



FECAL COLIFORM LEVELS FOR WATERS FLOWING INTO FIDALGO BAY

Final Report to Samish Indian Nation to meet requirements of Agreement Number 1AA08-91 from the Washington Department of Ecology

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Fidalgo Bay Watershed Report- November 2008

This study focuses on the sources of high levels of fecal coliform that were documented in Fidalgo Bay during 2005-2007 (Figures 1 and 2). Sewage and animal waste present in amounts that produce no visible effect on the estuarine ecosystem may render marine shellfish unsafe to eat and result in closure of commercial shellfish beds. Fidalgo Bay is used by Tribal and non-tribal shellfish harvesters and it is important for fecal coliform levels to be within acceptable limits for human consumption. A pilot study was initiated to address the high fecal coliform levels found at stations along Highway 20. Levels were unacceptably high after rain events (Table 1). The drainage that empties into Fidalgo Bay through a culvert at Station 2 was targeted for this pilot study because it was a day-lighted creek that has some outflow all year long, there are several landowners to interact with and gain permission to access the stream, and high levels of fecal coliform have been documented at the outfall.

This project has six goals:

1. Develop a Water Quality Assurance Protocol Plan (QAPP) to guide water quality sampling within the overall Fidalgo Bay watershed that meets Washington State Departments of Ecology and Natural Resources standards.
2. Develop a Watershed Map
3. Prioritize sites where high levels of fecal coliform enters Fidalgo Bay as determined from ongoing studies.
4. Conduct one pilot study to sample a stream or storm water drainage within the watershed to identify potential sources of high levels of fecal coliform.
5. Engage landowners/residents in information sessions to address sources of fecal coliform.
6. Inform State, County and City governments of sources of fecal coliform within their respective jurisdictions.
7. Seek additional sources of funding to expand the project.

The first goal was met with an approved QAPP dated April 3, 2008. Approval was granted by Kyle Murphy, Washington State Department of Natural Resources; Laurie Webster and Dave Hallock, Washington State Department of Ecology. The QAPP is on file at the Department of Natural Resources, the Samish Indian Nation and at Washington State Department of Ecology.

The second goal was met with the following:
The Fidalgo Bay Watershed Map-

- A Geographical Information Systems consultant was hired to train the Samish GIS department in the specific use of ArcGIS tools used to conduct hydrologic and topological analysis.
 - This exercise was extremely useful as an educational tool (took 3 full days to build)

- Building the watershed map will be useful for other agencies as this is the first map of its kind that we could find for Fidalgo Bay.
 - The final map allowed us to gain an approximate size of this watershed.
 - The final map allowed us to get estimates on land use designation within the watershed, and
 - The map will allow us to analyze impervious surface area within the watershed (quite time consuming and so has not yet been done).
- The city of Anacortes provided storm water related GIS layers: storm water sub basins, pipelines, and outfall locations.
 - These layers were useful in estimating the watershed ‘edges’ in areas of low elevation.
 - These layers will be more useful in the future when we want to gain a more detailed picture of storm water runoff patterns within the city, as it affects the Fidalgo Bay.
- The Environmental Department at Shell refinery on March’s Point provided their runoff/water containment information.
 - This is a complex hand drawn map and not easily incorporated into a GIS system.
 - We did use the outfall sites into the bay as mapped by Shell.
 - May be useful down the line when we want to figure out storm water runoff patterns for March’s Point
- Skagit County GIS Department provided digital parcel information.
 - The parcel information was useful for identifying landowners whose property bordered the targeted sampling areas.
- We gathered information from the Skagit County Assessor’s Office regarding impervious surface data.
 - The Assessor’s Office only carries this information for large commercial properties.
 - Provides some information useful in the analysis of impervious surfaces of the Fidalgo Bay watershed.

The Fidalgo Bay watershed map was created using ArcGIS 9.2 hydrological and topographical analysis tools. The information is based on USGS 10 meter Digital Elevation Models which have been hydrologically corrected. The DEM was adjusted to more accurately depict surface water drainage. However, it is difficult to get accuracy in the low elevations, particularly in the north area of the City of Anacortes. We incorporated digital information from the city regarding their storm water system: storm water sub-basins, pipes, and outfall locations. The sub-basins were used to gauge how well the watershed line matched this information. In the lower elevations, where the DEM becomes less reliable, and where the city storm water system has altered the runoff pattern, the watershed shape becomes increasingly estimated.



