Scatter Creek Monitoring Summary Report 2008-2009

Heather S. Saunders
Thurston County Public Health and Social Services Department
Environmental Health Division
(360) 867-2626

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Introduction

The Scatter Creek Aquifer is an important ground water resource in the southwest part of Thurston County. Agriculture, public water systems, and individual wells owners rely on this single source aquifer in the Grand Mound Area. The aquifer is prolific, shallow and unprotected. Historically this has been an area of high nitrate and intermittent positive coliform results.

Because of the combination of importance and extreme vulnerability, the Thurston County Health Department continues to monitor the status of the aquifers water quality and quantity. From September of 2008 through the present, thirty-four wells were monitored for static water level, nitrate, coliform, and field parameters. A subset of wells was monitored for major cations (Ca, Mg, Na, Mn, K and Fe), major anions (HCO3, SO4, NO3+NO2, and Cl) and silica (SiO2).

This report provides a summary of the 2008-2009 data.

Study Methods

The monitoring network presently includes 32 wells. Twenty-two wells were monitored for four quarters starting in September 2008. An additional 12 wells in the western half of the study area were added during the fourth quarter of 2008. Monitoring was discontinued at two wells: one at the owner's request and one with a previously unidentified water treatment system making this location unrepresentative of the aquifer's water quality. Well locations are shown on the map on page 2.

Well Selection

While dedicated monitoring wells are preferred for any study of the ground water resource, it was not economically feasible for Thurston County to install monitoring wells. Therefore residential wells are being used for monitoring.

In the eastern half of the study area the wells were selected to focus on an area previously identified as an area of "high nitrates". Wells in this area were selected by the hydrogeologist to facilitate future modeling.

Wells in the western half of the area were selected to provide geographic coverage of the study area. To obtain coverage in three dimensions, wells of varying depths and screened intervals were also selected in each section if possible. However because most wells were completed at similar depths there is limited representation of vertical aspects.

LITTLEROCK RD SW
173RD AVE SW
SCATTER CREEK
CASE RD SW
TILLEY RD S
OLD HWY 99 SE
183RD AVE SW
SARGENT RD SW
OLD HWY 99 SW
I-5
DENMARK ST SW
HWY 12/US 12
197TH AVE SW
CARPER ST SW
JAMES RD SW
OLD HWY 9 SW
OLD HWY 99 SW
THURSTON COUNTY
Scatter Creek Sampling Results
2008-2009
Sample Wells
Aerial Photography Taken May 2006
Thurston GeoData Center
1,250 625 0 1,250
Feet

Additional factors considered when selecting wells for the network included:

- Permission to sample for the long term
- Adequate well construction and sealing, including surface and sanitary seals
- Well log availability or known well depth
- Accessibility for sampling and water-level measurements
- Sampling point located ahead of any treatment devices
- Adequate sample tap
- Previous sampling history
- Limited water use during work hours to facilitate accurate static water levels.

Well Sampling Procedures

Water levels were measured using a calibrated electric probe at each well. Measurements are recorded to the 0.01 foot and are accurate to 0.03 foot unless noted otherwise. Every effort is made to obtain static water levels. Where possible, wells were selected such that the owner would be away from home during sampling. Owners that are likely to be home are contacted about 20 minutes in advance of arrival and asked to refrain from using water. Potential interferences with water levels, such as a nearby well pumping, are noted in the field book. When there is suspected interference, water levels are recorded and then rechecked after a five minute interval to ensure the reading is consistent, before recording the water level. The electric probe is decontaminated with a bleach solution and rinsed with clean tap water between sample sites.

Samples are obtained from a tap located as close to the wellhead as possible and prior to any water treatment. Wells and water lines are purged for a minimum of 15 minutes before sampling and **samples are collected while the pump is running.**

Field parameters, including temperature, pH, conductivity, and dissolved oxygen are observed and recorded at approximately 5 minute intervals during purging. Purging continues for at least 15 minutes and until at least two field parameters are stable. Temperature generally never “stabilizes”; rather it exhibits a stable pattern of dropping to a specific low at the bottom of the pump cycle. Samples are grabbed at or near the bottom of the temperature cycle.

To ensure that samples are taken at or near the bottom of the pump cycle and while the pump is running, multiple points are used for discharge. After the first two quarters of sampling we supplemented using multiple discharge points by adding a “Y” fitting so water continues to flow from the sample tap to the YSI to measure the field parameters during sampling. This allows the sampler to ensure that the sample is grabbed at the lowest point on the temperature cycle. Duplicate results are obtained at a minimum of 10% of the wells and submitted to the laboratory as blind samples. Samples are placed in bottles supplied by the laboratory, kept on ice, and shipped or delivered to the laboratory using standard methods for the particular parameter(s) tested.

Well Numbering

The USGS convention for numbering was followed with a minor adjustment. Unique numbers were assigned using Township, Range, Section, Quarter/Quarter Letter and sequential numbers, except that where the USGS would number the first well in Township 16 North, Range 03 East, Section 21, Quarter/Quarter "P", as 16N/03E-21P01, the letter "T" was added following the Quarter/Quarter letter to indicate the numbering was created by Thurston County. This was done in an attempt to retain unique numbers knowing that the USGS works—and thus assigns well numbers -- in the same geographic area. The location of the extra "T" after the Quarter/Quarter designator allows for easy sorting and grouping of the wells by location, while allowing the data to be combined with data sets generated by the USGS and still ensuring that the numbers are unique. Shortened versions of the numbers, including only the last six characters are used in most tables and graphs.

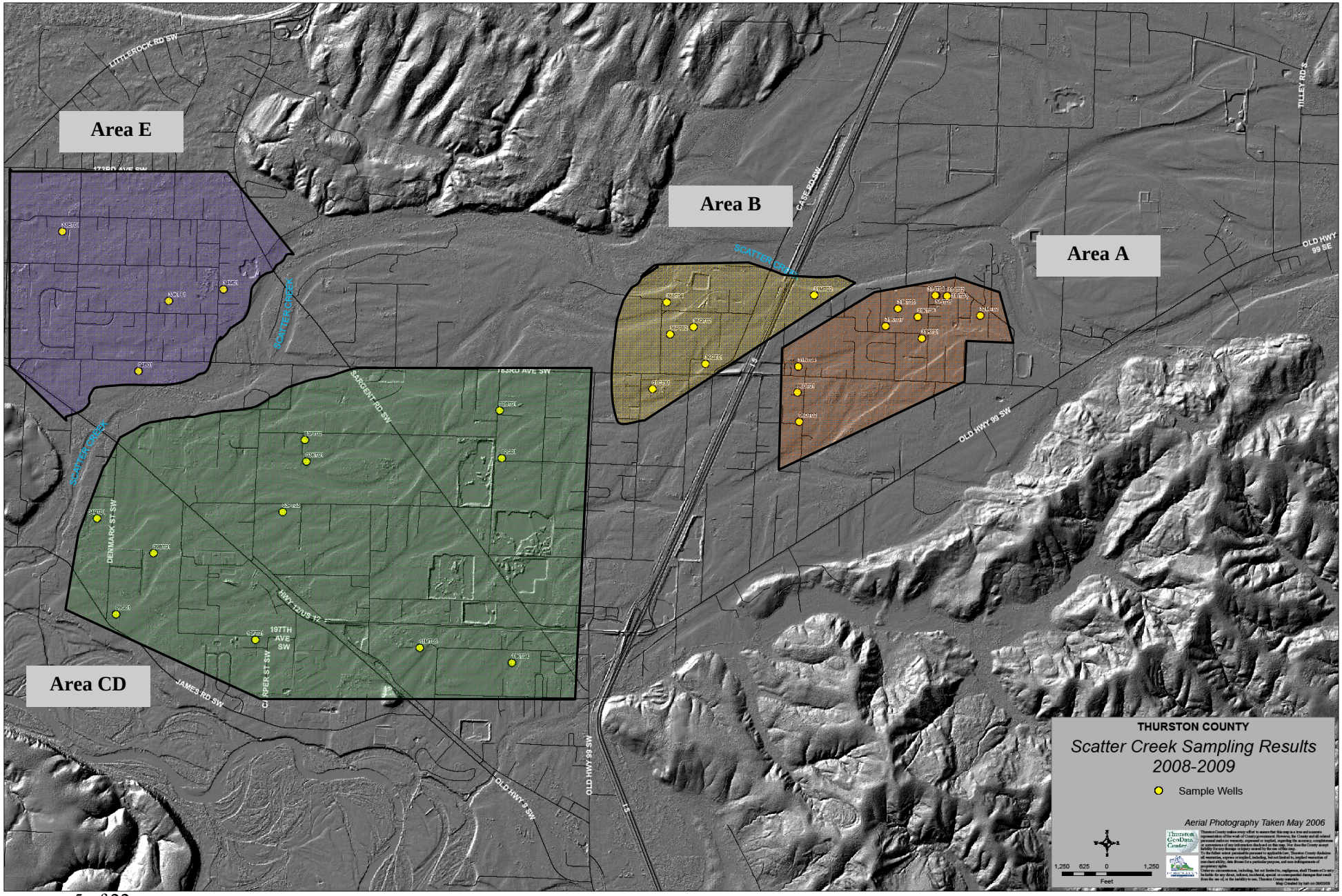
Analysis/ Evaluation

Initial review of the data indicated that dividing the study area into sub-areas could be valuable. The initial delineation of sub-areas was based on a combination of flow information from Sinclair & Hershey, the previously mapped "high" Nitrate plume, examination of the LiDAR shade map, relationship to Scatter Creek and proximity to the Chehalis River. Five areas were identified but due to the limited amount of data in area "D" and similarity of data in areas "C" and "D", they were combined into area "CD" (Figure 1, page 5).

