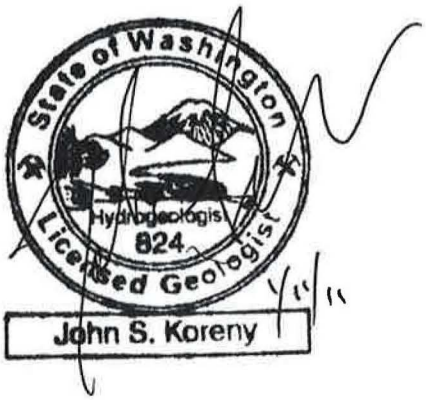
CITY OF HOQUIAM

Groundwater Supply Project

Phase II – Install Test Monitoring Wells Report



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1.0 INTRODUCTION

The City of Hoquiam (City) is evaluating the potential to develop a ground water supply at the City water treatment plant property to provide a supplemental and/or backup supply to the existing surface water supply. The project site is about 7 miles north of the City on Highway 101 in Grays Harbor County as shown on **Figure 1**.

The prior Phase I report identified the water treatment plant site as a potential site for ground water supply. There was very little previous information regarding the hydrogeologic conditions at the site. The goals of this Phase II study were to identify whether an aquifer exists that can provide a municipal ground water supply with adequate water quality. This Phase II report describes test well drilling, aquifer and water quality testing completed during April and May, 2010. Recommendations for installation of production wells and a treatment system are presented at the conclusion of the report.

2.0 BACKGROUND INFORMATION

The City currently operates diversion dams on Davis Creek and the West Fork Hoquiam River that provide a surface water supply. The dams are located about 7 miles north of the City. A water treatment plant is located on a property along Hwy 101 just south of the dams. The water is then conveyed by pipeline into the City. The City is evaluating the potential for developing a ground water supply that may serve as a supplemental and/or backup supply to the existing surface water supply.

2.1 Project Approach

Phase I Identify Potential Ground Water Supply Locations (Prior Phase)

HDR previously completed a planning-level study to identify a location for a wellfield. This is described in the January 2009 "*Water Supply Strategy Report*". The study indicated that the older (deep) sand and gravel deposits at the City treatment plant property near the West Fork Hoquiam River may support a municipal ground water supply. Several other locations were also considered, including the alluvial aquifer along the Hoquiam River and the unconsolidated sea level aquifer along the Chehalis River close to the City. However, these locations likely have poor water quality or may be vulnerable to contamination. The City decided to proceed with investigating the feasibility of developing a ground water supply on the water treatment plant property.

Phase II Install Test Monitoring Wells (Current Phase)

This phase of investigation included installing 6-inch diameter test wells with 5-inch diameter well screens, performing aquifer pumping tests and analyzing the water quality to ascertain the quantity and quality of ground water at the property.

Phase III Design, Install, and Test Production Wells (Future Phase)

If the City decides to proceed forward, the next phase of the project would involve installing one to two large-diameter production wells and performing multi-day aquifer tests to ensure that the wells are able to operate properly over a long-term period.

Phase IV Design and Construct Conveyance and Treatment System (Future Phase)

If the City decides to continue proceeding forward, the fourth phase of the project would involve designing the infrastructure to pump, treat, and convey the water from the production wells (drilled during Phase III) into the City's existing system. A treatment system would likely be needed (most likely an air-stripper) to remove constituents from the ground water. A bid design and specification would be prepared to construct the conveyance and treatment system.

2.2 Water Rights

Two applications were submitted to the Washington State Department of Ecology (Ecology) on August 7, 2009 to change/transfer two surface water rights on Davis Creek and the West Fork of the Little Hoquiam River to a ground water withdrawal. The Davis Creek surface water right is certificate number 82 with an instantaneous limit of 15 cubic feet per second (cfs) and a priority date of June 19, 1924 and the W. Fork Little Hoquiam River surface water right is certificate number 7103 with an instantaneous limit of 2.2 cfs and a priority date of June 19, 1953. A change/transfer was requested to add a ground water source in the amount of 1,000 gallons per minute (gpm). Ecology issued a preliminary permit on September 23, 2009 for water right application CS2-SWC82 and CS2-SWC7103. This preliminary permit expires October 29, 2011 as the City recently renewed the application for another year. A copy of the water right application and the preliminary permit is included in **Appendix A**.