Figure 1 Watershed emptying into Fidalgo Bay is outlined in a heavy blue line with major streams indicated with a thin blue line. The area of the watershed is approximately 9.2 square miles.

Despite these issues the watershed map provides a first attempt at mapping the Fidalgo Bay watershed. In speaking with multiple agencies we had not been able to

find a watershed map for this water body, so this offers a first glimpse. It allowed us to gain an approximate size, to get estimates on land use designation, and will allow us to analyze impervious surface area.

In gathering information for this ongoing mapping project we solicited information from the City of Anacortes, Shell Refinery on March's Point, Skagit County GIS data, and the Skagit County Assessor's Office.

Goals 3-6 were met with site prioritization based on the previous Fidalgo Bay study and one drainage was targeted for the pilot study.

The pilot study was assigned each of the following tasks which were completed October 30, 2008 following the detailed timeline below.

1. Obtain tax parcel information along target streams or storm water drainages - February 28, 2008.
2. Obtain landowner permission to access their property – April 30, 2008.
3. Obtain 100 ml pre-sealed, coliform plastic bottles with preservative and a cooler to hold samples on ice – Stock on Hand
4. Field day to collect samples, record site information, position data, date and time in a field notebook and store samples on ice until delivery to a certified laboratory - May 12, 2008.
5. Bring samples to analytical laboratory within 4 hours of collection along with a filled out chain of custody form - May 12, 2008.
6. Input results from laboratory analysis into a standard ACCESS database - June 25, 2008
7. Automatically edit for outliers and spot check 10% of the database – June 25, 2008.
8. Enter data into Ecology's database - Ongoing.
9. Analyze data with ACCESS and EXCEL – June 25, 2008.
10. Write and edit report in WORD - August 1, 2008
11. Present results to public and stakeholders - August 8, 2008 & October 9, 2008
12. Submit final report to Department of Ecology - October 30, 2008

Preparation for sampling-

Homeowners along the unnamed stream were notified by letter with follow-up calls to verify accessibility to properties bordering the stream of interest. Edge Environmental Lab in Burlington was notified of the date we would be sampling so they could transport the samples to Bellingham and have the capacity to run the analysis within 24 hours of field collection. Field instruments were tested and in good working order. Field gear was gathered including sterile jars and gloves.

Sampling protocol-

Two technicians and the quality assurance coordinator were on site May 12, 2008. Landowner availability was instrumental in determining the date of the site visit. Rain events were not considered and the most recent rain was on May 10th with 7.34 mm recorded at the weather station at the Samish Department of Natural Resources on Fidalgo Bay. Initial contact was made with the uppermost landowner who showed us the trail along the stream. We commenced sampling taking our position information with a Trimble GPS, water temperature, salinity and pH with an YSI 556 meter. Each water sample for fecal coliform analysis was collected wearing a fresh pair of gloves, from the free flowing portion of the stream. Photographs of each site were taken with a digital camera (Appendix B). The stream was flowing throughout the area sampled. As we progressed downstream each landowner was met and showed us access points to the stream. Collection protocol as outlined in the QAPP was followed at each station. A replicate sample was collected at station 7. The final station was located at a culvert running under Highway 20 and emptying into Fidalgo Bay. Samples were put on ice as they were collected and brought to Edge Environmental Laboratory in Burlington by 4:00 pm. The samples were transported to their Bellingham Laboratory by 6:30 pm and the analysis was run by the state certified laboratory beginning at 6:30 pm. All collections and analysis were completed within 24 hours of the beginning of collection.