Water Levels

Almost all the wells in the study area show significant seasonal fluctuation compared to most aquifers. Water levels are shown in Figures 2-5 on page 6. For the water levels measured, the water table was – on average -- closest to the surface in March and farthest from the surface in September. Continuous water level data available from the USGS well located at 16N/02W-29L02P2, up-gradient of the TCHD monitoring network, indicates that none of our sampling events occurred during the extreme water levels. The orange arrows overlaid on the USGS hydrograph (Figure 6, page 7) correspond to the timing of TCHD monitoring events. Peak levels at the USGS well in January of this year were about 5 feet higher than March levels. Of the wells in this network, the measurement closest to the surface was 13.4 feet below ground level at well 36LT04, a moderately shallow well in close proximity to Scatter Creek. Extrapolating from the USGS data it is reasonable to assume that water levels at this well were within 10 feet of the surface at some point. It is also one of the wells that showed the largest variation in water level over the course of the year – about 20 feet. Wells 09G01 and 33ET01 showed the least seasonal variation. Well 09G01 is moderately close to the Chehalis River, a major surface water barrier and groundwater discharge area. Well 33ET01 completed at 100 feet is a deep well for this study which probably accounts for the slight seasonal variation.

Figure 1 – Well Locations Overlaid on LIDAR Shade Map



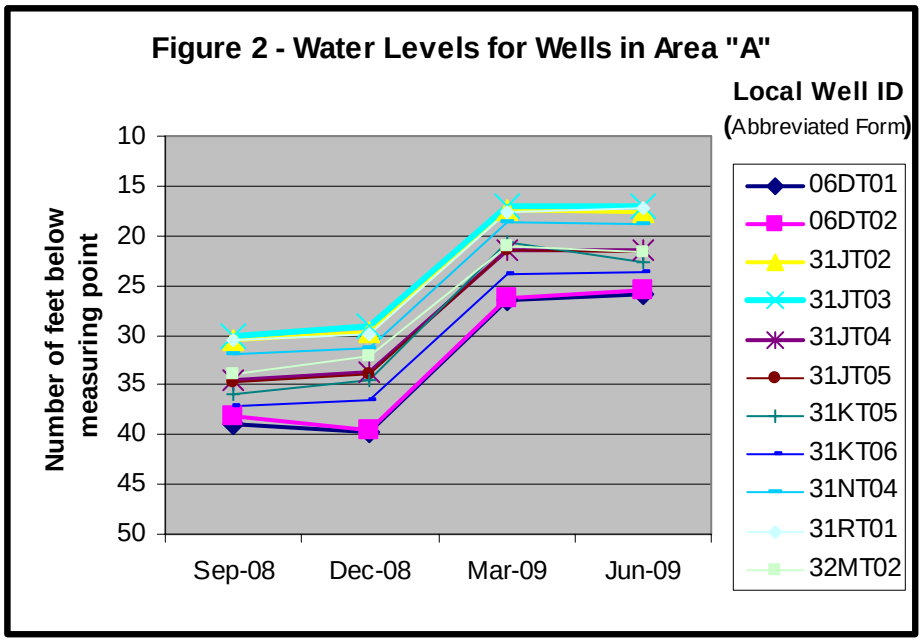


Figure 2 - Water Levels for Wells in Area "A"
Local Well ID
(Abbreviated Form)
Number of feet below measuring point
10
15
20
25
30
35
40
45
50
Sep-08
Dec-08
Mar-09
Jun-09
06DT01
06DT02
31JT02
31JT03
31JT04
31JT05
31KT05
31KT06
31NT04
31RT01
32MT02

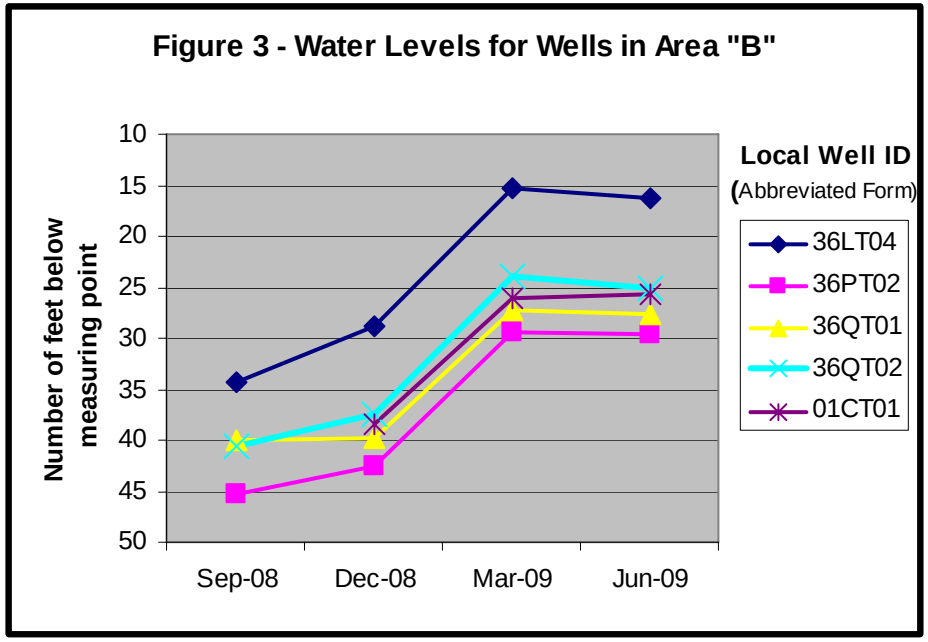


Figure 3 - Water Levels for Wells in Area "B"
Local Well ID
(Abbreviated Form)
Number of feet below measuring point
10
15
20
25
30
35
40
45
50
Sep-08
Dec-08
Mar-09
Jun-09
36LT04
36PT02
36QT01
36QT02
01CT01

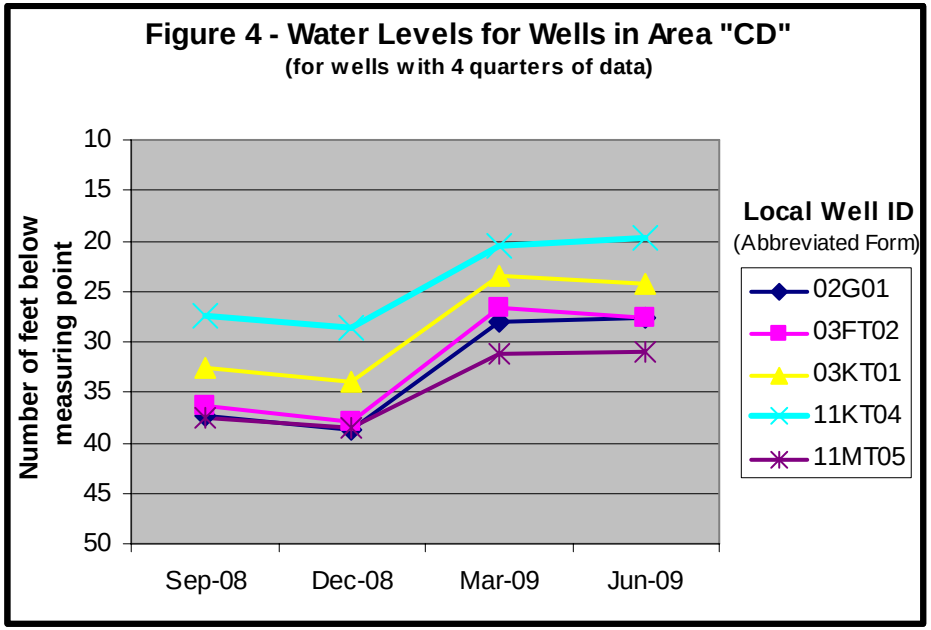


Figure 4 - Water Levels for Wells in Area "CD"
(for wells with 4 quarters of data)
Local Well ID
(Abbreviated Form)
Number of feet below measuring point
10
15
20
25
30
35
40
45
50
Sep-08
Dec-08
Mar-09
Jun-09
02G01
03FT02
03KT01
11KT04
11MT05

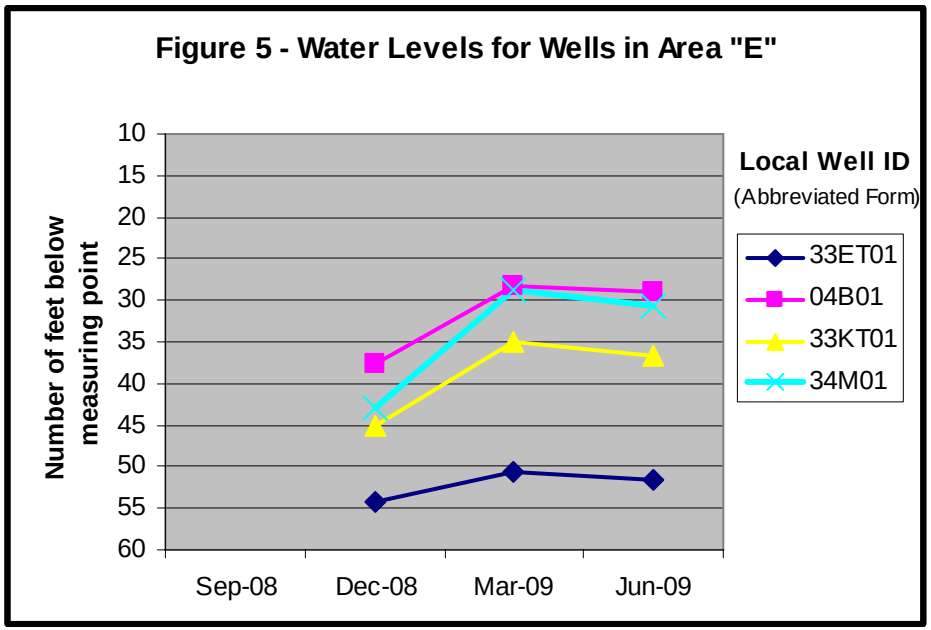
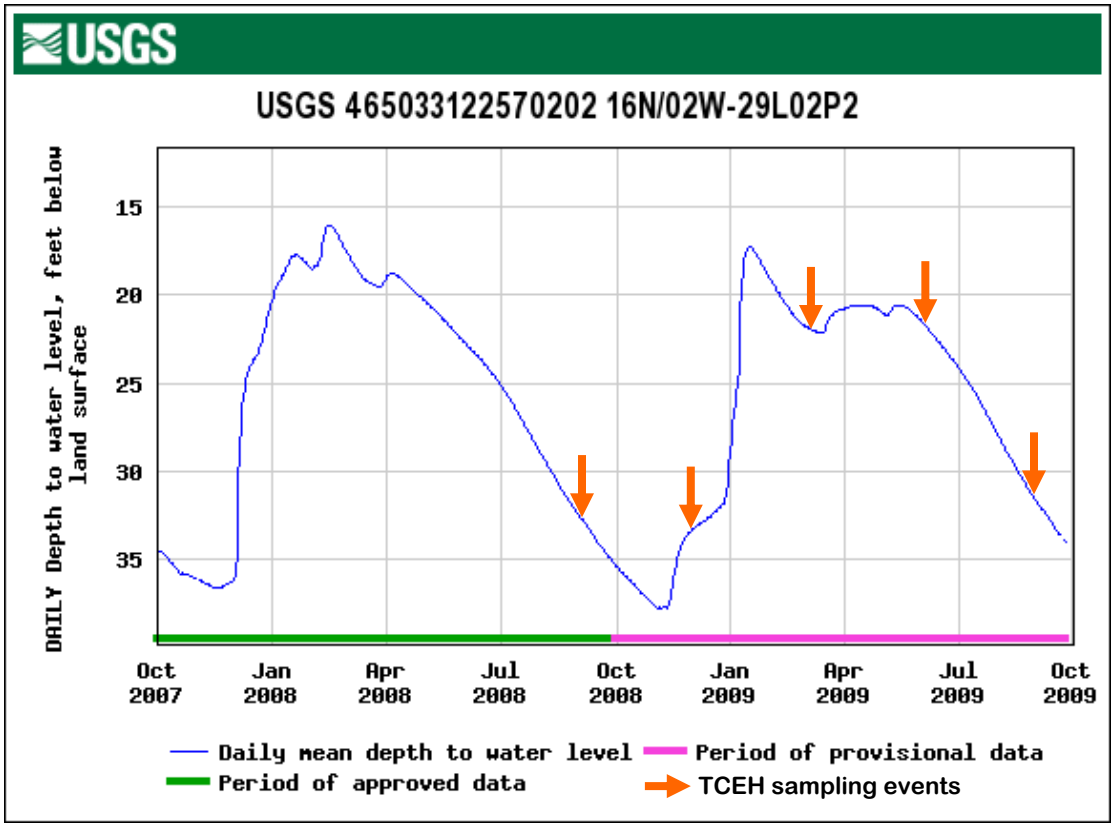