2.3 Geologic Setting

The geology of the region is described in the Phase I investigation report (HDR, 2009) based on information from Eddy (1996), Moore (1965) and Rau (1986). The City-owned treatment plant property is located adjacent to the West Fork of the Hoquiam River within an north-south trending alluvial river valley. The uplands to the east and the west of the West Fork Hoquiam River valley are composed of a thin layer of glacial drift overlying the Montesano Formation or bedrock. **Figure 2** and **Figure 3** shows the geology and topography of the region.

The major geologic formations in the vicinity of the water treatment plant property are the older alluvial deposits of sand and gravel and the Montesano Formation. Sand and gravel deposits were observed along the scarps and banks of the West Fork Hoquiam River valley north of New London during field reconnaissance, as shown in the photograph on **Figure 4.** These sand and gravel deposits overlie low permeability siltstone and conglomerate which is probably the Montesano Formation. The river bed is incised through the sand and gravel deposits and is eroded into the conglomerate or siltstone with up to about 60 feet of total incision (see **Figure 4**).

A few domestic wells are completed in the sand and gravel deposits along New London Road. The drilling log for the Stoken residence well (located along New London Road directly south of the water treatment plant property) reports that the well was completed in "packed gravel" at a depth of 87 feet below grade, the depth to ground water was 67 feet below grade and the pumping test yielded 25 gpm with 0 ft of drawdown.

A dewatering well during the City water treatment plant construction also encountered ground water. City staff familiar with construction of the water treatment plant report large ground water pumping yields during construction dewatering. The aquifer is above the tidal zone and ground water quality is likely to be much better than the downstream alluvial aquifer. Specific information on water quality was not available on the domestic well logs. There are no other deep well logs in this area to establish the depth of sand and gravel deposits or the stratigraphy below the river bed exposures prior to test well drilling.

2.4 West Fork Hoquiam River

The West Fork Hoquiam River flows south along the northern and western border of the property. The West Fork of the Hoquiam River is tidally influenced about six linear miles north of the mouth of the Hoquiam River to about River Mile 9.5 near Dekay Road. The West Fork of the Hoquiam River is not tidally influenced above Dekay Road. Dekay Road is about one mile south of the water treatment plant property.

Tetra Tech (2003) reports that the flow in the West Fork Hoquiam River has been monitored in 1942, 1943 and 2002 at Dekay Road. The average flow in July, August and September ranged from 8 to 17 cfs over these three years. A hydrograph from 2002 and average flow statistics from 1942, 1943 and 2002 from the Tetra Tech (2003) report is presented in **Appendix B.**

3.0 TEST WELL DRILLING AND CONSTRUCTION

Three six-inch diameter test wells were installed at the water treatment plant property. The locations of the wells are shown on **Figures 5 and 6**. Prior to this investigation, little information was available regarding the site hydrogeology. The City decided to install six-inch diameter test wells to obtain data on hydrogeology and water quality prior to constructing larger-diameter production wells. Large-diameter production wells are expensive to install and test wells provide hydrogeologic data to optimize the placement of production wells.

Drilling and well installation was conducted by Arcadia Drilling of Montesano, Washington using a truck-mounted air-rotary drilling rig from April 22 to April 27, 2010. The wells were constructed by driving 6-inch diameter steel casing ahead of a tri-cone rotary drilling bit. Soil cuttings and accumulated water in the borehole were blown out of the casing using compressed air. Soil samples were collected as they were blown out of the borehole. Static water levels were measured regularly in the casing during drilling. Compressed air drill stem tests were used when ground water was encountered during drilling to estimate the potential ground water yield at depth as drilling progressed.