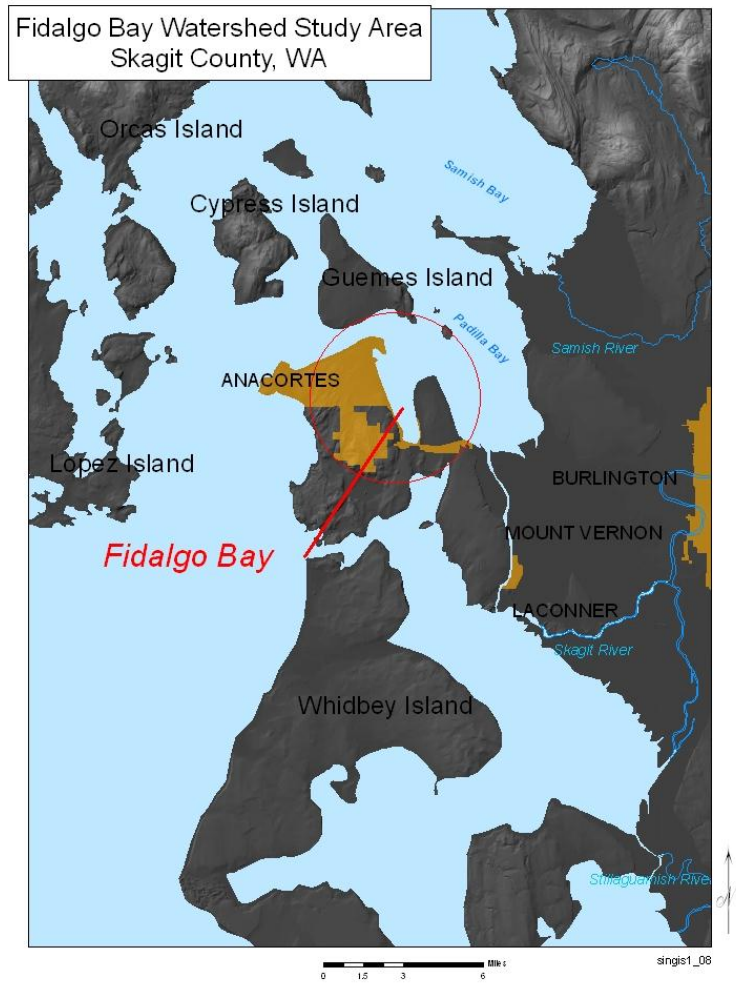


Figure 2. Fidalgo Bay (circled in red) is in Skagit County, Washington. It is accessible via State Highway 20.