Figure 5 - Water Levels for Wells in Area "E"
Local Well ID
(Abbreviated Form)
Number of feet below measuring point
10
15
20
25
30
35
40
45
50
55
60
Sep-08
Dec-08
Mar-09
Jun-09
33ET01
04B01
33KT01
34M01

Figure 6 - USGS data with overlay showing timing of Thurston County sampling events.



Nitrates

Comparing the 2008-2009 data with historical data suggests that nitrate levels may be decreasing in some areas and increasing in others. Limited data – in some cases a single sample – preclude absolute conclusions. The number of sampling events and number of wells sampled is included in the tables associated with the graphs so the reader is aware of the strengths and weaknesses of the data.

Nitrates were sampled quarterly. Of 120 samples the maximum nitrate value was 7.8 mg/L and the minimum value was 1.7 mg/L both during September of 2008. Average for the entire area over the entire period was 4.1 mg/L which exceeds the action level established by Thurston County of 4 mg/L. A map showing average nitrate values for the quarters from September 2008 through June 2009 is on page 8. A full listing of the 2008-2009 data is located in Appendix A.

The lack of temporal variation between quarters was noteworthy. Given this apparent consistency we averaged values over the year to compare to historical data.

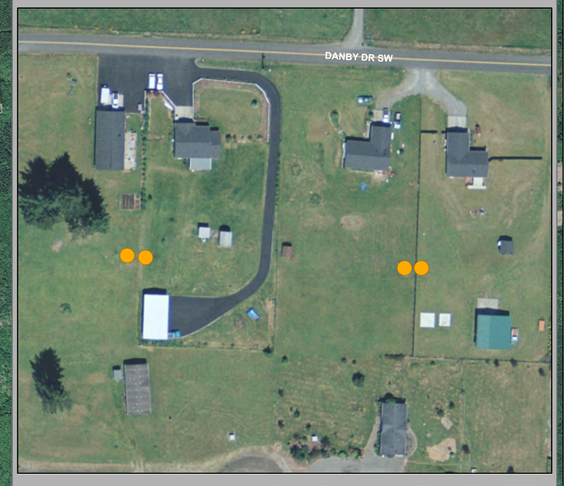
LITTLEROCK RD SW
173RD AVE SW
SCATTER CREEK
SARGENT RD SW
183RD AVE SW
CASE RD SW
SCATTER CREEK
I 5
Map Inset
TILLEY RD S
OLD HWY 99 SE
OLD HWY 99 SW
SCATTER CREEK
DENMARK ST SW
HWY 12/US 12
197TH AVE SW
CARPER ST SW
JAMES RD SW
OLD HWY 99 SW
I 5

THURSTON COUNTY

Scatter Creek Sampling Results 2008-2009

Nitrate Results

- 0.1 to 1.9 mg/L
- 2.0 to 3.9 mg/L
- 4.0 to 5.9 mg/L
- 6.0 to 9.9 mg/L
- > 10 mg/L



Aerial Photography Taken May 2006

N W E S

1,250 625 0 1,250

Feet

Thurston GeoData Center

THURSTON COUNTY

Map Created by kah on 07/21/09

Nitrate levels continue to be high relative to the rest of the county. The same pattern of high nitrates is still apparent in the area around Danby and Leitner Roads (Area "A"). Historically, this nitrate contamination has largely been attributed to several commercial agriculture operations. Significant strides in reducing potential contamination from agricultural activities were achieved in the last three decades. Manure piles were, and are, more commonly covered, lined lagoons to store animal waste have been constructed, and manure is more likely to be applied at agronomic rates. Four dairies went out of business further reducing the nitrate loading. Within area "A", nitrate values have increased between the 1980's and 1990's and decreased between the early 1990's and present (Figure 7, page 10). While the identification of specific contributions from individual sources is presently not possible, it is probable that the leveling off of nitrates is primarily due to changes in agriculture.[1]

Minimum, maximum, and average levels of nitrate in Area B have increased since the 1980's. The average nitrate for 5 samples from the 1980's was 2.2 mg/L. The average nitrate for 19 samples during 2008-2009 was 3.5 mg/L (Figure 8, page 10). Well 36QT02 has the largest seasonal variation. Due to uncertainty concerning whether this variation is the result of poor well construction or the aquifer's ambient water quality, we intend to replace this well.

There is more historical data in Area CD, partly because it is a larger geographic area. Nitrate levels in CD are similar to those in Area A in that they have increased since the 1980's and appear to have leveled off since the 1990's (Figure 9, page 11). However, the absolute values are lower than those in area A with an average nitrate value of 3.2 mg/L for the four quarters of monitoring. The data also shows the least seasonal variation between quarters.

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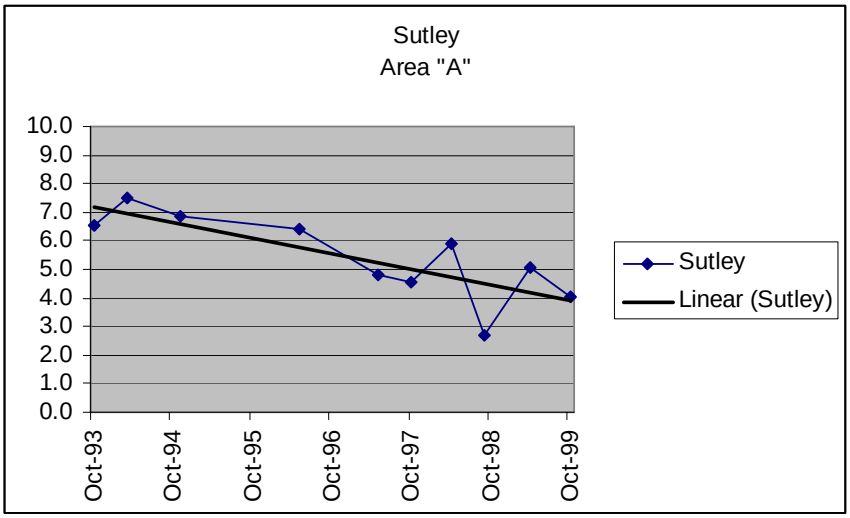
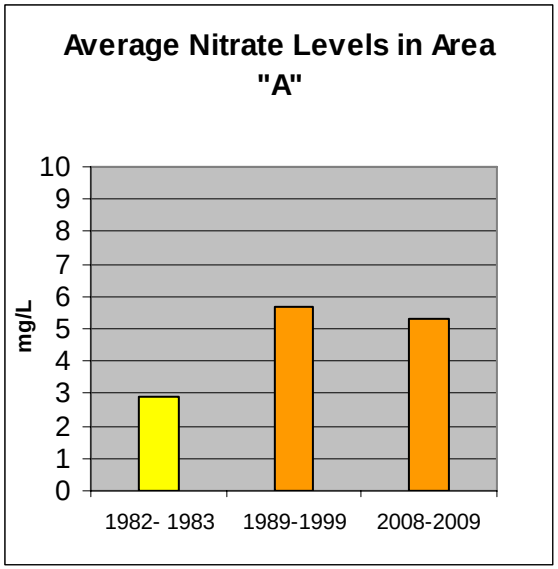
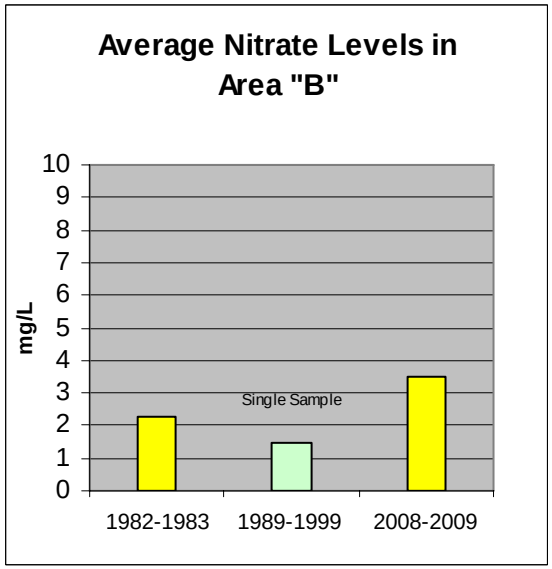
[1] Because of the large data gap between 1999 and 2008 it is not clear how much of the drop in Nitrate occurred during the 1990's and how much occurred in the last ten years. In Area A a single well that is in close proximity to wells 31JT02, 03, 04, and 05 was sampled on two occasions in the 1980's yielding nitrate levels of 2.4 mg/L and 3.4 mg/L for an average of 2.9 mg/L. However the same well was sampled in the 1990's and clearly was higher on average. Plotting the data for that well over the following decade shows a decrease in Nitrate levels from 1993 to 1999. In 2008 the wells in close proximity to the Sutley's well averaged 4.6 mg/L Nitrate so it is possible Nitrate levels dropped the most during the 1990's and have been largely stable since 2000 in this area. Continuing the present monitoring will allow us to evaluate current trends.