Once the desired completion depth was achieved, the 6-inch diameter casing was pulled back and a well screen was installed below the casing. Well screen was constructed of 5-inch diameter wire-wound stainless-steel Johnson well screen with 0.040 to 0.050-inch slot openings and a welded end cap. Five feet long well screen sections were welded together to form either 15 or 20 feet of well screen in each well. The annulus between the well screens and the casing was sealed using rubber packers. A sand filter pack was not installed around the well screen because the coarse sand and gravel deposits in the formation served as a natural filter pack. The wells were developed using air surging for about one hour to remove the fine sand and silt around the well screen. A sealed well cap was placed on the top of each well. The well logs for the three wells constructed are presented on **Figures 7, 8 and 9**. The well construction details are summarized in **Table 1** and ground water levels recorded on May 3, 2010 are in **Table 2**.

Table 1. Test well construction information.

Well ID	Well Const. Date	Surveyed Location		Elevation (ft msl)		Casing Above Ground (ft)	Borehole Depth (ft bgs)	Total Well Depth (ft bgs)	Well Screen Interval (ft bgs)
		Easting Coord.	Northing Coord.	Top of Casing	Ground Surface				
TW-1	22-Apr-10	650,749	785,690	54.45	52.42	2	179	178	163-178
TW-2	23-Apr-10	650,182	785,589	52.12	50.18	2	200	176	166-176
TW-3	26-Apr-10	650,819	785,279	36.10	33.66	2	180	156	136-156

Notes:
ft btoc = ft below top of casing
Well coordinates in State Plane Coordinate, feet

Table 2. Test Well 3 aquifer pumping test analysis results using Theis equation type curve matching.

	Observation Well 1	Observation Well 2
Transmissivity, T, (ft^2/day)	2,260	7,050
Hydraulic Conductivity, k, (ft/day)	30	94
Storativity, S, (unitless)	0.00067	0.0047

3.1. Test Well 1

Test Well 1 was located adjacent to the driveway to the treatment plant between Highway 101 and the main water treatment plant property and about 150 feet south of the West Fork Hoquiam River. The well log is presented in **Figure 7**. An upper confined sandy-gravel aquifer was encountered from 43 to 63 feet below ground surface (bgs) with a static water level at 31 feet bgs. This upper confined aquifer was air tested at 25 gallons per minute (gpm). A confining unit of silty sandy gravel was encountered from 63 to 78 feet bgs. A second confined aquifer of sandy gravel was encountered from 78 to 87 feet bgs with a static water level at 52 feet bgs. The air test for this second confined aquifer yielded 8 gpm. Grey clay was encountered from about 87 to 99 feet bgs. A sandy gravel aquifer that was encountered from 99 to 177 feet bgs. The static water level for this aquifer was 9 to 10 ft bgs when measured at 98 feet, 130 feet and 170 feet below grade. The aquifer was air tested at 100 gpm at 98 feet bgs, 30 gpm at 130 ft bgs and 100 gpm at 170 ft bgs. Drilling continued from 177 to 179 feet in sandy clay indicating a lower confining unit. The well was completed at 178 feet and a 15-foot long stainless steel well screen was set from 163 to 178 feet bgs. The static ground water level in the well was 9.5 feet below the top of casing at completion corresponding to an elevation of about 45 feet. The well was developed by air surging for about one hour.

3.2 Test Well 2

Test Well 2 was located about 500 ft south of the water treatment plant. The well log for TW-2 is presented on **Figure 8**. An upper water bearing zone of sandy silty gravel was encountered to a depth of 26 feet. A confining unit of silty gravel and then clay was present from 26 feet to 104 feet bgs. A sandy gravel confined aquifer with layers of silt and clay was present from 104 feet bgs to the bottom of the borehole at 200 feet bgs. An air test was completed at multiple depths in the interval from 104 to 200 feet bgs and produced only about 5 to 10 gpm, indicating that the confined aquifer is less productive at this location than at TW-1 and TW-3. The static level in the confined aquifer was about 20 feet below the top of casting at the time of well completion corresponding to an elevation of 30 feet. The well was developed by air surging for about one hour.

