2002	18.00	19.3
Aug. 2002	19.50	17.3
Sep. 2002	19.39	19.9
Oct. 2002	20.72	21.9
Nov. 2002	19.61	19.3

The final data pool consisted of 19,714 15-minute data records obtained from the critical condition period months of May through October, minus non-suitable data: outliers, incomplete, and instrument recording-limited data. Each record consisted of a single 15-minute temperature reading at each of 12 individual sampling sites. The initial multiple regression analysis was made to determine if the water temperature within the upper reach of Selah Ditch (sampling station 8) was significantly correlated to any of the point source outfalls that discharge there. Such analysis determined that there was a significant ($r = 0.9769$) correlation between the water temperature in the upper reach of Selah Ditch and the water temperature of the combined 18”/24” stormwater sewer flow (composed of industrial discharges from Hi-Country Foods Corp., Larson Fruit Co., Matson Fruit Co, and Tree Top, Inc., as well as, background storm water and ground water) and with the temperature of the POTW effluent.

According to the regression analysis, the water temperatures sampling stations 6 and 7 were associated with 95.4 percent of the variability in water temperature within the upper reach of Selah Ditch. Such a strong correlation is understandable since those two discharges represent the majority of the flow that enters the upper reach of Selah Ditch.

Equation 1, below, resulted from that analysis:

$$\text{Station 8 temp. (°F)} = 1.469 + (0.515 \times \text{Station 6 temp.}) + (0.458 \times \text{Station 7 temp.})$$

Table 15 presents the regression statistics for Equation 1.

Table 15: Results of Multiple Regression Analysis of Upper Reach Selah Ditch Water Temperatures Compared to Water Temperatures at Sampling Stations 6 and 7

Parameter	Slope	Standard Error	T-statistic	P-value
Constant	1.46863	0.103896	14.1355	<0.00001
Sampling station 6 temp.	0.515435	0.00162722	316.757	<0.00001
Sampling station 7 temp.	0.457734	0.00110296	415.006	<0.00001

Table 15 illustrates that the greatest influence (largest slope) on upper reach water temperatures during the critical condition is exerted by the temperature of the effluent flowing out the 24″ stormwater sewer outfall (sampling station 6). The POTW effluent (sampling station 7) exerts a slightly lower influence. A second regression correlation analysis was then performed so as to determine the most important influence on the water temperatures in the 24″ stormwater sewer. The analysis determined that 92.2 percent of the water temperature variability in the 24″ stormwater sewer was associated with the water temperature at the upstream sampling stations 3, 4 and 5. The analysis was based on 21,752 15-minute records of temperature data. Equation 2, below, resulted from that analysis:

Station 6 temp. (°F) = -0.009 + (0.230 x Station 3 temp.) + (0.660 x Station 4 temp.) + (0.107 x Station 5 temp.).

Table 16 presents the regression statistics for Equation 2.

Table 16: Results of Multiple Regression Analysis of 24″ Stormwater Sewer Temperatures Compared to Water Temperatures at Sampling Stations 3, 4 and 5

Parameter	Slope	Standard Error	T-statistic	P-value
Constant	0.00889988	0.0050566	1.76005	0.0784
Sampling station 3 temp.	0.229642	0.00391637	58.6364	<0.00001
Sampling station 4 temp.	0.660222	0.00266873	247.392	<0.00001
Sampling station 5 temp.	0.10683	0.00207793	51.4117	<0.00001

According to Table 16, the majority of the influence on the temperatures at sampling station 6 (24″ stormwater sewer effluent) appears to be exerted by the temperature of the upstream combined 18″/24″ stormwater flow (sampling station 4). Such flow is a mixture of industrial discharges from Hi-Country Foods Corp., Larson Fruit, and Matson Fruit, along with infiltrated ground water. A much lesser influence is exerted by the Tree Top, Inc. discharges of non-contact cooling water (sampling station 3), while the least influence is caused by that facility's minor discharge amounts of the hot contact cooling water (sampling station 5). [Note: During the critical condition period, Tree Top, Inc. diverts the majority of its hot contact cooling water to an industrial sprayfield located on the northeast side of the city, adjacent to the Yakima River. Only a very small amount of residual contact cooling water actually enters Selah Ditch.]

Finally, a third regression analysis was conducted to determine if the hotter contact cooling water discharged by Hi-Country Foods Corp. (sampling station #1) to the far upstream 24″ stormwater sewer was influencing the water temperature in the downstream 18″/24″ stormwater sewer (sampling station 4). An analysis of 21,835 sets of data determined that 69.8 percent of the water temperature variability at sampling station 4 was associated with the water temperatures at upstream sampling stations 1 and 2. Equation 3, below, resulted from that analysis:

Station 4 temp. (°F) = -5.254 + (0.086 x Station 1 temp.) + (1.004 x Station 2 temp.).

Table 17 presents the regression statistics for Equation 3.

Table 17: Results of Multiple Regression Analysis of 24″ Stormwater Sewer Temperatures Compared to Water Temperatures at Sampling Stations 1 and 2

Parameter	Slope	Standard Error	T-statistic	P-value
Constant	-5.2542	0.341917	-15.3669	<0.00001
Sampling station 1	0.0856163	0.00136142	62.8875	<0.00001
Sampling station 2	1.00421	0.0009344	164.802	<0.00001

According to Table 17, the majority of temperature influence in the downstream 24″ stormwater sewer (sampling station 4) is exerted by the stormwater sewer flow that passes through sampling station 2. The flow is composed of minor amount of contact cooling water from Larson Fruit Co. and Matson Fruit Co., as well as a substantial amount of infiltrated shallow ground water (est. at 150,000 GPD). Comparatively little temperature influence was exerted by the hot contact cooling water discharges from Hi-Country Foods Corp. (sampling station 1). The fact that only 69.8 percent of the water temperature variability at sampling station 4 is associated with the above discharges, suggests the existence of a substantial cooling mechanism in the stormwater sewer between sampling stations 2 and 4, assumed to be additional infiltrating ground water.

In summary, the water temperature in the upper reach of Selah Ditch is caused by the temperatures within the stormwater and the POTW effluents. The prior's temperature is influenced primarily by the area's warm shallow ground water that infiltrates into the stormwater sewer system. Such ground water has a maximum temperature of 18.2°C, which was the maximum of over 100 measurements collected from September 1991 through August 2004 at the nearby Tree Top, Inc. sprayfield upgradient of industrial wastewater application site. The warm shallow ground water is assumed to be composed primarily of infiltrating irrigation return flow and surface water in hydraulic continuity with the nearby Yakima River. These assumptions are supported by studies conducted by Ashbury (2003) and Blakeney (2003), which respectively suggest that the geomorphic characteristics of the area promote connectivity between the river and ground water, and that also a significant portion of ground water is recharged by local runoff and precipitation.