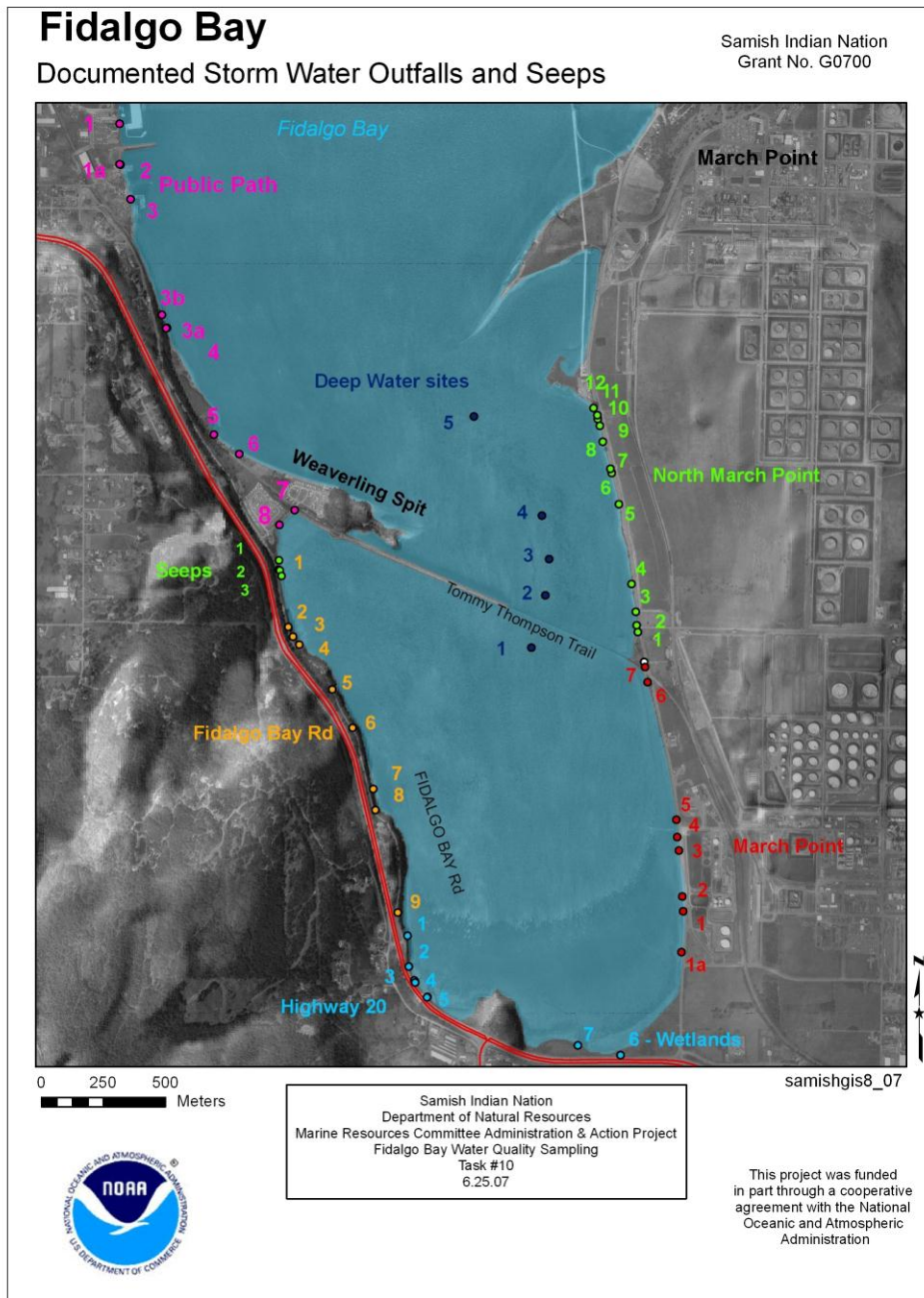


Figure 3. Baseline data was obtained from stations sampled for Fecal Coliform levels in the southern end of Fidalgo Bay, Anacortes, Washington. Forty-three stations were sampled every two weeks between January 2006 and December 2007. These data were used to identify areas with high levels of fecal coliform. Highway 20 site 2 was the target of this pilot study.

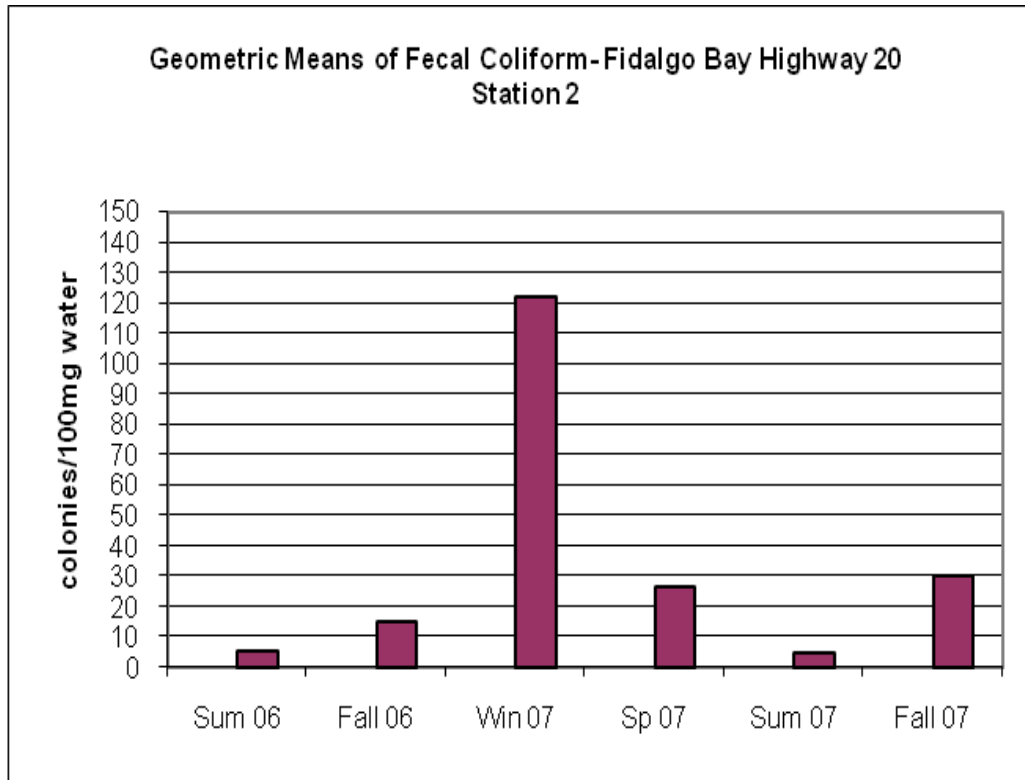


Figure 3. Highway 20 station 2 failed the Washington State Department of Ecology’s water quality standards for fecal coliform during Winter Quarter, 2007.