3.3 Test Well 3

Test Well 3 was located about 150 ft west of the current water treatment plant and about 100 feet south of the West Fork Hoquiam River. The well log for TW-3 is presented on **Figure 9**. A low-yield confined water bearing zone was encountered from about 17 to 76 feet bgs. This was underlain by a dry clay from 76 to 91 feet bgs. A deeper confined aquifer was encountered from 91 to 165 feet. An air test was completed at a depth of 155 feet resulting in a yield of about 120 gpm. The static water level in the deep aquifer was above the top of the ground surface (corresponding to an elevation of 44 feet) and the well was flowing indicating that the aquifer is artesian. Silty clay was encountered from 165 to 180 feet. The borehole was sealed with bentonite below 160 feet. The well completed at a depth of 156 feet with a 0.050-inch

slotted screen installed from 136 to 156 feet bgs. The well was developed by air surging for about one hour. After well development the well was flowing at a rate of between 30 and 40 gpm. The well was completed with a sampling port, a pressure valve and a vented standpipe due to the artesian conditions.

4.0 AQUIFER TESTING

An aquifer test was completed on wells TW-1 and TW-3 to evaluate the well performance and to obtain information on the hydraulic characteristics of the aquifer. A submersible pump was installed in each well by Arcadia Well Drilling. The well outflow during pumping was routed to a totalizing flow meter and through a discharge pipe. The drawdown in the pumping well was measured using a ground water level meter. The drawdown in the observation wells was measured using electronic recording pressure transducers and manually using a ground water level meter.

4.1 Test Well 1

The aquifer test for TW-1 was completed on April 29, 2010. A submersible pump was set in the well with the pump intake at about 150 feet below the top of casing. The pump test ran for about 4 hours. The well was pumped at 225 gallons per minute for about 2 hours with a total drawdown of about 145 feet below top of casing. This indicates that the well could not support this high of a ground water pumping rate. After 2 hours the pumping rate was reduced to 200 gpm and the ground water level again fell to about 145 feet below top of casing. The pumping rate was then reduced to 187 gpm and the final ground water level at the end of 4 hours of pumping was 133.4 feet below top of casing. The specific capacity of TW-1 is 1.4 gpm/ft. The pumping rate and drawdown during the test is shown on **Figure 10**. Drawdown was not recorded in TW-3 during aquifer test pumping because TW-3 was flowing during the test and a pressure valve was not yet installed on the well. Drawdown was not recorded in TW-2 due to instrument error.

4.2 Test Well 2

An aquifer test was not completed on TW-2 because the aquifer in the vicinity of the well does not produce enough ground water to support a municipal water supply.

4.3 Test Well 3

The aquifer test for TW-3 was completed on April 30, 2010. The initial pump rate was set to 250 gpm, but the pump was unable to sustain this pumping rate because methane in the well was coming out of solution during pumping caused the pump bowls to air lock. Reducing the pumping rate caused the pump to stabilize. After some trial and error the pump was found to be stable at 150 gpm. The well was pumped 150 gpm for about 7 hours and 30 minutes with a ground water level of about 64.5 feet below the top of casing and a total drawdown of 70 feet. The specific capacity of TW-3 is 2.1 gpm/ft. The pumping rate and drawdown in the pumping

well is shown on **Figure 11**. Drawdown was measured in observation wells TW-1 and TW-2 using electronic pressure transducers. About 2.8 feet of drawdown was recorded in observation well TW-1 and about 0.5 feet of drawdown was recorded in observation well TW-2, as shown on **Figures 12** and **13**.

The results of the TW-3 aquifer pumping test were analyzed using the software AquiferTest by Sclumberger Water Services (formerly Waterloo Hydrogeologic). The test was analyzed using the Theis equation and assumptions. The results from the TW-2 drawdown data indicate a transmissivity of 7,060 ft^2/day, a hydraulic conductivity of 94 ft/day and a storativity of 0.0047 and the results for the TW-1 observation well drawdown data indicate a transmissivity of 2,260 ft^2/day, a hydraulic conductivity of 30 ft/day and a storativity of 0.00067. This is typical of a medium permeability sandy gravel confined aquifer. These results are limited because the production well screen does not fully penetrate the aquifer and the pumping test did not extend long enough to test the long term response of the aquifer to pumping. A longer pumping test with a larger-diameter, full-penetrating production well would be needed to better define the aquifer yield. The type matching curve for the aquifer analysis is presented in **Figure 14**.