The extremely hot industrial discharges from Hi-Country Foods Corp. have had a limited effect on the overall instream temperatures in the upper reach of Selah Ditch, within the range of high receiving water temperatures that have been historically observed. However, the upper reach receiving water temperature must be limited to a maximum of 18.3°C according to Chapter 173-201A WAC. In such case, the facility's effluent temperatures will assume a much more predominant role in causing receiving excessive receiving water temperatures and, therefore, will need to be substantially reduced. Yakama Juice (present owner of the Hi-Country Food Corp. facility) will need to be given a future NPDES temperature limitation of 25.6°C (78°F) during the critical condition period in order to allow Selah Ditch to comply with Class A temperature criterion.

Tree Top, Inc.'s present NPDES temperature limitation of 29.4°C (85°F) can be maintained during the critical condition period, as long as the facility continues to divert the majority of its hot contact cooling water out of Selah Ditch. If the facility desires to revert to discharging its contact cooling waters back into Selah Ditch during the critical condition period, then an engineering study must be performed to determine an appropriate temperature limitation for Tree Top, Inc.'s discharges.

2. Upper Reach vs. Lower Reach of Selah Ditch

Table 18 details the monthly maximum and monthly average water temperatures within the upper and lower reaches of Selah Ditch during the critical condition period.

Table 18: Selah Ditch - Monthly Maximum and Monthly Average Critical Condition Water Temperatures (°C)

Sampling Month	Stream Reach	Monthly Maximum Temperature	Monthly Average Temperature
Aug. 2001	Upper	21.9	19.1
"	Lower	23.6	19.3
Sep. 2001	Upper	20.4	18.2
"	Lower	20.9	16.5
Oct. 2001	Upper	18.3	17.1
"	Lower	19.0	14.9
May 2002	Upper	17.8	15.4
"	Lower	19.3	14.3
Jun. 2002	Upper	19.3	17.8
"	Lower	19.6	17.2
Jul. 2002	Upper	21.3	18.7
"	Lower	23.9	19.0
Aug. 2002	Upper	21.1	18.9
"	Lower	22.9	18.7
Sep. 2002	Upper	20.6	18.3
"	Lower	21.1	16.6
Oct. 2002	Upper	19.0	17.4
"	Lower	19.3	14.7

According to Table 18, the monthly maximum water temperatures were always observed to be greater in the lower reach than in the upper reach of Selah Ditch. The monthly average water temperatures, however, were generally greater in the upper reach than in the lower reach. Only during July and August, the hottest months of the summer, were the average water temperatures in the lower reach of Selah Ditch greater than the average water temperatures in the upper reach.

The seasonal increase in water temperatures in the lower reach of Selah Ditch is concluded to be primarily due to non-point sources, since there are no known point sources in the area. The principal heating mechanism is theorized as solar radiation. This is in contrast to the situation in the upper reach, which is dependent upon point source heat sources. Ice (2001) determined that "direct short-wave solar radiation is the primary energy input that causes elevated stream temperatures in the summer [without shading vegetation]." This conclusion is supported by the *Selah Ditch Temperature Study*, which similarly concluded that "summertime cooling of the waters in Selah Ditch can best be accomplished through the development of vegetative cover."

TMDL Analysis

Critical Condition Discussion

1. **Ammonia**

   No seasonal critical condition period for ammonia was identified. The critical condition period for ammonia is consequently considered to be year-round.

2. **Chlorine**

   No seasonal critical condition period for chlorine was identified. The critical condition period for chlorine is consequently considered to be year-round.

3. **Dissolved Oxygen**

   A seasonal critical condition period of April 1 through October 31 was determined for dissolved oxygen (correlates with that of temperature).

4. **Fecal Coliform Bacteria**

   No seasonal critical condition period for FC bacteria was identified. The critical condition period for FC bacteria is consequently considered to be year-round.

5. **Temperature**

   A seasonal critical condition period of April 1 through October 31 was determined for water temperature. Such period coincides with that for DO and illustrates the close relationship that typically occurs between DO and temperature.

Loading Capacity Analysis

Identification of the loading capacity of a water body is an important step in developing a TMDL. Loading capacity is defined as: "the greatest amount of loading that a water body can receive without violating water quality standards (40 CFR §130.2(f))." The *Selah Ditch Multiparameter TMDL* will use a variety of different measure of "daily loads" to fulfill the requirements of Section 303(d) of the federal Clean Water Act. The loading capacities and allocations for the TMDL are expressed in units of lbs/day and mg/L for ammonia, BOD_5, chlorine and DO; while FC bacteria are expressed in cfu/day. Temperature was expressed in both °C and "percent effective shade." The load allocation (LA) for temperature expressed as "percent effective shade" is allowed under EPA regulations [defined as "*other appropriate measures*" in 40 CFR §130.2(i)].

Table 19 details the loading capacities for ammonia, BOD_5, chlorine, dissolved oxygen (DO), fecal coliform (FC) and temperature. The loading capacities are based on the critical condition flow of Selah Ditch, which was determined to be 3.08 mgd (July 2003 in Table 9).

Table 19: Selah Ditch - Loading Capacities for Ammonia, BOD_5, Chlorine, Dissolved Oxygen, Fecal Coliform Bacteria and Temperature

Parameter	Loading Capacity
Ammonia	23.5 lbs/day
BOD_5	51.4 lbs/day
Chlorine	0.28 lbs/day
Dissolved Oxygen	205.5 lbs/day
Fecal Coliform Bacteria	116.6×10^{10} cfu/day
Temperature	18.3°C

1. Ammonia

The loading capacity for ammonia is based on the state's water quality chronic ammonia criterion (0.915 mg/L[5]) and was calculated as: (3.08 mgd) x (0.915 mg/L) x (8.34 lbs/gallon) = 23.5 lbs/day. The chronic criterion was selected since it is more stringent than the acute criterion and therefore more conservative for the protection of all beneficial uses.

2. BOD_5

The loading capacity for BOD_5 is based on the maximum concentration for the receiving water as documented in the 1988 *Selah Wastewater Treatment Plant Receiving Water Survey*. The loading capacity was calculated as: (3.08 mgd) x (2.0 mg/L) x (8.34 lbs/gallon) = 51.4 lbs/day.

[5] Ammonia criteria were calculated from the formulas given in Table 1 and using a temperature of 23.9°C, a pH of 7.83, an instream ammonia concentration of 0.08 mg/L, an acute TCAP of 20 and a chronic TCAP of 15. The acute and chronic ammonia criteria were subsequently calculated as 5.667 mg/L and 0.915 mg/L, respectively.