Table 1- Geometric Means of Fecal coliform at Highway 20 station 2 (Figure 2) along Fidalgo Bay. Samples were obtained every two weeks from January 2006-March 2008. Geometric Means were averaged for wet (Oct-Mar) and dry (Apr-Sep) seasons in order to have at least 10 samples per period. Department of Ecology’s standards state that for fresh water “Fecal coliform organism levels must not exceed a geometric mean value of 50 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 100 colonies/100 mL.” Failed standards are highlighted in red.

Station	Dry 2006		Wet 2006-07		Dry 2007		Wet 2007-08	
	Geo Mean	Sample size, %failed	Geo Mean	Sample size, %failed	Geo Mean	Sample size, %failed	Geo Mean	Sample size, %failed
HWY 2	15.02	14, 21%	40.61	11, 36%	6.71	15, 6%	46.92	9, 33%

Highway 20, Station 2 was chosen for the pilot project based on several criteria identified as necessary to meet the goals of the pilot study. Tasks 1& 2 were to

develop experience in identifying landowners along a drainage, contacting them and gaining access permission. This is a critical aspect of the project as much of the land in the watershed is on private property. We obtained access to the entire reach of the stream learning that an introductory letter must be followed up with a phone call in order to initiate a dialogue. Station 2 was one of the few “hot spots” that was an active stream for most of the year and was also flowing on the surface so we could trace its path and approach landowners.

Table 2- Physical parameters collected on May 12, 2008 along an unnamed stream draining into the southwest corner of Fidalgo Bay (Highway 20, station 2).

	Date, Time	Site	Temp	Cond	SpCond	DO Conc	DO	Fecal Colonies/100ml	pH	Comments
	M/D/Y		C	mS/cm	mS/cm	mg/L	%			
1	5/12/2008 11:06	0508- 001	7.95	0.101	0.15	7.4	62.4	<2	5.81	
2	5/12/2008 11:11	0508- 002	7.68	0.102	0.153	10.89	91.3	2	5.68	
3	5/12/2008 11:19	0508- 003	7.8	0.107	0.16	11.78	99	<2	5.91	
4	5/12/2008 11:33	0508- 004	8.44	0.118	0.173	11.74	100.2	<2	6.31	
5	5/12/2008 11:44	0508- 005	8.21	0.14	0.207	4.01	34	4	6.16	
6	5/12/2008 11:57	0508- 006	8.28	0.129	0.189	11.91	101.3	<2	6.74	
7	5/12/2008 12:20	0508- 007	8.94	0.135	0.195	11.62	100.4	4	6.8	
8	5/12/2008 12:20	0508- 008	8.94	0.135	0.194	11.61	100.3	<2	6.8	Replicate
9	5/12/2008 12:28	0508- 009	9.6	0.139	0.196	11.17	98.1	4	6.89	
10	5/12/2008 12:39	0508- 010	12.15	0.179	0.237	10.87	101.3	2	5.58	
11	5/12/2008 12:52	0508- 011	12.52	9.975	13.096	10.1	99.4	4	5.5	
12	5/12/2008 1:32	0508- 012						<2		Blank