Figures 7 & 8





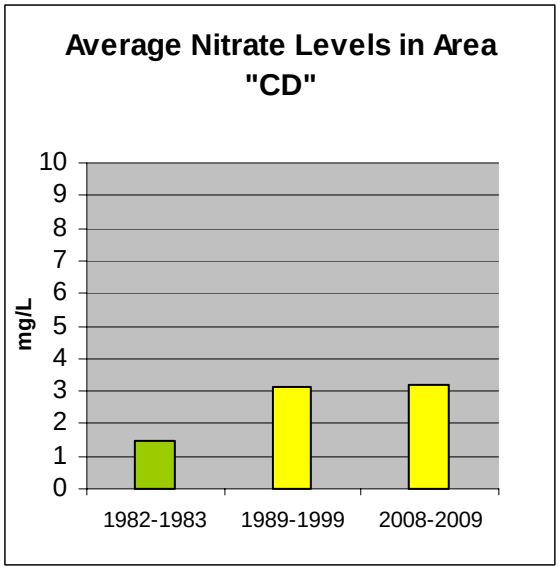
AREA "A"

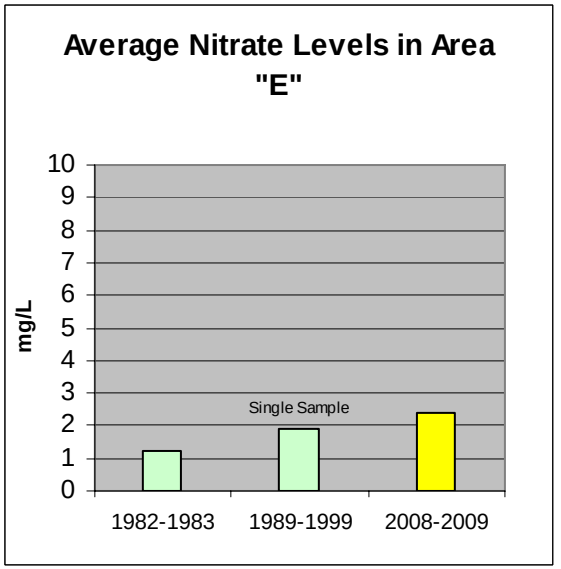
Data Period	# of Wells	# of Samples	NITRATE, mg/L		
			Minimum	Maximum	Average
1982-1983	1	2	2.4	3.4	2.9
1989-1999	3	29	1.1	11.9	5.7
2008-2009	14	52	3.4	7.8	5.3

AREA "B"

Data Period	# of Wells	# of Samples	NITRATE, mg/L		
			Minimum	Maximum	Average
1982-1983	2	5	0.8	4.0	2.2
1989-1999	1	1	1.48	1.48	1.48
2008-2009	5	19	1.7	5.2	3.5

Figures 9 & 10





AREA "CD"

Data Period	# of Wells	# of Samples	NITRATE, mg/L		
			Minimum	Maximum	Average
1982-1983	6	11	0.1	2.7	1.5
1989-1999	14	23	2	5.4	3.1
2008-2009	13	43	2.7	5.2	3.2

AREA "E"

Data Period	# of Wells	# of Samples	NITRATE, mg/L		
			Minimum	Maximum	Average
1982-1983	3	8	0.9	1.5	1.2
1989-1999	1	1	1.9	1.9	1.9
2008-2009	4	12	1.9	3.1	2.4

Northwest of Scatter Creek in Area "E" the average nitrate level, based on 12 samples from four wells, was 2.4 mg/L. Nitrate levels appear to have increased slightly in this area since 1982 (Figure 10, page 11). A review of aerial photographs from 1992, 1996 and 2006 shows that the land recently converted to residential use was previously in hay fields or lay fallow. This is in contrast to Area "A" where the land was subjected to intensive agricultural use before conversion to residential use. Since the land in Area "E" was not subjected to as much intense nitrate loading from past agricultural use it may be easier to observe the impact of residential on-site systems and lawn care products on nitrate levels. The current data will provide a baseline to observe the impact of residential use as monitoring is continued in the future.

While there is not much quarterly variation in nitrate levels, there is some variation. Figures 11–14 on page 13 show quarterly nitrate trends for each well grouped by area.

The data from Area "A" also suggests that there may be some correlation of higher Nitrate values with those areas that are not in surface channels shown by the LIDAR shade map (Figures 15, 16, & 17, page 14; Map, page 15). The wells with the highest average Nitrates appear to lie outside the channels and to show the least quarterly variation. Wells located in or near the channels show more quarterly variation and, on average, lower nitrate levels. Additional wells and additional data would be needed to determine if this apparent correlation is real.

Coliform

Wells were sampled for total coliform each quarter. When total coliform was unsatisfactory, the laboratory conducted additional tests to determine whether E.coli were present. Ten of 114, or nine percent of the routine samples were unsatisfactory. E. Coli was absent in all routine and repeat samples. Although some sample taps were used that are considered less-than-ideal for sampling, such as frost-free outdoor taps, this is still an unusually high percent of unsatisfactory returns for ground water. Repeat samples were taken in some, but not all cases. During the first and second quarter of sampling repeat samples were taken for all tests that were "unsatisfactory" when access could be obtained. Budget constraints precluded continuing to take repeat samples and homeowners were unwilling to pay the sample costs, opting instead to wait for the next quarter's results.

Table 1 on page 16 shows unsatisfactory coliform results and follow-up sampling. The unsatisfactory samples did not show any spatial pattern. Results of all samples are included in Appendix A.