5.0 SUMMARY OF WELL DRILLING AND TESTING AND ANALYSIS OF HYDROGEOLOGIC CONDITIONS

This section summarizes the hydrogeology of the site based on the collected field data and regional geologic information from published reports. A ground water flow map is presented in **Figure 15** and a hydrogeologic cross-section is presented in **Figure 16**.

Three test wells were drilled at the subject property, TW-1, TW-2 and TW-3. An upper water bearing zone, a clay confining unit and a deep confined aquifer was encountered in the test wells during drilling. The deep confined aquifer was encountered in the three wells at depths ranging from about 99 to 104 ft below grade (elevation -50 to -60 feet below sea level) for the top of the aquifer to about 165 to 177 ft below grade (elevation -110 to -150 feet) at the bottom of the aquifer.

The static ground water level in the wells was measured on May 3, 2010. The ground water level measurements are reported on **Table 3**. Static ground water levels in the deep confined aquifer were above the ground surface at TW-3 (indicating artesian conditions) and near the ground surface in TW-1. The ground water levels in TW-1 and TW-3 are above the water surface in the West Fork Hoquiam River immediately north of the wells. The ground water flow direction on the water treatment plant is from the north to the south, as shown on **Figure 15**.

Table 3. Ground water levels and elevations recorded in test wells on May 3, 2010.

Well ID	Top of Casing Elevation (ft, NAVD '88)	5/3/2010 Depth to Ground Water (ft)	5/3/2010 Ground Water Elevation (ft NAVD '88)
TW-1	54.45	- 16.93	37.52
TW-2	52.12	- 15.97	36.15
TW-3	36.10	+ 2.86	38.96

Note:

1. *Depth to ground surface: Negative value indicates ground water level below ground surface, positive value indicates ground water level above ground surface.*

The deep confined aquifer in TW-1 and TW-3 produced about 100 to 120 gpm upon air testing during drilling, but TW-2 only produced about 5 to 10 gpm during air testing. This indicates that the aquifer is much less productive in the vicinity of TW-2 as compared to TW-1 and TW-3. Test wells TW-1 and TW-3 were completed with partially penetrating screens at the bottom 20 feet of the aquifer.

Aquifer pumping tests were completed in TW-1 and TW-3 to evaluate the yield of the deep confined aquifer. The pumping test rate at TW-1 and TW-3 was 150 to 225 gpm. Methane production in the well limited testing at a higher rate due to air-locking of the pump bowls. TW-1 was pumped for four hours with about 133 feet of drawdown in the pumping well and a specific capacity of 1.4 gpm/ft. TW-3 was pumped for about 7.5 hours at 150 gpm with about 65 feet of drawdown in the pumping well and a specific capacity of 2.1 gpm/ft. Drawdown was observed at the two observation wells TW-1 and TW-2 during pumping of TW-3 indicating that the aquifer is hydraulically-connected across the site. The results of the Theis analysis for the TW-2 observation well drawdown data during the TW-3 pumping test indicate a transmissivity of 7,060 ft^2/day, a hydraulic conductivity of 94 ft/day and a storativity of 0.0047 and the results for the TW-1 observation well drawdown data indicate a transmissivity of 2,260 ft^2/day, a hydraulic conductivity of 30 ft/day and a storativity of 0.00067. This is typical of a sandy gravel confined aquifer. The results from this aquifer test are only approximate, and are limited because the production well is not fully penetrating and the pumping test did not extend long enough to test the recharge or the lateral boundaries of the aquifer. A longer pumping test with a large-diameter, fully-penetrating production well would be needed to better define the long-term aquifer yield potential at the site.