3. Chlorine

The loading capacity for chlorine is based on the state's water quality chronic chlorine criterion (0.011 mg/L) and was calculated as: (3.08 mgd) x (0.011 mg/L) x (8.34 lbs/gallon) = 0.28 lbs/day. The chronic criterion was selected since it is more stringent than the acute criterion, and therefore the more conservative.

4. Dissolved Oxygen

A simplistic loading capacity for dissolved oxygen is based on the Class A dissolved oxygen minimal criterion of 8.0 mg/L and was calculated as: (3.08 mgd) x (8.0 mg/L) x (8.34 lbs/gallon) = 205.5 lbs/day.

5. Fecal Coliform Bacteria

The loading capacity for FC is based on the Class A geometric mean criterion of 100 cfu/100mL and was calculated as: (3.08 mgd) x (100 cfu/100 mL) x (3.785×10^{9} mL/mgd) = 116.6×10^{10} cfu/day.

6. Temperature

The determination of a "natural condition" scenario for the Selah Ditch is impossible, since it is completely man-made. However, the "natural condition" of the nearby Yakima River (17.8°C from Gilbert and Evermann, 1895) can be used to assume a surrogate "natural condition" for the ditch. The surrogate "natural condition" water temperature for Selah Ditch is assumed to be equal to the Class A water quality temperature criterion of 18.0°C. Starting with 17.8°C, a substantial temperature increase should undoubtedly result from the greater heat flux that would result from the shallower and slower flow conditions of the ditch as compared to the much larger and faster moving Yakima River. Thus, the actual surrogate "natural condition" water temperature of Selah Ditch is assumed to be at least 18.0°C, but is undeterminable at this time.

Load Allocations

The non-point sources of pollution to a water body are given load allocations (LAs), which are needed to compare to point source wasteload allocations. The only non-point source of pollutants to Selah Ditch is the west-side tributary, which contains a mix of both storm water and naturally occurring water. The critical condition flow in the tributary was found to be 0.38 mgd. Table 20 details the LAs established for Selah Ditch.

1. Ammonia

The LA for ammonia in Selah Ditch is set at 0.06 lbs/day, which was derived from the maximum concentration (0.02 mg/L) collected from the west-bank tributary during the 1988 sampling: 0.06 lbs/day = [(0.38 mgd) x (0.02 mg/L) x (8.34 lbs/gallon)]. Compared to the calculated water quality chronic criterion of 0.915 mg/L, the LA represents a "de minimis" amount of ammonia obtained from non-point sources surrounding the ditch.

Table 20: Selah Ditch - LAs for Ammonia, BOD_5, Chlorine, Dissolved Oxygen, Fecal Coliform Bacteria, and Temperature

Parameter	LA
Ammonia	0.06 lbs/day
BOD_5	6.3 lbs/day
Chlorine	0
Dissolved Oxygen	25.4 lbs/day
Fecal Coliform Bacteria	3.5×10^{10} cfu/day (geometric mean of 24 cfu/100mL)
Temperature	Minimum of 90% effective shade

2. BOD_5

The LA for BOD_5 in Selah Ditch is set at 6.3 lbs/day, which was derived from the receiving water concentration (2.0 mg/L) utilized in the Streeter-Phelps analysis outlined in the 1988 *Selah Wastewater Treatment Plant Receiving Water Survey*: 6.3 lbs/day [(0.38 mgd) x (2.0 mg/L) x (8.34 lbs/gallon)]. Such value is also the maximum BOD_5 concentration obtained from the west-side tributary.

3. Chlorine

The LA for chlorine in Selah Ditch is set at zero, as there are estimated to be no non-point sources of chlorine in the area surrounding Selah Ditch.

4. Dissolved Oxygen

The LA for dissolved oxygen in Selah Ditch is set at 25.4 lbs/day, which was derived from the Class A water quality criterion of 8.0 mg/L: 25.4 lbs/day = [(0.38 mgd) x (8.0 mg/L) x (8.34 lbs/gallon)]. The LA is a daily minimum concentration, not a daily maximum concentration, since it is based on a minimum water quality criterion rather than a maximum criterion.

5. Fecal Coliform Bacteria

The LA for FC bacteria in Selah Ditch is set to 3.5×10^{10}, which was derived from the geometric mean bacterial density (24cfu/100mL) as obtained from the 1988 data collected in the west-bank tributary to Selah Ditch: 3.5×10^{10} cfu/day = [(0.38 mgd) x (24cfu/100mL) x (3.785x109 mL/mgd)]. Such LA indicates that non-point FC bacteria densities are already in compliance with the State's Class A FC criteria.

6. Temperature

The "natural condition" temperature of Selah Ditch is impossible to verify since it is a man-made water body, but a surrogate "natural condition" is assumed to be 18.0°C. Additionally, the riparian vegetation surrounding Selah Ditch represents a lower (sparse) "natural condition" than what would be typically expected to be present due to degradation by considerable anthropogenic activities.

The role of riparian vegetation in maintaining a healthy stream condition and water quality is well documented in the scientific literature, and that shade provided by riparian vegetation is one of the most important regulators of temperature in small streams where solar radiation is the predominant energy source. Summer stream temperature increases due to the removal of riparian vegetation are well documented (e.g. Holtby 1988, Lynch et al. 1984, Rishel et al. 1982, Patric 1980, Swift and Messer 1971, Brown et al. 1971, and Levno and Rothacher 1967). These studies generally support the findings of Brown and Krygier (1970) that loss of riparian vegetation results in larger daily temperature variations and elevated monthly and annual temperatures. Finally, Sullivan and Adams (1991) also concluded that daily maximum temperatures are strongly influenced by the removal or degradation of riparian vegetation.

Summaries of the scientific literature on the thermal role of riparian vegetation in forested and agricultural areas are provided by Belt et al. 1992, Beschta et al. 1987, Castelle and Johnson 2000, Ice 2001, and Wenger 1999. All of these summaries recognize that the scientific literature indicates that riparian vegetation plays an important role in controlling stream temperature. The list of important benefits that riparian vegetation has upon the stream temperature includes:

A. Near stream vegetation height, width and density combine to produce shadows that can reduce solar heat flux to the surface of the water;

B. Riparian vegetation creates a thermal microclimate that generally maintains cooler air temperatures, higher relative humidity, lower wind speeds, and cooler ground temperatures along stream corridors; and

C. Near stream vegetation increases bank stability and can affect channel morphology. Near stream vegetation also affects flood plain and instream roughness, contributing coarse woody debris and influencing sedimentation, stream substrate compositions and stream bank stability.