Figure 11 - Quarterly Nitrate Trends Area A

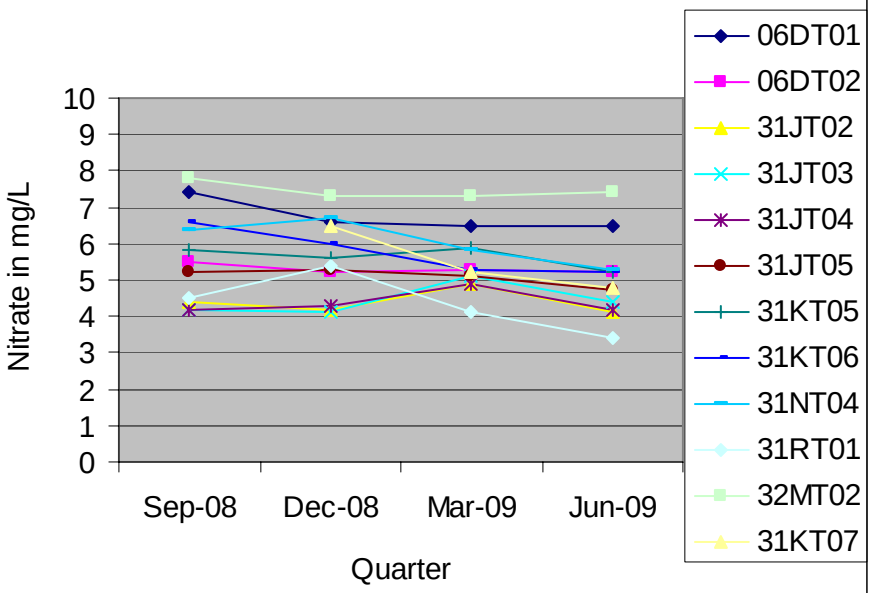


Figure 12 - Quarterly Nitrate Trends Area B

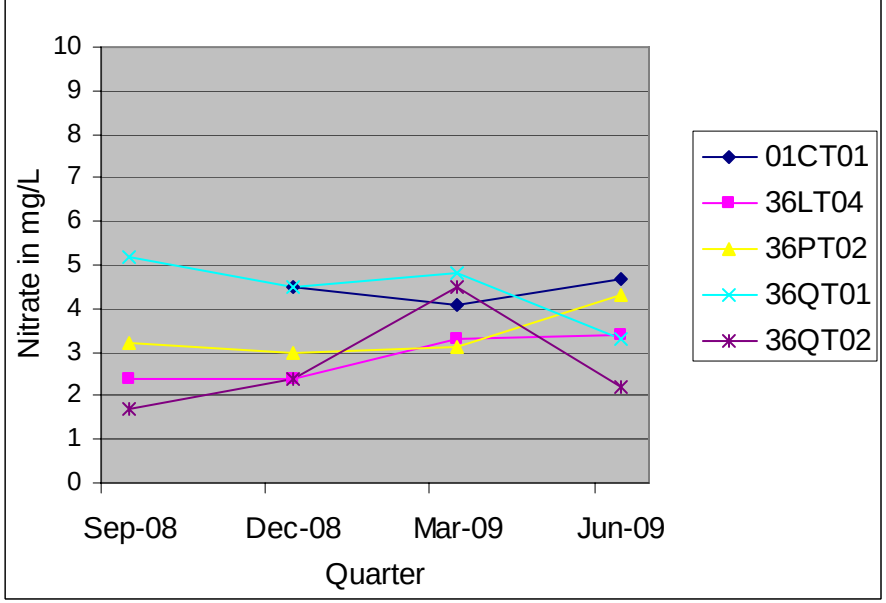


Figure 13 - Quarterly Nitrate Trends Area CD

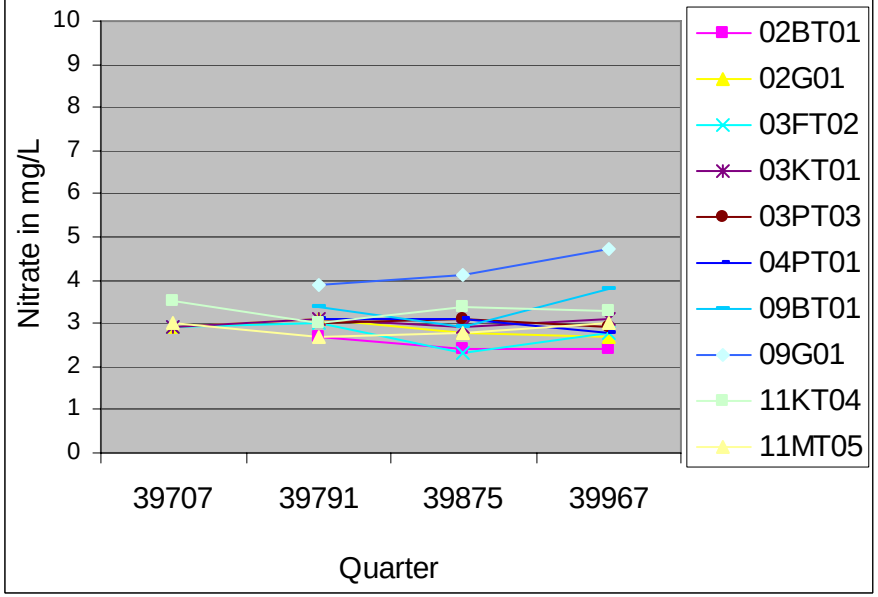
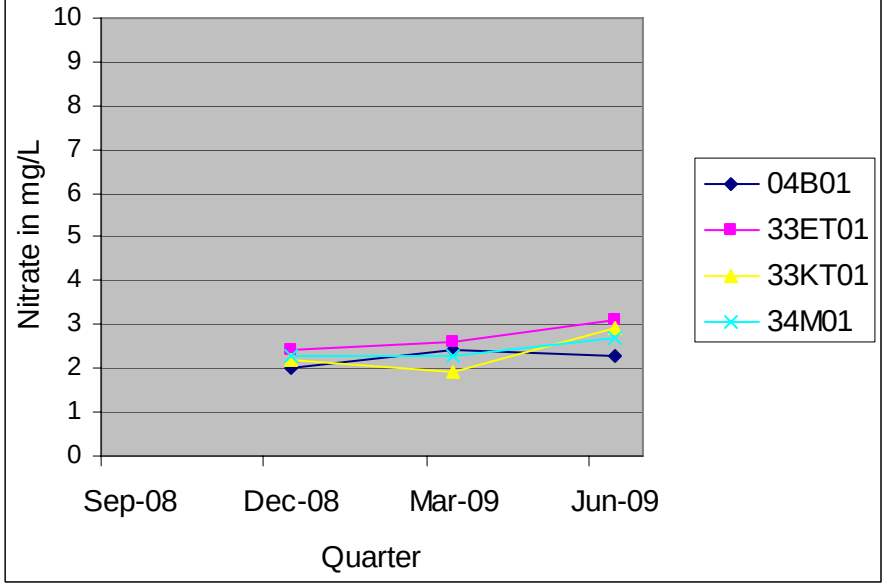


Figure 14 - Quarterly Nitrate Trends Area E



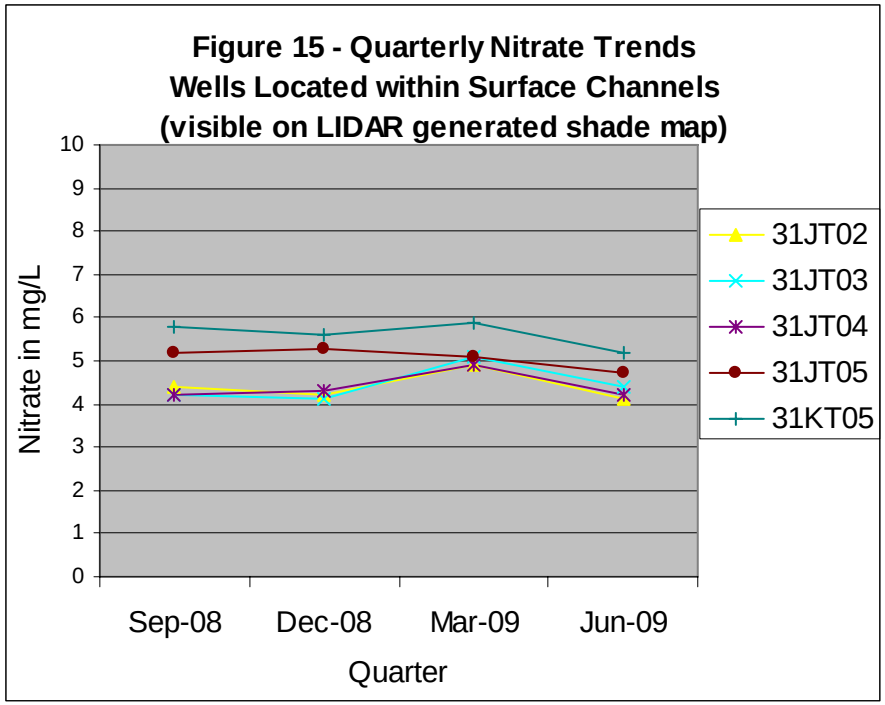


Figure 15 - Quarterly Nitrate Trends
Wells Located within Surface Channels
(visible on LIDAR generated shade map)
Nitrate in mg/L
10
9
8
7
6
5
4
3
2
1
0
Sep-08
Dec-08
Mar-09
Jun-09
Quarter
31JT02
31JT03
31JT04
31JT05
31KT05

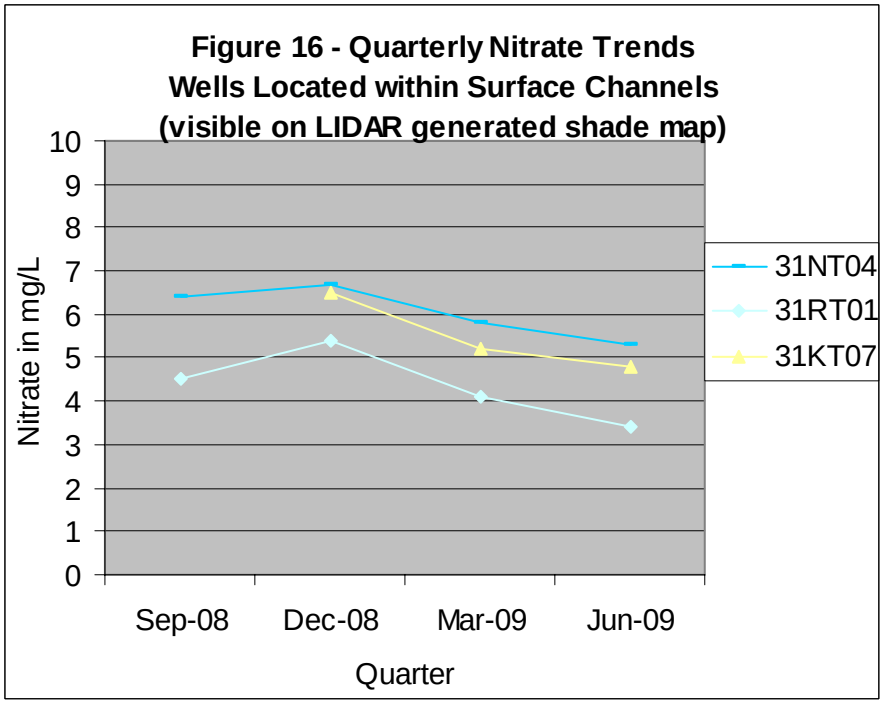


Figure 16 - Quarterly Nitrate Trends
Wells Located within Surface Channels
(visible on LIDAR generated shade map)
Nitrate in mg/L
10
9
8
7
6
5
4
3
2
1
0
Sep-08
Dec-08
Mar-09
Jun-09
Quarter
31NT04
31RT01
31KT07