6.0 GROUND WATER QUALITY SAMPLING AND ANALYSIS

6.1 Sample Collection Methods

Ground water samples were collected from each of the three test wells on May 18, 2010 after well development and aquifer pumping tests were completed. Prior to each ground water sampling event the wells were pumped to remove at least three well volumes using an electric pump. Samples collected for metals analysis were field filtered using an in-line QED 0.45 micron field filter and samples collected for the analysis of other parameters were not field filtered. Samples were placed in new, clean jars and preserved according to the EPA method for each analysis, placed on ice and delivered to the analytical laboratory. Zero head-space containers with rubber septums were used for samples submitted for methane, hydrogen sulfide and volatile organic compounds. Chain of custody forms were filled out by the HDR field representative. The samples were analyzed by AmTest, Inc. in Kirkland, Washington for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), poly-nuclear aromatic (PNAs) compounds, metals, several other inorganic compounds (chloride, fluoride and cyanide), methane and hydrogen sulfide.

6.2 Ground Water Quality Results

The analytical results for ground water samples from TW-1, TW-2 and TW-3 are presented and compared to the Federal drinking water standards in **Table 4**. The full analytical report is presented in **Appendix C**. The following is a summary of the ground water quality analytical results:

- **Methane:** Methane was detected in TW-1, TW-2 and TW-3 at levels ranging from 20 to 32 mg/l. Methane (CH_4) is a colorless and odorless flammable and explosive gas. Methane is the primary gaseous compound in natural gas. It is created by the decomposition of carbonaceous matter under anerobic conditions by bacteria. Methane occurring in ground water is created by a carbonaceous source rock or sediment and is released to an overlying aquifer. If the aquifer is confined and the ground water is under pressure the methane can not escape to the atmosphere and it dissolves into the water column. When the ground water is pumped to the surface the methane comes out of solution as a gas. Methane in air is flammable in the range of 5 to 15 percent by volume. A Federal drinking water standard has not been established for methane. Methane can be removed from drinking water supplies by aeration. A summary article on methane in potable ground water supplies is presented in **Appendix D**.
- **Hydrogen Sulfide:** Hydrogen sulfide is often found in ground water producing methane. However, hydrogen sulfide was reported at a concentration below the method detection limit for the samples from TW-1, TW-2 and TW-3.

- **Metals:** Metal compounds (listed in **Table 3**) were reported at concentrations below the Federal drinking water standards. Iron was reported at 0.2 mg/l[1] in TW-3 and the Federal drinking water standard for iron is 0.3 mg/l. The metals most commonly found in drinking water, manganese, iron and arsenic were well below the Federal drinking water standards. Manganese was reported at 0.03 mg/l in TW-3 and the Federal drinking water standard for manganese is 0.05 mg/l. Arsenic was very low at concentrations ranging from 0.0007 to 0.0009 mg/l.
- **Chloride:** Chloride was detected at 190 mg/l in TW-1, 230 mg/l in TW-2 and 290 mg/l in TW-3. The Federal drinking water standard for chloride is 250 mg/l.
- **Volatile Organic Compounds:** Toluene was detected at 261 µg/l[2] in TW-3. All other VOCs were below the method detection limit. The Federal drinking water standard for toluene is 1,000 µg/l. The concentration of Toluene in ground water may be reduced by aeration treatment.
- **Semi-Volatile Organic Compounds:** The SVOC compound bis (2-ethylhexyl) phthalate was detected at 17 µg/l. The method detection limit for this compound is 2 µg/l. There is no Federal drinking water standard for bis (2-ethylhexyl) phthalate. No other SVOCs were detected in the ground water samples from TW-1, TW-2 and TW-3.
- **Polynuclear Aromatic Hydrocarbons:** The analytical results for PNA compounds were reported to be below method detection limits.

[1] mg/l is an abbreviation for milligrams per liter or parts per million.
[2] µg/l is an abbreviation for nanograms per liter or parts per billion.