The rates of heating can be dramatically reduced when high levels of shade exist and heat flux from solar radiation is minimized. The overriding justification for increases in shade from riparian vegetation is to minimize the contribution of solar heat flux in stream heating. There is a natural maximum level of shade that a given stream is capable of attaining. The importance of shade decreases as the width of a stream increases.

The predominant source of non-point heat flux in Selah Ditch is solar radiation. Riparian shade is the most important method for mitigating the solar radiation reaching the water's surface. Sullivan et al. (1991) studied stream heating in a variety of streams throughout Oregon and Washington and stated that "stream shading has a stronger influence on stream temperature in small streams, while temperatures in large streams are primarily influenced by air temperature." Since the Selah Ditch is very narrow (<2 meters), obtaining complete (100 percent) shading of the water's surface is quite feasible. Maloney et al. (1999) found in an intensive study of 12 narrow streams in eastern Oregon that watersheds with less than 75 percent effective shade typically exceed temperature standards.

The determination of a "natural condition" temperature for Selah Ditch is an elusive goal because there is no true "natural condition", since it is man-made. This technical assessment relies on a surrogate "natural condition" for Selah Ditch that is assumed to equal to the Class A criterion of 18.0°C. The *Selah Ditch Multiparameter TMDL* will use "effective shade" as a surrogate measure of heat flux to fulfill the requirements of Section 303(d) of the Clean Water Act. The *Report of the Federal Advisory Committee on the Total Maximum Daily Load Program* (FACA Report, July 1998) offered a discussion that indicates the appropriateness of the use of surrogate measures in development of a TMDL. "Effective shade" is defined as the fraction of incoming solar shortwave radiation above the vegetation and topography that reaches the surface of the water body.

"Maximum mature riparian vegetation" is defined as the maximum amount of mature riparian vegetation that can be supported by the natural environment of a specific site. In the case of Selah Ditch, allowing the growth of the maximum amount of mature riparian vegetation will provide a maximum amount of effective shade. The establishment of mature riparian vegetation is also expected to have a secondary benefit of improving microclimate conditions, which should promote cool water temperatures. The TMDL adaptive management strategy may also be utilized to address other potential influences on water temperature such as sediment loading, ground water inflows and hyporheic exchange.

Although Maloney et al. (1999) indicated that a minimum of 75 percent effective shade would be required to meet water quality standards, the *Selah Ditch Multiparameter TMDL* sets the temperature LA to a minimum of 90 percent effective shade. The LA will be achieved through the application of the following best management practice (BMP): maximum mature riparian vegetation. The LA will result in the lower reach of Selah Ditch complying with the state's water quality standards. Establishment of a maximum amount of mature riparian vegetation is expected to also have a secondary benefit of reducing channel widths and improving microclimate conditions, which will additionally help achieve water quality standards.

Wasteload Allocations

Table 21 details the wasteload allocations (WLAs) that are associated with the point source discharges to Selah Ditch: POTW and the 18" and 24" stormwater sewer effluents. The outfalls for these discharges are in close proximity to each other within the upper reach of Selah Ditch, close to power sources and have easy access for construction and monitoring activities. Therefore, considerable reasonable assurance exists that point source pollution can be minimized.

The POTW's present NPDES permit contains specific effluent limitations for ammonia, BOD_5, and chlorine, which were all based on a POTW design flow of 2.0 mgd. However, the WLAs in Table 21 were calculated using an actual average flow rate of 1.0 mgd. The WLAs represent more conservative (stringent) requirements than the present NPDES permit. The municipal stormwater discharges are not presently permitted, but will be required to be permitted via a phase II stormwater permit. The stormwater WLAs are based on an actual average flow of 1.562 mgd.

Table 21: Selah Ditch - WLAs for Ammonia, BOD_5, Chlorine, Dissolved Oxygen, Fecal Coliform Bacteria and Temperature

Parameter	WLA – POTW Effluent	WLA – Stormwater Effluent
Ammonia	2.5 mg/L	0.18 mg/L
BOD_5	10.0 mg/L	2.0 mg/L
Chlorine	0.011 mg/L	0.015 mg/L
Dissolved Oxygen	8.4 mg/L	8.4 mg/L
Fecal Coliform Bacteria	10 cfu/100 mL	186 cfu/100 mL (98% reduction)
Temperature	18.0°C: April 1 – Oct. 31; 18.0°C: Nov. 1– Mar. 31	18.0C: April 1 – Oct. 31; 25.0°C: Nov. 1– Mar. 31

1. Ammonia

After subtracting the LA (0.06 lbs/day) from the entire loading capacity (23.5 lbs/day) , the remaining capacity was divided into WLAs for both the city of Selah POTW and the municipal stormwater sewer system. The actual division utilized by Ecology was: 90 percent attributable to the POTW and 10 percent attributable to the municipal stormwater sewer system. The POTW is considered to be the predominant discharger of ammonia because it treats nitrogen-rich industrial and sanitary wastewaters. Whereas, the stormwater system should only contain minimal amounts of ammonia since industrial and sanitary wastewaters should not be discharging into the system.

Accordingly, the ammonia WLA for the POTW effluent is set to a daily maximum of 2.5 mg/L (derived from 21.1 lbs/day), which is 13.8 percent more stringent than the ammonia effluent limitation (2.9 mg/L) presently contained in the facility's NPDES permit. The ammonia WLA for the stormwater sewer discharges is set to a daily maximum of 0.18 mg/L (derived from 2.3 lbs/day). The storm water has historically complied with its WLA, since the maximum ammonia concentration in the stormwater sewer system was only determined to be 0.04 mg/L. The application of both the POTW and stormwater WLAs will assure the protection of the state's water quality ammonia chronic criterion (0.915 mg/L) throughout the Selah Ditch. The use of concentration-based WLAs will allow for future growth of the POTW and the stormwater sewer system; whereas mass-based WLAs do not.

2. Chlorine

The chlorine WLA for the POTW effluent is set to a daily maximum of 0.011 mg/L (derived from 0.09 lbs/day), which is equal to the water quality chronic criterion and represents a concentration 45 percent more stringent than the chlorine effluent limitation contained in the facility's NPDES permit. The stormwater WLA concentration of 0.015 mg/L was derived from 0.19 lbs/day [0.015 mg/L = [(0.19 lbs/day)/(1.562 mgd) x (8.34 lbs/day)]], which was calculated by subtracting the POTW WLA from the loading capacity: [(0.28 – 0.09 = 0.19)]. The application of both the POTW and stormwater WLAs will assure the state's water quality chronic chlorine criterion (0.011 mg/L) is protected throughout the Selah Ditch. The use of concentration-based WLAs will allow for future growth of the POTW and the stormwater sewer system.