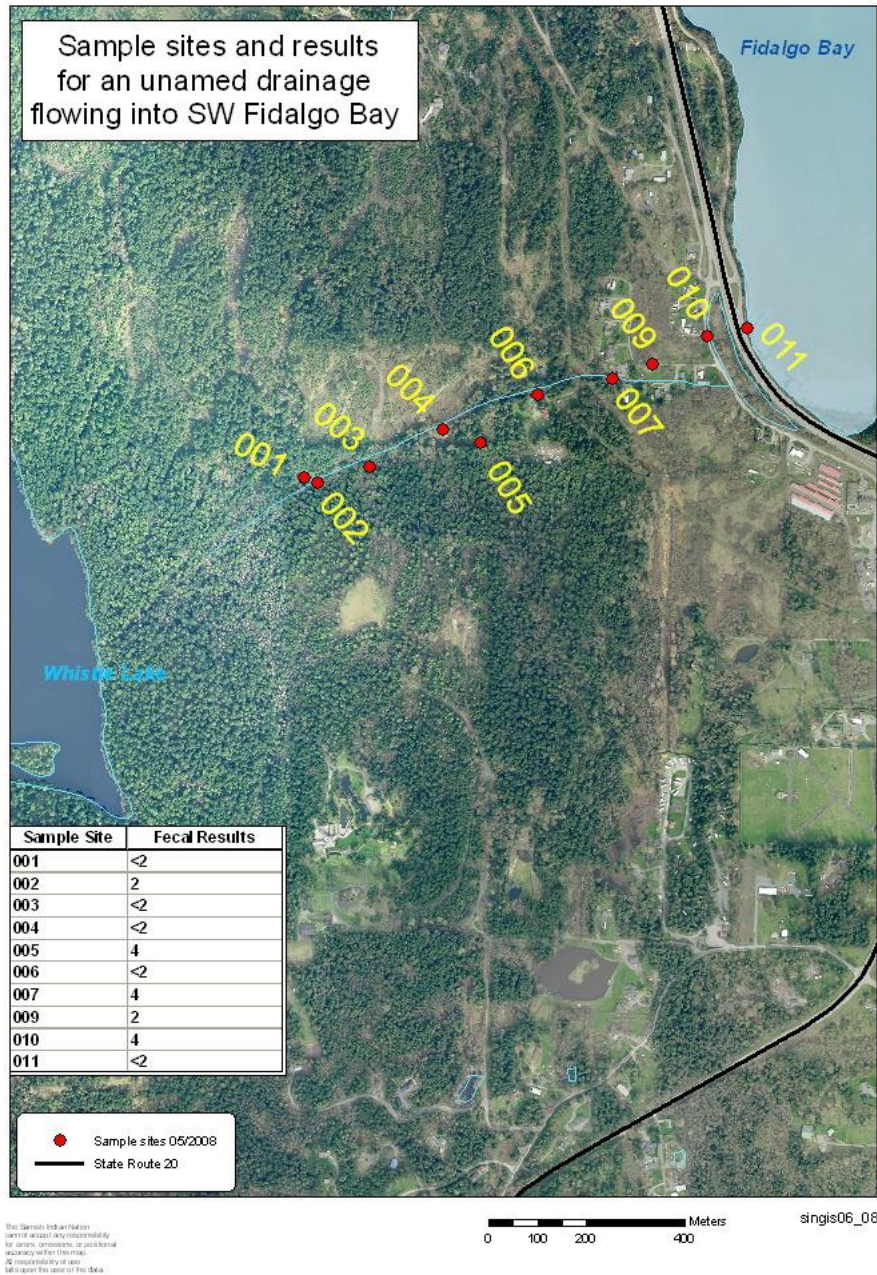


Figure 4. Aerial photograph of the unnamed stream sampled on May 12, 2008. Sampling sites were located along drainage from Whistle Lake to Fidalgo Bay and ran from public lands through private property. During this one sampling event, fecal coliform results were well within acceptable levels all along the drainage (see Table embedded in Figure 4). All levels were within the 50 colonies/100 milliliter sample standards that apply to fresh water (salinity less than 10 ppt).