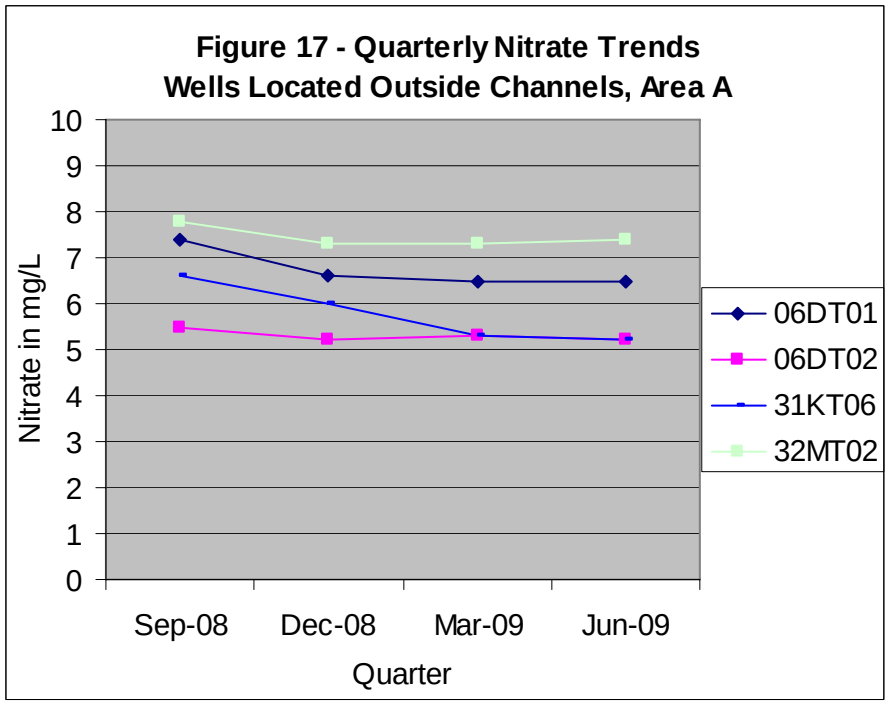
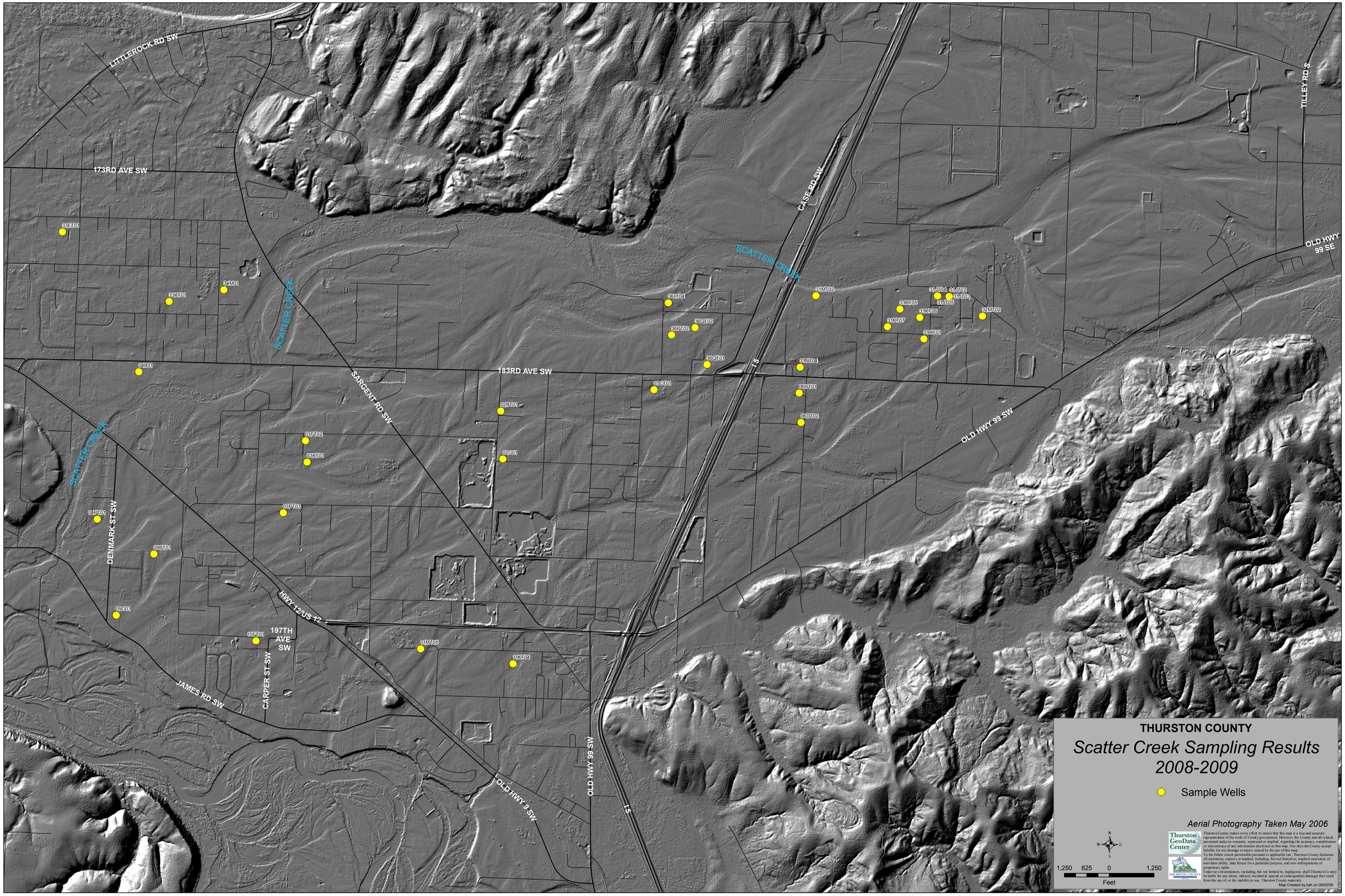


Figure 17 - Quarterly Nitrate Trends
Wells Located Outside Channels, Area A
Nitrate in mg/L
10
9
8
7
6
5
4
3
2
1
0
Sep-08
Dec-08
Mar-09
Jun-09
Quarter
06DT01
06DT02
31KT06
32MT02



THURSTON COUNTY

Scatter Creek Sampling Results 2008-2009

Sample Wells

Aerial Photography Taken May 2006

1,250 625 0 1,250

Feet

Map Created by kah on 09/03/09

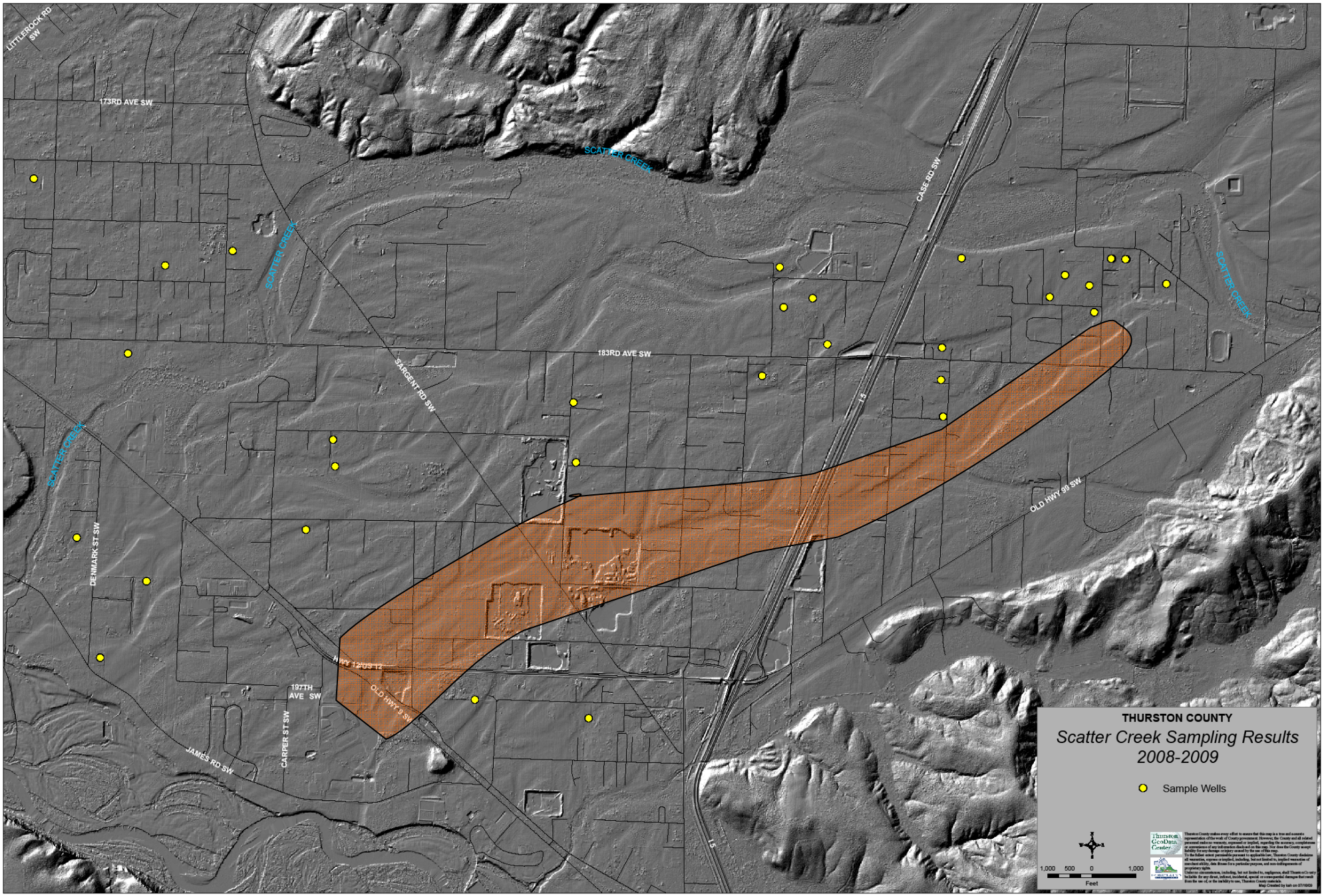
Table 1. Coliform Results

ID	Name	Date	Total Coliform	E_COLI	Follow Up Sample	Comments
36QT01	Duranceau	08-Sep-08	Unsatisfactory	Absent	Yes	Follow up sample taken inside house was also unsatisfactory.
36QT01	Duranceau	16-Sep-08	Unsatisfactory	Absent		This sample was follow-up to 9/8/08 sample. Told Pete we would sample again once system had been disinfected and well inspected.
31RT01	Branam	09-Sep-08	Unsatisfactory	Absent	No	Following quarter also unsatisfactory, however house is temporarily vacant.
32MT02	Bredl	10-Sep-08	Unsatisfactory	Absent	Yes	Follow up sample taken in house was satisfactory. All subsequent samples taken inside the house have been satisfactory.
31RT01	Branam	01-Dec-08	Unsatisfactory	Absent	No	House does not appear to be occupied. Did not take coliform samples in following quarters since system was not disinfected and house vacant.
31JT03	Abner	02-Dec-08	Unsatisfactory	Absent	Yes	Follow up sample taken in house was satisfactory
09BT01	Houseman	08-Dec-08	Unsatisfactory	Absent	No	Owner did not return call.
10FT01	Vogan	03-Mar-09	Unsatisfactory	Absent	No	Owner declined to continue with study.
31JT04	Brown	02-Jun-09	Unsatisfactory	Absent	No	Discussed with owner. Owner will investigate if sample is unsatisfactory following quarter
09G01	Schneider	08-Jun-09	Unsatisfactory	Absent	No	Samples previously taken inside house and were satisfactory. June '09 sample taken at outside tap.
03PT03	Coyle	10-Jun-09	Unsatisfactory	Absent	No	Owner did not return call. If following quarter is unsatisfactory will follow up with letter and additional calls as needed.