3. Dissolved Oxygen

The interim dissolved oxygen (DO) WLAs for the POTW and stormwater sewer effluents are based on a proportional distribution of the remaining DO loading, after first substracting the LA from the loading capacity of Selah Ditch. The interim DO WLA for the POTW is a daily minimum of 8.4 mg/L (derived from 70.3 lbs/day): [(70.3 lbs/day)/(1.0 mgd) x (8.34 lbs/day)]. The WLA for the stormwater sewer is also a daily minimum of 8.4 mg/L (derived from 109.8 lbs/day): [(109.8 lbs/day)/(1.562 mgd) x (8.34 lbs/day)].

The TMDL initially sets interim DO and BOD_5 WLAs because there was adequate monitoring data collected in 1988, but yet that data is more than ten years old and is in violation of Ecology's water quality Policy #1-11 (revised September 2002). Such policy stipulates that, whenever possible, data of less than ten years should be utilized. Ecology has calculated interim WLAs based on that older data and will also conduct additional monitoring after the POTW has implemented the addition of increased aeration equipment. The future monitoring will allow a final set of DO and BOD_5 WLAs to be calculated and to be incorporated in the TMDL through modification of the TMDL.

An interim BOD_5 WLA for the POTW is set to a daily maximum of 10.0 mg/L (derived from 83.4 lbs/day), which was the recommended limit for future TMDLs as documented in the 1988 *Selah Wastewater Treatment Plant Receiving Water Survey* through the use of Streeter-Phelps analyses. Those analyses concluded that at the downstream end of Selah Ditch there would occur a total DO deficit of 1.58 mg/L with a POTW effluent BOD_5 concentration of 30.0 mg/L and an ammonia concentration of 10.0 mg/L. Whereas, a total DO deficit of 0.51 mg/L would occur with a POTW effluent BOD_5 concentration of 3.0 mg/L and an ammonia concentration of 0.05 mg/L. A recent Streeter-Phelps analysis was conducted, which resulted in the maximum DO deficit occurring well outside of the boundaries of Selah Ditch and actually in the downstream Yakima River, into which the ditch eventually discharges. This is because the ditch is relatively short and the instream flow comparatively fast, which causes the greatest DO depletion to occur far downstream.

The interim BOD_5 WLA for the POTW represents a 67 percent more stringent value than the present NPDES POTW effluent limitation of 30 mg/L. An interim BOD_5 WLA for storm water is set to 2.0 mg/L (derived from 26.1 lbs/day). The use of interim DO and BOD_5 concentration limitations will, to the best of Ecology's present knowledge, will result in compliance with Class A water quality standards.

To ensure that Selah Ditch complies in the future with the Class A DO criterion of 8.0 mg/L, the TMDL will require that DO be monitored after the installation, operation and equilibrium of the required aeration equipment (est. to be completed in 2008) that is required in the POTW's *Plan to Increase Dissolved Oxygen in Effluent Discharge*, which must be submitted to Ecology by the city of Selah by December 31, 2004. The future monitoring will allow for the determination of final DO and BOD_5 WLAs that might be needed to ensure that Selah Ditch complies with the state's Class A DO criterion. If final WLAs are different from the interim WLAs, the *Selah Ditch Multiparameter TMDL* will be modified to incorporate the final WLAs.

4. Fecal Coliform Bacteria

The FC WLA for the POTW is set to a monthly geometric mean density of 10 cfu/100mL, which corresponds to a geometric mean loading of 3.8×10^{10} cfu/day [(1.0 mgd) x (10 cfu/100 mL) x (3.785×10^{9} mL/mgd)]. The stormwater WLA is set to a monthly geometric mean bacteria density of 186 cfu/100mL (derived from 109.3×10^{10} cfu/day), which was calculated by subtracting the LA and POTW WLA from the total loading capacity: 109.3×10^{10} cfu/day = [(116.6×10^{10} – (3.5×10^{10} + 3.8×10^{10})] and then: 186 cfu/100mL = [(109.9×10^{10} cfu/day)/(1.562 mgd) x (3.785×10^{9} mL/mgd)]. The application of both the POTW and stormwater WLAs will assure the protection of the state's Class A water quality FC geometric mean criterion (100 cfu/100mL) throughout Selah Ditch.

5. Temperature

During the critical condition period (April 1 through October 31), the temperature WLAs for the POTW and stormwater sewer discharges are set to a daily maximum of 18.0°C. During the non-critical period (November 1 through March 31), the temperature WLAs for the POTW and stormwater sewer discharges are set to a daily maximum of 18.0°C and 25.0°C, respectively. Even with the higher stormwater sewer WLA during the non-critical condition period, such discharges have never caused exceedances of the Class A water quality temperature criterion (see Table 7). This is because of the significant temperature buffering capacity of Selah Ditch during the cold winter months. The industrial dischargers to the city's stormwater sewer system will be limited by their own NPDES temperature effluent limitations that have been previously documented in this report. However, the city of Selah has the ultimate responsibility for complying with all of the WLAs given above in Table 21, and thus will be given a priority to comment on future NPDES effluent limitations for those industrial dischargers.

Reasonable Assurance

The ultimate goal of the *Selah Ditch Multiparameter TMDL* is to comply with the applicable state water quality criteria for ammonia, chlorine, DO, FC bacteria and temperature beginning in the year 2024. The 20-year goal is required specifically to allow for the growth of "maximum mature riparian vegetation", which will provide the minimum 90 percent effective shade along the entire length of Selah Ditch. The ammonia and chlorine targets have already effectively been met. The DO target is required to be met by the year 2010; while, the FC target is required to be met by the year 2014.

The *Selah Ditch Multiparameter TMDL* will utilize the concept of adaptive management to ensure that the LAs and WLAs presented in Tables 20 and 21, respectively, are on schedule to be achieved in compliance with the TMDL's targets and timelines. This means that after every five-year period, beginning with the year 2010, effectiveness monitoring will be conducted of all TMDL parameters. The implementation of all BMPs will be reviewed and evaluated through that monitoring and implementation efforts may need to be readjusted to ensure that acceptable levels of positive change are occurring for each parameter, and that the goals of the TMDL are on schedule to be met. Once met, the TMDL targets are expected to be maintained. Ecology is reasonably assured that the TMDL goals will be met on schedule due to the following:

1. Ammonia

The principal source of ammonia pollution to Selah Ditch is via the effluent discharged by the city of Selah POTW. The POTW WLA of 2.5 mg/L is substantially more stringent than the previous NPDES ammonia effluent limitation of 2.9 mg/L. Even so, the POTW effluent has never exceeded the more stringent limitation. The ammonia level in the stormwater effluent, although not previously monitored extensively, has also been typically far less that the daily maximum stormwater WLA (0.18 mg/L) previously stipulated in this TMDL. The parameter of ammonia is therefore already considered to be in compliance with state water quality standards and provides a significant amount of reasonable assurance that the TMDL targets will be met on schedule.