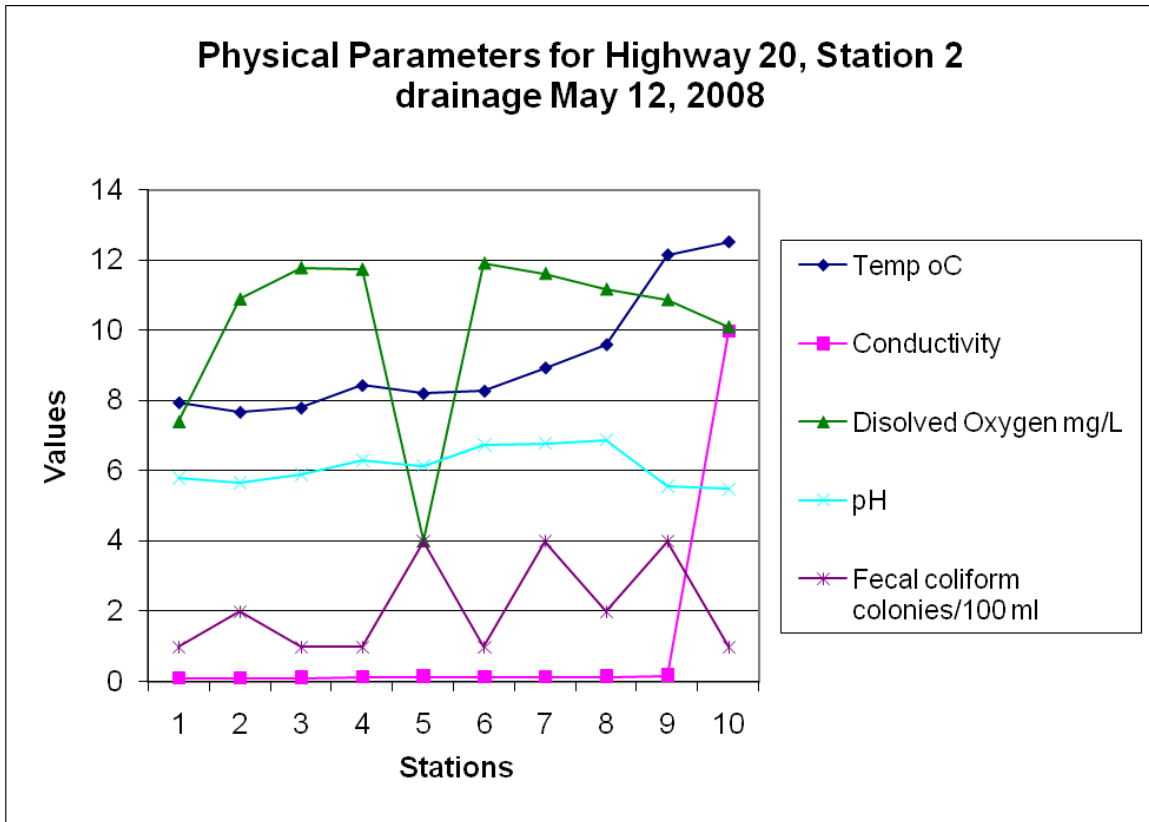


Figure 5. Study results of physical parameters along the unnamed stream. Temperature and salinity was elevated at the Fidalgo Bay station (10) while pH was fairly constant along the stream. Dissolved oxygen was relatively low at the first and fifth stations but still above low oxygen levels of 3 mg/L. Fecal coliform was low for all stations.

Summary: There is a record of periodic high levels of fecal coliform in this system; however, on the day the pilot study was conducted the levels were low. There were no sample sites that indicated a problem, yet we know that measuring the drainage by the Department of Ecology's standards that high levels do occur frequently enough to warrant further investigation. Future testing under various conditions and during the wet season (October- March) is recommended. No sources of contaminants were identified in the May sampling. Further testing after a rain event may be needed to identify areas where fecal coliform is entering the drainage. The field notebook, Excel document with data entry, photo record and chain of custody forms are stored at Samish Indian Nation, Department of Natural Resources, Anacortes, WA.

Quality Control: A replicate sample was taken at site 007. A blank sample (012) from a freshly opened distilled water bottle was included in the analysis. Quality control standards were met for this study.

Sampling Design: The sampling design proved adequate. A sufficient number of landowners were cooperative to allow sampling the complete stream. The technical staff was well trained and observant of all protocols. The pilot study was completed successfully and the Samish Indian Nation is trained and equipped to continue further studies in the Fidalgo Bay watershed.

Landowners were not easy to engage and we recommend face to face visits to familiarize landowners with the project and gain flexibility when choosing the sampling date.

With the completion of this grant we have in place the protocols and methods to perform a watershed-wide assessment. Previous studies have documented several sites in Fidalgo Bay where water quality standards are hazardous. Shellfish harvest is open in Fidalgo Bay and human health is an issue. Future funding is necessary in order to carry out an intense and comprehensive study of this watershed with the intension of finding and resolving water quality issues.

Presenting Results to Public and Stakeholders:

Results were reported to the public and stakeholders at two meetings on August 8 and October 9, 2008. All landowners that participated in the project were invited to the meeting on August 8th, as well as local stakeholders and partners. The meeting was held at the Samish Indian Nation Environmental Program office and included a representative from The Department of Natural Resources. On October 9th the results were presented to numerous stakeholders, partners and the public at the Skagit County Marine Resources Committee. This meeting included representatives from local tribes, local government, Western Washington University, public interest representatives and non-profit organizations.

During both meetings the project was described in detail and the results were shared with the meeting participants. Possible identification of additional funding sources to carry out the remainder of the project throughout the watershed and Puget Sound was also discussed. At this time DNR and the Samish Tribe continue to work with stakeholders and partners in an effort to identify and acquire additional funding.