Recommendations

- Decrease monitoring of the majority of the network to twice yearly or even yearly given the lack of temporal variation. Use the cost savings to increase the number of wells monitored or for special investigations.
- Adjust the monitoring schedule to capture high and low water level periods. Monitor in February and again in September/October.
- Add wells in areas that are not geographically well represented. Add wells in the apparent channel delineated in Figure 18, page 18. Add wells further East, with a preference for wells for which there is historic data.
- Drop two of the four wells that are in close proximity to each other on Leitner road (31JT02, 03, 04, & 05). The strong correlation in Nitrate values and water levels show that some of these wells can be eliminated.
- Obtain useful historical data from the Thurston County lab data base by accurately locating the wells. First refine the well location using the well delegation data base or address or tax parcel from the GIS system, and then further refine the location by using a geographic positioning system.
- Install dedicated sample taps at wellheads provided homeowner has indicated a willingness to continue as part of a many-year extended study. This will allow for collection of incontrovertible coliform data.
- Examine surface seals of wells returning unsatisfactory coliform results to ensure the surface seal is intact. This requires a homeowner's willingness to dig up the upper level of the well's surface seal.
- Sample for viruses at one or two dedicated sampling wells near wells that have previously returned unsatisfactory samples and have elevated nitrate. Evidence of viral pathogens may elevate the level of concern in a way intermittent coliform presence does not.
- Involve the school systems in the grant application and monitoring efforts.

Figure 18 – Surface Channel Evident on LiDAR Shade Map



LOCALID	LOCALID	LASTNAME	DATESAMPLE	SWL	PH	COND	TEMP	DO	NITRATE	TOTAL COLIFORM	E_COLI
15N/02W-06DT01	06DT01	Nausley	10-Sep-08	38.92	6.6	204	11.38	6.7	7.4	Satisfactory	Absent
15N/02W-06DT01	06DT01	Nausley	02-Dec-08	39.7	6.5	201	11.15	6.09	6.6	Satisfactory	Absent
15N/02W-06DT01	06DT01	Nausley	04-Mar-09	26.51	6.5	197	11.09	5.9	6.5	Satisfactory	Absent
15N/02W-06DT01	06DT01	Nausley	02-Jun-09	25.9	6.5	196	11.12	6.63	6.5	Satisfactory	Absent
15N/02W-06DT02	06DT02	Doke	10-Sep-08	38.15	6.4	158	11.52	10.17	5.5	Satisfactory	Absent
15N/02W-06DT02	06DT02	Doke	02-Dec-08	39.46	6.4	158	10.94	9.17	5.2	Satisfactory	Absent
15N/02W-06DT02	06DT02	Doke	04-Mar-09	26.33	6.4	156	10.86	9.36	5.3	Satisfactory	Absent
15N/02W-06DT02	06DT02	Doke	02-Jun-09	25.49	6.3	81	11.11	9.7	5.2	Satisfactory	Absent
15N/03W-01CT01	01CT01	Dugas	09-Dec-08	38.46	6.5	151	10.4	7.88	4.5	Satisfactory	Absent
15N/03W-01CT01	01CT01	Dugas	03-Mar-09	26.05	6.4	142	10.82	8.89	4.1	Satisfactory	Absent
15N/03W-01CT01	01CT01	Dugas	03-Jun-09	25.7	6.3	136	11.01	9.65	4.7	Satisfactory	Absent
15N/03W-02BT01	02BT01	Lockhart	08-Dec-08	36.14	6.6	137	10.17	6.92	2.7	Satisfactory	Absent
15N/03W-02BT01	02BT01	Lockhart	03-Mar-09	23.95	6.5	136	10.13	6.53	2.4	Satisfactory	Absent
15N/03W-02BT01	02BT01	Lockhart	08-Jun-09	24.23	6.5	131	10.45	6.82	2.4	Satisfactory	Absent
15N/03W-02G01	02G01	Kalnoski	16-Sep-08	37.41	6.5	137	10.6	7.06	2.9	Satisfactory	Absent
15N/03W-02G01	02G01	Kalnoski	09-Dec-08	38.69	6.5	141	10.5	7.3	3.1	Satisfactory	Absent
15N/03W-02G01	02G01	Kalnoski	11-Mar-09	27.93	6.5	136	10.5	7.52	2.8	Satisfactory	Absent
15N/03W-02G01	02G01	Kalnoski	08-Jun-09	27.65	6.4	138	10.68	7.59	2.7	Satisfactory	Absent
15N/03W-03FT02	03FT02	Prato	16-Sep-08	36.3	6.4	111	10.89	10.38	2.9	Satisfactory	Absent
15N/03W-03FT02	03FT02	Prato	08-Dec-08	37.89	6.4	115	10.5	10.09	3.0	Satisfactory	Absent
15N/03W-03FT02	03FT02	Prato	02-Mar-09	26.73	6.4	108	10.49	10.42	2.3	Satisfactory	Absent
15N/03W-03FT02	03FT02	Prato	09-Jun-09	27.64	6.3	113	11.19	11.28	2.8	Satisfactory	Absent
15N/03W-03KT01	03KT01	Biago	17-Sep-08	32.55	6.6	124	10.69	10.66	2.9	Satisfactory	Absent
15N/03W-03KT01	03KT01	Biago	08-Dec-08	33.93	6.6	127	10.7	8.77	3.1	Satisfactory	Absent
15N/03W-03KT01	03KT01	Sabella	02-Mar-09	23.49	6.5	130	10.6	8.4	2.9	Satisfactory	Absent
15N/03W-03KT01	03KT01	Sabella	09-Jun-09	24.26	6.4	132	10.75	9.97	3.1	Satisfactory	Absent
15N/03W-03PT03	03PT03	Coyle	08-Dec-08	33.9	6.7	135	10.77	9.19	3.0	Satisfactory	Absent
15N/03W-03PT03	03PT03	Coyle	02-Mar-09	25.31	6.6	133	10.65	9.42	3.1	Satisfactory	Absent
15N/03W-03PT03	03PT03	Coyle	10-Jun-09	25.9	6.5	131	11.15	9.43	2.9	Unsatisfactory	Absent
15N/03W-04B01	04B01	Smiley	08-Dec-08	37.62	6.6	110	10.28	8.66	2.0	Satisfactory	Absent
15N/03W-04B01	04B01	Smiley	11-Mar-09	28.17	6.4	114	10.28	9.12	2.4	Satisfactory	Absent
15N/03W-04B01	04B01	Smiley	10-Jun-09	29.06	6.4	108	10.55	9.6	2.3	Satisfactory	Absent
15N/03W-04PT01	04PT01	Balch	08-Dec-08	27.01	6.5	121	10.68	10.22	3.1	Satisfactory	Absent

LOCALID	LOCALID	LASTNAME	DATESAMPLE	SWL	PH	COND	TEMP	DO	NITRATE	TOTAL COLIFORM	E_COLI
15N/03W-04PT01	04PT01	Balch	02-Mar-09	20.05	6.5	122	10.76	10.82	3.1	Satisfactory	Absent
15N/03W-04PT01	04PT01	Balch	09-Jun-09	20.84	6.4	117	11.12	10.96	2.8	Satisfactory	Absent
15N/03W-09BT01	09BT01	Houseman	08-Dec-08	28.79	6.8	151	10.89	8.37	3.4	Unsatisfactory	Absent
15N/03W-09BT01	09BT01	Houseman	11-Mar-09	22.62	6.8	152	10.65	8.32	2.9	Satisfactory	Absent
15N/03W-09BT01	09BT01	Houseman	08-Jun-09	22.89	6.8	147	11.35	8.33	3.8		
15N/03W-09G01	09G01	Schneider	09-Dec-08	32.51	6.7	155	11.23	7.64	3.9	Satisfactory	Absent
15N/03W-09G01	09G01	Schneider	02-Mar-09	28.66	6.7	156	11.23	7.28	4.1	Satisfactory	Absent
15N/03W-09G01	09G01	Schneider	08-Jun-09	29.11	6.6	160	11.53	8.77	4.7	Unsatisfactory	Absent
15N/03W-10FT01	10FT01	Vogan	10-Dec-08	36.3	6.8	174	11.51	8.01	5.2	Satisfactory	Absent
15N/03W-10FT01	10FT01	Vogan	03-Mar-09	31.36	6.8	175	11.11	7.41	5.2	Unsatisfactory	Absent
15N/03W-11KT04	11KT04	Ensley	17-Sep-08	27.4	6.6	150	11.76	7.27	3.5	Satisfactory	Absent
15N/03W-11KT04	11KT04	Ensley	03-Dec-08	28.53	6.6	151	11.25	7.4	3.0	Satisfactory	Absent
15N/03W-11KT04	11KT04	Ensley	04-Mar-09	20.53	6.6	152	11.2	6.94	3.4	Satisfactory	Absent
15N/03W-11KT04	11KT04	Ensley	02-Jun-09	19.72	6.5	152	11.62	7.06	3.3	Satisfactory	Absent
15N/03W-11MT05	11MT05	Smith	17-Sep-08	37.58	6.8	143	11.8	7.53	3.0	Satisfactory	Absent
15N/03W-11MT05	11MT05	Smith	09-Dec-08	38.54	6.8	147	11.82	5.66	2.7	Satisfactory	Absent
15N/03W-11MT05	11MT05	Smith	02-Mar-09	31.18	6.8	154	12.71	5.61	2.8	Satisfactory	Absent
15N/03W-11MT05	11MT05	Smith	10-Jun-09	31.06	6.7	152	12.58	7.49	3.0	Satisfactory	Absent
16N/02W-31JT02	31JT02	Green	09-Sep-08	30.55	6.7	206	11.24	4.69	4.4	Satisfactory	Absent
16N/02W-31JT02	31JT02	Green	02-Dec-08	29.65	6.7	200	10.93	4.79	4.2	Satisfactory	Absent
16N/02W-31JT02	31JT02	Green	09-Mar-09	17.49	6.6	198	10.4	4.66	4.9	Satisfactory	Absent
16N/02W-31JT02	31JT02	Green	02-Jun-09	17.56	6.6	193	11.19	4.2	4.1	Satisfactory	Absent
16N/02W-31JT03	31JT03	Abner	09-Sep-08	30.07	6.7	206	11.14	4.68	4.2	Satisfactory	Absent
16N/02W-31JT03	31JT03	Abner	02-Dec-08	29.16	6.7	200	10.93	4.73	4.1	Unsatisfactory	Absent
16N/02W-31JT03	31JT03	Abner	10-Dec-08							Satisfactory	Absent
16N/02W-31JT03	31JT03	Abner	09-Mar-09	17	6.6	200	10.84	4.59	5.1	Satisfactory	Absent
16N/02W-31JT03	31JT03	Abner	02-Jun-09	17.07	6.6	195	11.18	4.22	4.4	Satisfactory	Absent
16N/02W-31JT04	31JT04	Brown	09-Sep-08	34.52	6.7	201	11.02	4.69	4.2	Satisfactory	Absent
16N/02W-31JT04	31JT04	Brown	02-Dec-08	33.77	6.7	201	10.97	4.69	4.3	Satisfactory	Absent
16N/02W-31JT04	31JT04	Brown	09-Mar-09	21.4	6.7	196	10.9	4.52	4.9	Satisfactory	Absent
16N/02W-31JT04	31JT04	Brown	02-Jun-09	21.52	6.6	195	11.09	4.41	4.2	Unsatisfactory	Absent
16N/02W-31JT05	31JT05	Mosby	09-Sep-08	34.63	6.7	202	11.1	4.36	5.2	Satisfactory	Absent
16N/02W-31JT05	31JT05	Mosby	02-Dec-08	33.91	6.6	198	10.99	4.56	5.3	Satisfactory	Absent