2. Chlorine

The principal source of chlorine pollution to Selah Ditch was historically determined to have been discharged in the city of Selah POTW effluent. The WLA of 0.011 mg/L is equal to the water quality chronic criterion. Fortunately, the POTW has already converted from chlorine to UV disinfection. The chlorine pollution in the stormwater effluent (the next greatest source of chlorine) is limited by a similar WLA but slightly less stringent concentration of 0.015 mg/L. The parameter of chlorine in Selah Ditch is presently considered in compliance with state water quality standards.

3. Dissolved Oxygen

The source of the lowest DO to Selah Ditch is the effluent discharged by the city of Selah POTW. The city is required to submit to Ecology a *Plan to Increase Dissolved Oxygen in Discharge Effluent* by December 30, 2004. Both the interim WLAs for the POTW and the stormwater discharges are equal to 8.4 mg/L, which is slightly more stringent than the Class A DO criterion. There is a requirement for additional DO monitoring to be conducted after the complete implementation of BMPs required by the above plan. Final WLAs for both DO and BOD_5 will then be re-calculated and incorporated into the TMDL as a modification. This method should give adequate reasonable assurance that the TMDL targets will be met on schedule.

4. Fecal Coliform Bacteria

The principal source of FC pollution to the upper reach of Selah Ditch is via the municipal stormwater sewer system, especially at the 18″ diameter stormwater outfall. The city of Selah has substantial experience in conducting sewer investigations to determine sources of concentrated FC pollution and has previously conducted such investigations. In addition, the city has incorporated UV disinfection at its POTW, which ensures that low FC densities at that facility will continue. This method should give adequate reasonable assurance that the TMDL targets will be met on schedule.

5. Temperature

The predominant source of heat to the upper reach of Selah Ditch is the effluent that is discharged through the 24” diameter stormwater sewer system. Since the city of Selah’s municipal stormwater discharges are now to be controlled through an NPDES permit, the inclusion of a specific temperature effluent limitation applicable to the stormwater discharges provides reasonable assurance that temperatures in the upper reach of Selah Ditch will meet the TMDL target on schedule. During the critical condition period, the stormwater WLA is set to a daily maximum of 18.0°C. However, the stormwater sewer non-critical condition WLA is set to 25.0°C since the warmer temperature is beneficial to the salmonids that occupy Selah Ditch during the winter. The city of Selah will need to work with its industrial dischargers to make sure that the stormwater sewer discharges to the ditch comply with the above limitations. The city is in the position to adopt municipal code changes that would reasonably assure compliance with the above temperature limitations.

The next predominant heat source to the upper reach is the city of Selah POTW effluent. Additional reasonable assurance is derived due to the facility, beginning with its 2011 NPDES permit, will be required to comply with a specific daily maximum WLA (temperature limitation) of 18.0°C during the critical condition period (April 1 through October 31), rather than an implied temperature limitation of 18.0EC. During the non-critical condition period, the POTW will also be given the same effluent limitation of 18.0°C, since during that period its effluent is much cooler and has never exceeded the Class A temperature criterion.

Reasonable assurance that Selah Ditch will comply with the Class A temperature criterion comes from the fact that minimization of point source water temperatures in the upper reach should also contribute substantially to the minimization of downstream water temperatures according to Boyd (1996). In fact, the *Selah Ditch Temperature Study* determined that: “While the downstream stations have tended to be cooler, the overall influence has been the warm water discharged at the top [upstream] end of the ditch.”

Downstream water temperatures are predominantly influenced by solar radiation. The *Selah Ditch Temperature Study* specifically noted that: “…solar radiation and air temperature have become the dominating influence upon the temperature of the water within the [lower reach of the] ditch.” Thus, reducing solar radiation is the principal method for lowering water temperatures in the lower reach of Selah Ditch. The addition of effective shade is the most viable method of decreasing solar radiation reaching the water body.

The narrowness of Selah Ditch (<2 meters) and a re-vegetation project of “maximum mature riparian vegetation” provide a substantial amount of reasonable assurance that the LA of a minimum of 90 percent effective shade will be completed throughout the length of the ditch. However, such project will require the greatest amount of time (20 years) compared to any other parameter for complete implementation.

6. In General

Additional reasonable potential for reaching water quality standards is through prior proactive steps taken by the Yakama Nation and the Department of Wildlife and Fisheries, which have constructed sinuosity into the lower reach of Selah Ditch, as well as increased the amount of large woody debris (LWD) available for fish habitat. The future implementation of "maximum mature riparian vegetation" will additionally encourage vegetation stability of the ditch's shoreline through the planting of grass.

The approach of the *Selah Ditch Multiparameter TMDL* will be one of adaptive management. If future compliance monitoring (every five years) indicates that any water quality parameter of interest is not on schedule to meet its respective TMDL target, then additional and/or alternative management actions will need to be implemented, as long as they are still considered reasonable and demonstrated to be effective. Adaptive management will end only when no further reasonable actions can be implemented, or when the targets of the TMDL have been met. This method of adaptive management provides additional reasonable assurance that the goals of the TMDL will be met.

Still further reasonable assurance exists due to the cooperative nature of the city of Selah, local industrial dischargers, local residents, and governmental agencies. A cooperative association between all such entities is extremely vital to ensure that the planned BMPs required by the TMDL will be carried out in a timely manner. A final reasonable assurance is that whenever applicable BMPs are not voluntarily being implemented and Ecology has reason to believe that an individual site or facility is causing pollution in violation of RCW 90.48.080, Ecology may pursue orders, directives, permits, or civil or criminal sanctions to gain compliance with the state's water quality standards (WAC 173-201A-160).

Margin of Safety

The statute requires that a margin of safety (MOS) be identified to account for uncertainty when establishing a TMDL. The MOS can be explicit in the form of an allocation, or implicit in the use of conservative assumptions in the analysis. Several implicit assumptions used in the analysis of the *Selah Ditch Multiparameter TMDL* provide an inherent MOS over uncertainty as required by the statute, and are listed below:

- Each targeted parameter has been based on the worst-case (critical condition) historical water quality monitoring data. This represents a substantial amount of MOS.

- The critical condition period for temperature was selected as April 1 through October 31, even though actual data has indicated substantially shorter time period (April 7 - October 22). This represents a slight amount of MOS.
- The use of WLAs for ammonia, chlorine and temperature based on daily maximums rather than on averages represents a substantial amount of MOS. Likewise, the use of a daily minimum WLA for DO rather than an average-based WLA represents a similar slight amount of MOS.

- The use of WLAs for ammonia and chlorine based on chronic water quality criteria rather than based on acute water quality criteria represents a substantial amount of MOS.