APPENDIX A



Burlington WA	1620 S Walnut St - 98233
Cosworth Office	800.755.9295 • 360.757.1400 • 360.757.1402fax
Bellingham WA	805 Orchard Dr Suite 4 - 98225
Microbiology	360.671.0668 • 360.671.1577fax

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Data Report

Client Name: Samish Indian Nation
 PO Box 217
 Anacortes, WA 98221

Report Date: 5/14/2008
 Reference Number: 08-06233
 Project: Fidalgo Bay

Collected By: TW & JW

Date Received: 5/12/2008
 Peer Review:

Lab Number: 13372		Sample Description: 0508-001 - Fidalgo Bay						Sample Date: 5/12/2008			
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
E-14551	FECAL COLIFORM	<2	1.1		MPN/100 l	1.0	SM9221 E	5/13/08	dl	mpx_060513	
Lab Number: 13373		Sample Description: 0508-002 - Fidalgo Bay						Sample Date: 5/12/2008			
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
E-14551	FECAL COLIFORM	2	1.1		MPN/100 l	1.0	SM9221 E	5/13/08	dl	mpx_060513	
Lab Number: 13374		Sample Description: 0508-003 - Fidalgo Bay						Sample Date: 5/12/2008			
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
E-14551	FECAL COLIFORM	<2	1.1		MPN/100 l	1.0	SM9221 E	5/13/08	dl	mpx_060513	
Lab Number: 13375		Sample Description: 0508-004 - Fidalgo Bay						Sample Date: 5/12/2008			
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
E-14551	FECAL COLIFORM	<2	1.1		MPN/100 l	1.0	SM9221 E	5/13/08	dl	mpx_060513	
Lab Number: 13376		Sample Description: 0508-005 - Fidalgo Bay						Sample Date: 5/12/2008			
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
E-14551	FECAL COLIFORM	4	1.1		MPN/100 l	1.0	SM9221 E	5/13/08	dl	mpx_060513	
Lab Number: 13377		Sample Description: 0508-006 - Fidalgo Bay						Sample Date: 5/12/2008			
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
E-14551	FECAL COLIFORM	<2	1.1		MPN/100 l	1.0	SM9221 E	5/13/08	dl	mpx_060513	
Lab Number: 13378		Sample Description: 0508-007 - Fidalgo Bay						Sample Date: 5/12/2008			
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
E-14551	FECAL COLIFORM	4	1.1		MPN/100 l	1.0	SM9221 E	5/13/08	dl	mpx_060513	

PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
 ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
 D.F. = Dilution Factor

WSDOE Lab C1251
 WSDOH Lab 045

FORM: MULT_RESULT

Lab Number: 13379		Sample Description: 0508-008 - Fidalgo Bay						Sample Date: 5/12/2008				
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments	
E-14551	FECAL COLIFORM	2	1.1		MPN/100	1.0	SM9221 E	5/13/08	dl	mp_06513		

Lab Number: 13380		Sample Description: 0508-009 - Fidalgo Bay						Sample Date: 5/12/2008				
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments	
E-14551	FECAL COLIFORM	2	1.1		MPN/100	1.0	SM9221 E	5/13/08	dl	mp_06513		

Lab Number: 13381		Sample Description: 0508-010 - Fidalgo Bay						Sample Date: 5/12/2008				
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments	
E-14551	FECAL COLIFORM	4	1.1		MPN/100	1.0	SM9221 E	5/13/08	dl	mp_06513		

Lab Number: 13382		Sample Description: 0508-011 - Fidalgo Bay						Sample Date: 5/12/2008				
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments	
E-14551	FECAL COLIFORM	<2	1.1		MPN/100	1.0	SM9221 E	5/13/08	dl	mp_06513		

Lab Number: 13383		Sample Description: 0508-012 - Fidalgo Bay						Sample Date: 5/12/2008				
CAS ID#	Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments	
E-14551	FECAL COLIFORM	<2	1.1		MPN/100	1.0	SM9221 E	5/13/08	dl	mp_06513		

APPENDIX B

Site Photos taken on 12 May 2008. Site numbers refer to numbers in figure site”.



Beginning of flow, site 001



Site 002



Site 003



Site 004



Site 005



Site 006



Site 007 and 008 (replicate sample number)



Site 009



Site 010



Site 011- Outfall into Fidalgo Bay