LOCALID	LOCALID	LASTNAME	DATESAMPLE	SWL	PH	COND	TEMP	DO	NITRATE	TOTAL COLIFORM	E_COLI
16N/02W-31JT05	31JT05	Mosby	09-Mar-09	21.53	6.6	195	10.7	4.5	5.1	Satisfactory	Absent
16N/02W-31JT05	31JT05	Mosby	02-Jun-09	21.66	6.6	192	11.22	4.39	4.7	Satisfactory	Absent
16N/02W-31KT05	31KT05	McDougal	09-Sep-08	35.86	6.6	185	11.06	6.21	5.8	Satisfactory	Absent
16N/02W-31KT05	31KT05	McDougal	03-Dec-08	34.44	6.5	190	10.81	7.14	5.6	Satisfactory	Absent
16N/02W-31KT05	31KT05	McDougal	04-Mar-09	20.74	6.5	174	10.79	7.89	5.9	Satisfactory	Absent
16N/02W-31KT05	31KT05	McDougal	01-Jun-09	22.65	6.4	152	11.07	6.63	5.2	Satisfactory	Absent
16N/02W-31KT06	31KT06	Metzger	09-Sep-08	37.21	6.6	206	10.99	4.71	6.6	Satisfactory	Absent
16N/02W-31KT06	31KT06	Metzger	01-Dec-08	36.62	6.6	201	10.83	4.64	6.0	Satisfactory	Absent
16N/02W-31KT06	31KT06	Metzger	04-Mar-09	23.93	6.5	198	10.75	4.53	5.3	Satisfactory	Absent
16N/02W-31KT06	31KT06	Metzger	01-Jun-09	23.75	6.5	186	11.11	4.7	5.2	Satisfactory	Absent
16N/02W-31KT07	31KT07	Heitstuman	10-Dec-08	30.91	6.3	178	10.92	8.8	6.5	Satisfactory	Absent
16N/02W-31KT07	31KT07	Heitstuman	04-Mar-09	17.62	6.4	150	10.91	9.41	5.2	Satisfactory	Absent
16N/02W-31KT07	31KT07	Heitstuman	01-Jun-09	17.29	6.3	134	11.61	8.6	4.8	Satisfactory	Absent
16N/02W-31MT01	31MT01	Kelley	10-Sep-08	34.85	6.4	171	12.24	4.5	6.0	Satisfactory	Absent
16N/02W-31MT01	31MT01	Kelley	10-Dec-08							Satisfactory	Absent
16N/02W-31MT02	31MT02	Foss	08-Sep-08	36.23	6.6	155	13.15	6.09	3.8	Satisfactory	Absent
16N/02W-31MT02	31MT02	Foss	03-Dec-08	35.26	6.7	161	10.51	6.33	4.1	Satisfactory	Absent
16N/02W-31MT02	31MT02	Foss	04-Mar-09	20.23	6.7	157	10.34	6.48	4.1	Satisfactory	Absent
16N/02W-31MT02	31MT02	Foss	03-Jun-09	20.62	6.6	147	11.4	6.6	5.1	Satisfactory	Absent
16N/02W-31NT04	31NT04	Wolverton	15-Sep-08	31.84	6.5	189	10.92	8.13	6.4	Satisfactory	Absent
16N/02W-31NT04	31NT04	Wolverton	10-Dec-08	31.27	6.5	190	1100	7.42	6.7	Satisfactory	Absent
16N/02W-31NT04	31NT04	Wolverton	10-Mar-09	18.67	6.5	182	10.9	6.78	5.8	Satisfactory	Absent
16N/02W-31NT04	31NT04	Wolverton	09-Jun-09	18.78	6.5	180	11.05	8.02	5.3	Satisfactory	Absent
16N/02W-31RT01	31RT01	Branam	09-Sep-08	30.52	6.4	149	11.22	3.5	4.5	Unsatisfactory	Absent
16N/02W-31RT01	31RT01	Branam	01-Dec-08	29.98	6.3	162	10.85	4.56	5.4	Unsatisfactory	Absent
16N/02W-31RT01	31RT01	Branam	11-Mar-09	17.7	6.4	145	10.88	6.32	4.1		
16N/02W-31RT01	31RT01	Branam	01-Jun-09	17.22	6.3	121	10.84	4.95	3.4		
16N/02W-32MT02	32MT02	Bredl	10-Sep-08	34	6.6	213	10.8	4.04	7.8	Unsatisfactory	Absent
16N/02W-32MT02	32MT02	Bredl	02-Dec-08	32.13	6.6	210	10.23	3.89	7.3		
16N/02W-32MT02	32MT02	Bredl	10-Dec-08							Satisfactory	Absent
16N/02W-32MT02	32MT02	Bredl	09-Mar-09	21.12	6.5	207	9.37	3.77	7.3	Satisfactory	Absent
16N/02W-32MT02	32MT02	Bredl	08-Jun-09	21.57	6.5	193	10.64	3.9	7.4		
16N/03W-33ET01	33ET01	Cookston	09-Dec-08	54.34	6.6	114	10.7	8.03	2.4	Satisfactory	Absent

LOCALID	LOCALID	LASTNAME	DATESAMPLE	SWL	PH	COND	TEMP	DO	NITRATE	TOTAL COLIFORM	E_COLI
16N/03W-33ET01	33ET01	Cookston	03-Mar-09	50.67	6.6	115	10.39	8.68	2.6	Satisfactory	Absent
16N/03W-33ET01	33ET01	Cookston	03-Jun-09	51.52	6.5	114	11.4	9.18	3.1	Satisfactory	Absent
16N/03W-33KT01	33KT01	Smith	09-Dec-08	45.08	6.5	120	10.41	6.84	2.2	Satisfactory	Absent
16N/03W-33KT01	33KT01	Smith	03-Mar-09	34.91	6.5	115	10.4	6.97	1.9	Satisfactory	Absent
16N/03W-33KT01	33KT01	Smith	09-Jun-09	36.78	6.4	115	10.65	7.24	2.9	Satisfactory	Absent
16N/03W-34M01	34M01	Palumbo	09-Dec-08	42.82	6.3	99	9.55	9.5	2.3	Satisfactory	Absent
16N/03W-34M01	34M01	Palumbo	03-Mar-09	28.8	6.2	114	10.06	8.7	2.3	Satisfactory	Absent
16N/03W-34M01	34M01	Palumbo	09-Jun-09	30.73	6.1	110	10.54	8.65	2.7	Satisfactory	Absent
16N/03W-36LT04	36LT04	Relaford	15-Sep-08	34.38	6.4	157	10.9	5.61	2.4	Satisfactory	Absent
16N/03W-36LT04	36LT04	Relaford	03-Dec-08	28.9	6.4	161	9.88	7.85	2.4	Satisfactory	Absent
16N/03W-36LT04	36LT04	Relaford	10-Mar-09	15.26	6.4	133	9.25	8.88	3.3	Satisfactory	Absent
16N/03W-36LT04	36LT04	Relaford	03-Jun-09	16.23	6.3	125	10.53	6.82	3.4	Satisfactory	Absent
16N/03W-36PT02	36PT02	Haury	16-Sep-08	45.37	6.4	142	11.53	6.18	3.2	Satisfactory	Absent
16N/03W-36PT02	36PT02	Haury	03-Dec-08	42.54	6.5	149	10.33	6.8	3.0	Satisfactory	Absent
16N/03W-36PT02	36PT02	Haury	10-Mar-09	29.44	6.4	146	9.58	8.68	3.1	Satisfactory	Absent
16N/03W-36PT02	36PT02	Haury	03-Jun-09	29.61	6.4	130	10.45	7.52	4.3	Satisfactory	Absent
16N/03W-36QT01	36QT01	Duranceau	08-Sep-08	39.94	6.6	168	13.66	7.01	5.2	Unsatisfactory	Absent
16N/03W-36QT01	36QT01	Duranceau	16-Sep-08							Unsatisfactory	Absent
16N/03W-36QT01	36QT01	Duranceau	03-Dec-08	39.77	6.6	167	10.77	6.48	4.5		
16N/03W-36QT01	36QT01	Duranceau	09-Mar-09	27.28	6.5	163	10.51	5.79	4.8	Satisfactory	Absent
16N/03W-36QT01	36QT01	Duranceau	09-Jun-09	27.61	6.5	159	11.27	6.25	3.3		
16N/03W-36QT02	36QT02	Strong	15-Sep-08	40.6	6.4	185	10.83	1.6	1.7	Satisfactory	Absent
16N/03W-36QT02	36QT02	Strong	03-Dec-08	37.49	6.4	182	10.75	3.81	2.4	Satisfactory	Absent
16N/03W-36QT02	36QT02	Strong	10-Mar-09	23.95	6.4	196	10.3	5.36	4.5	Satisfactory	Absent
16N/03W-36QT02	36QT02	Strong	10-Jun-09	25.18	6.3	169	11.19	4.4	2.2	Satisfactory	Absent