- The inclusion of WLAs for DO, where no requirement had existed previously, provides a substantial MOS for that parameter.

- The LAs for ammonia, $BOD_{5,}$ and FC were all chosen from the maximum values found in the background water (west-side tributary) in the surrounding area. This represents a slight amount of MOS.

- The use of a temperature LA of a minimum of 90 percent effective shade gives a substantial amount of MOS since narrow waterways, such as Selah Ditch can easily obtain >99 percent effective shade when allowed to cultivate a maximum amount of mature riparian vegetation. The requirement for a BMP of “maximum mature riparian vegetation” will essentially guarantee the production of a minimum of 90 percent effective shade.

Summary and Conclusions

Ammonia

Ammonia in Selah Ditch was included in the state's 1996 and 1998 303(d)-listings even though instream concentrations of that parameter never exceeded 0.08 mg/L, which is substantially below both the state's water quality acute and chronic ammonia criteria of 5.667 mg/L and 0.915 mg/L, respectively. The ammonia LA was established as 0.02 mg/L, which indicates that non-point sources of ammonia are "de minimis." The city of Selah POTW is the predominant source of ammonia to Selah Ditch and has been given a stringent daily maximum WLA of 2.5 mg/L (90 percent of the remaining loading capacity). The stormwater discharges have been given a daily maximum WLA of 0.18 mg/L (10 percent of the remaining loading capacity). Due to the fact that these limitations have historically been complied with, the TMDL is already successful in compliance with the state's water quality standards regarding ammonia.

Chlorine

Even though the historical in-stream Selah Ditch chlorine concentrations have exceeded the state's Class A water quality criteria, the latest water quality monitoring (2003) determined that recent instream chlorine concentrations have been mitigated. Such mitigation is attributed to the fact that the POTW, once the predominant source of chlorine to Selah Ditch, recently completed a conversion from chlorine to UV disinfection. The only remaining source of chlorine is the stormwater sewer system. The chlorine LA was established as zero, since there are no non-point sources of chlorine. The POTW effluent must comply with a daily maximum equal to the chronic water quality chlorine criterion of 0.011 mg/L; whereas, the stormwater system discharges are limited to 0.015 mg/L.

Dissolved Oxygen

The minimum DO concentrations found in Selah Ditch have historically been well below the respective Class A minimum criterion of 8.0 mg/L. In September 1991, a discharge of "waters of evaporation" was eliminated that had allowed high BOD_5 wastewaters from Tree Top, Inc. to be discharged via the 24" stormwater sewer outfall. After mitigation, the DO concentrations in the 24" stormwater sewer system effluent increased dramatically. Unfortunately, the majority (75 percent) of the latest (2002 and 2003) in-stream DO concentrations are still up to 45 percent below the state's Class A DO criterion of a minimum of 8.0 mg/L. The LA for DO is set to the Class A DO criterion.

The present source of the lowest DO concentrations is the POTW effluent. Fortunately, the POTW is already under an NPDES permit requirement to complete a *Plan to Increase Dissolved Oxygen in Effluent Discharge* by December 30, 2004. The TMDL recommends interim DO WLAs for both the POTW and the stormwater discharges equal to 8.4 mg/L. The TMDL also recommends an interim BOD_5 WLA for the POTW of 10.0 mg/L and an interim BOD_5 WLA for stormwater discharges of 2.0 mg/L.

This assessment suggests that the parameters of DO and BOD_5 be re-examined after the installation of added aeration, as required by the above plan, and after a minor monitoring study has been conducted. Depending on the study's results, new final WLAs may be required in order to ensure that Selah Ditch DO concentrations comply with the State's Class A DO criterion of a minimum of 8.0 mg/L. Future monitoring of DO in Selah Ditch may require limiting other nutrients, such as nitrogen and phosphorus, because these nutrients exert a corresponding oxygen demand in waters.

Fecal Coliform Bacteria

The FC densities in Selah Ditch have historically exceeded their respective water quality criteria. However, the reason for the parameter of FC bacteria having not been previously included into either the 1996 or 1998 303(d) listings is not known. FC densities continue to exceed the State's Class A two-tiered bacterial criteria at various sampling stations along Selah Ditch, except in the POTW effluent (which has undergone disinfection). The highest densities of FC bacteria are being discharged via the 18" stormwater sewer (geometric mean = 3,891 cfu/100mL), which consists predominantly of municipal stormwater and minor amounts of industrial discharges. The WLA for the POTW effluent is set to a daily maximum of 10 cfu/100mL; while, the WLA for the stormwater discharges is set to a daily maximum of 186 cfu/100mL. The LA for FC bacteria is set to 3.5×10^{10} cfu/day.

Temperature

Selah Ditch has historically exceeded the state's Class A water quality criterion of 18.0°C, even though it has never been 303(d) listed for that parameter. All of the monthly maximum water temperatures collected throughout Selah Ditch were exceeding the Class A criterion during a critical condition period (May 1 through October 31) for the years 2001 and 2002. The state's proposed new water quality temperature criterion for Selah Ditch is 17.5°C (63.5°F), which is labeled the S*almon and Trout Spawning, Noncore Rearing, and Migration* aquatic life temperature criterion. Compliance with this latter criterion is to be compared to a 7-DADMax rather than a daily maximum temperature as for the Class A criterion. Selah Ditch has also historically exceeded the proposed water quality temperature criterion (Table 22) during the same critical condition period.

Water temperatures within the upper reach of Selah Ditch are controlled nearly equally by a combination of stormwater sewer and municipal effluents. The predominant industrial heat source to the stormwater sewer system was hot contact cooling water discharged by Hi-Country Foods Corporation during the critical condition period summer months, which has since gone out of business. The temperature effluent limitation in the facility's NPDES permit, to be reissued in 2011, will need to be substantially lowered in order to prevent continued excessive stormwater temperatures. The excessive temperature in the POTW effluent, during the summer months, is thought to be induced by solar radiation. Similarly, the city of Selah POTW NPDES permit to be issued in 2011, will need to include a specific temperature limitation.

Table 22: Lower Reach of Selah Ditch: 7-DADMax Water Temperatures (°C) during Critical Condition Months of May – October

Day of Month	Aug. 2001	Sept. 2001	Oct. 2001	May 2002	June 2002	July 2002	Aug. 2002	Sept. 2002	Oct. 2002
1		70.9	64.0	61.2	66.4	67.8	71.0	70.4	62.3
2		70.1	64.1	61.3	67.1	68.2	70.4	69.4	62.1
3		69.1	64.2	61.1	66.8	68.3	69.7	68.6	62.2
4	71.4	68.4	63.6	61.4	66.2	68.8	69.2	67.9	62.9
5	71.8	68.1	62.7	61.1	65.4	69.2	69.1	67.1	63.5
6	72.0	67.8	62.1	60.5	64.0	69.6	69.4	66.7	64.2
7	72.6	67.8	60.9	60.8	63.6	70.4	69.7	66.6	64.5
8	73.0	67.8	60.1	61.8	63.5	71.3	70.3	66.8	64.6
9	73.4	68.2	59.7	62.4	63.7	72.2	70.6	67.3	64.7
10	73.6	68.9	59.9	62.6	65.0	73.2	71.3	67.6	64.7
11	73.7	69.3	60.7	62.0	66.2	73.7	72.0	67.7	64.3
12	73.9	69.8	61.4	62.2	68.1	74.0	72.2	68.0	64.2
13	74.0	70.2	62.0	62.9	69.4	74.1	72.3	67.8	64.2
14	73.9	70.4	62.6	63.2	69.3	74.2	72.2	67.3	64.4
15	73.5	70.4	63.1	62.6	68.9	74.2	72.1	66.9	64.7
16	73.1	69.9	63.4	62.0	68.6	74.1	72.1	66.4	64.8
17	72.5	69.2	63.3	62.1	68.2	73.7	71.6	66.0	65.0
18	71.7	68.5	62.7	62.5	68.0	73.4	71.1	65.6	65.3
19	70.5	68.0	62.4	62.2	67.8	73.6	71.0	65.1	65.1
20	69.7	67.6	61.9	62.2	68.1	73.5	70.9	65.1	64.6
21	69.0	67.3	61.5	62.0	69.1	73.6	70.8	65.2	64.1
22	68.7	66.5	61.3	62.4	70.2	73.6	70.9	65.3	63.6
23	68.8	66.0	61.0	62.8	71.0	73.5	71.0	64.8	63.1
24	69.0	65.3	60.6	63.2	71.3	73.6	71.4	64.7	62.2
25	69.6	65.0	60.4	62.9	70.6	73.7	71.8	64.7	61.5
26	70.5	64.2	60.1	63.0	70.0	73.6	71.9	64.7	60.8
27	71.2	63.5	59.9	63.4	69.6	73.6	72.0	64.2	60.2
28	71.8	63.0	59.9	63.7	69.2	73.2	72.0	63.7	59.6
29	72.0	63.0	59.6	64.1	68.9	72.7	71.8	62.9	59.1
30	71.8	63.5	59.6	64.8	68.1	72.2	71.5	62.7	58.6
31	71.3	-	59.8	65.3	-	71.8	71.0	-	58.3

Shaded cells represent temperatures exceeding the *Salmon and Trout Spawning, Noncore Rearing, and Migration* aquatic life temperature criterion of 17.5°C (63.5°F).

The temperature effluent limitations stipulated in the most recent NPDES permits in the watershed, as well as the intentional diversion by Tree Top, Inc. of its hot contact cooling waters to a land application sprayfield during the critical condition period, have not prevented violations of the state's Class A water quality temperature criterion (18.0°C) in the upper reach of Selah Ditch. The WLAs required for both the POTW and stormwater discharges are set to a daily maximum of 18.0°C during the critical condition period (April 1 through October 31). However, during the non-critical condition period the temperature WLAs for the POTW and stormwater sewer discharges are set to 18.0°C and 25.0°C, respectively.

The lower reach of Selah Ditch presents a quite different scenario. The predominant heat source in the lower reach is heat flux obtained through solar radiation. Riparian shade has been determined to be the most important mechanism for reducing heat flux to the lower reach of Selah Ditch. In other TMDLs, the rates of heating have been shown to be dramatically reduced when high levels of shade exist. However, there is a natural maximum level of shade that a given stream is capable of attaining. This maximum level is considered to be the LA of a minimum of 90 percent effective shade.

Summer stream temperature increases due to insufficient riparian vegetation is well documented (e.g., Holtby 1988, Lynch et al. 1984, Rishel et al. 1982, Patric 1980, Swift and Messer 1971, Brown et al. 1971, and Levno and Rothacher 1967). Minimal riparian vegetation specifically results in the elevation of daily maximum, monthly average and annual average water temperatures (e.g., Brown and Krygier 1970, Sullivan and Adams 1991). In addition, Sullivan et al. (1990) determined that riparian shading and site elevation were the best factors at predicting stream temperatures in Washington. Accordingly, since the elevation of Selah Ditch is relatively low (1,120 feet) and constant, increasing the amount of riparian shade appears to be the most reasonable method for decreasing water temperatures within the lower reach of Selah Ditch. The conclusions made by this technical assessment are supported by the *Selah Ditch Temperature Study*, which stated that: "…during the summer, solar radiation has become the dominating influence upon the temperature by the time the water has traveled to the lower reach of Selah Ditch…," where shade is very sparse and almost non-existent (Figure 15).

Figure 15: Selah Ditch - Lower Reach Looking Northeast toward Golf Club Park

TMDL Schedule and Targets

The success of a TMDL is not due to calculating WLAs and LAs and setting goals, but rather in the actual compliance with such goals through BMP implementation. Compliance with the goals of the *Selah Ditch Multiparameter TMDL* is dependent upon the active support of the local municipality and community. That support is in turn dependent upon appropriate science and conclusions, as well as setting reasonable timelines for compliance. This technical assessment has utilized appropriate science and data in making conclusions concerning the sources of ammonia, BOD_5, chlorine, DO, FC, and temperature pollution to Selah Ditch.

The future Summary Implementation Strategy (SIS) will be the document that next describes what municipality, industries, and community activities will be implemented in order to comply with the state's water quality standards. That document will also set reasonable timelines and interim targets for reaching such compliance. An overall 20-year timeline for complying with all of the goals of the TMDL is reasonable in order to allow for the needed planning, funding, and implementation of all known available and reasonable technology (AKART) and BMPs, especially the complete implementation of "maximum mature riparian vegetation."

General milestones for the *Selah Ditch Multiparameter TMDL* will be the following:

- Sufficient young riparian vegetation is required to be planted by January 1, 2008.
- The NPDES effluent limitations stipulated by this TMDL will need to be included in the respective permits at the time of their renewal:
  - City of Selah POTW next NPDES permit expires on August 31, 2011.
  - Yakama Juice (Hi-Country Foods Corp.) next NPDES permit expires on June 30, 2011.
  - Tree Top, Inc. next NPDES permit expires on February 28, 2012.
- The interim DO and BOD_5 WLAs will be met by January 1, 2008. The final WLAs will be met by January 1, 2020.
- The FC bacteria WLAs will be met by January 1, 2015
- The temperature WLAs and LAs will be met by January 1, 2025.

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