Table 4. Results of water quality analysis for TW-1, TW-2 and TW-3.

Parameter	Unit	TW-1	TW-2	TW-3	Federal Drinking Water Standard
Inorganic Parameters					
Chloride	mg/l	190	230	290	250
Fluoride	mg/l	<0.3	<0.3	<0.3	2
Total Cyanide	mg/l	0.02	0.015	0.015	0.2
Sulfide	mg/l	<1	<1	<1	--
Methane					
Methane	mg/l	23	32	20	--
Metals					
Aluminum	mg/l	<0.01	<0.01	<0.01	0.05 to 0.2
Antimony	mg/l	<0.001	<0.001	<0.001	0.006
Arsenic	mg/l	<0.001	<0.001	<0.001	0.01
Barium	mg/l	0.0007	0.0009	0.0007	2
Beryllium	mg/l	<0.0005	<0.0005	<0.0005	0.004
Cadmium	mg/l	<0.0005	<0.0005	<0.0005	0.005
Chromium	mg/l	<0.001	<0.001	<0.001	0.1
Copper	mg/l	<0.001	<0.001	<0.001	1.3
Iron	mg/l	0.036	0.032	0.2	0.3
Lead	mg/l	<0.001	<0.001	<0.001	0.015
Mercury	mg/l	<0.0001	<0.0001	<0.0001	0.002
Manganese	mg/l	0.0025	0.0025	0.0317	0.05
Selenium	mg/l	<0.01	<0.01	<0.01	0.05
Silver	mg/l	<0.01	<0.01	<0.01	0.1
Thallium	mg/l	<0.001	<0.001	<0.001	0.002
Zinc	mg/l	0.008	0.005	0.004	5
Volatile Organic Compounds (VOCs)					
Tolune	ug/l	<1	<1	261	1
Other VOCs	ug/l	BMDL	BMDL	BMDL	--
Semi Volatile Organic Compounds (SVOCs)					
bis(2-Ethylhexyl)phthalate	ug/l	17	<2	<2	--
Other SVOCs	ug/l	BMDL	BMDL	BMDL	--
Polynuclear Aromatic Hydrcarbons (PNAs)					
PNAs	ug/l	BMDL	BMDL	BMDL	--
Notes:					
BMDL: Below method detection limit.					
--: not applicable.					

7.0 APPROACH FOR DEVELOPING A GROUND WATER SUPPLY

This section presents a planning level summary of a potential approach for developing a ground water supply at the water treatment facility based on the information collected to date.

7.1 Options for Operating Ground Water System

Ground water production wells may be useful to the City to augment surface water supplies or to provide a backup supply in the event that an emergency spill along Highway 101 causes surface water to be contaminated or unreliable. If ground water production wells are successfully installed, they potentially could be used to provide additional supply to the City to facilitate future growth. Ground water wells could also potentially reduce the dependence on the West Fork Hoquiam River surface water supply, thereby reducing the City's vulnerability to contamination from a potential Highway 101 spill and reducing the need for continued maintenance at the West Fork dam.

7.2 Production Wells

The data collected during this Phase II test well drilling program indicate that a deep confined aquifer is present at the site that may be able to provide a municipal ground water supply. We estimate that one or several production wells pumping 500 gpm each may be possible. However, the recharge characteristics and the pumping yield of this aquifer are not fully known. The aquifer pumping test at the two test wells was not long enough to test the aquifer boundaries or to determine the late-time drawdown over pumping for several days.

The next phase (Phase III) would involve installing production wells at the site to test out the aquifer performance at full-scale pumping. The first step would involve drilling one 16-inch diameter production well. This well would be screened across the entire deep confined aquifer with a 12-inch diameter well screen. We suggest a pumping test be completed for at least 3-4 days until the late-time drawdown stabilizes in the production well and observation wells. Depending on the results of the first production well testing, it may be possible to install a second production well on the property. Hydrogeologic analysis and testing would be required to ascertain the aquifer yield and drawdown at the site to avoid well interference problems. A hydrogeologic report describing the results of production well installation and testing would be needed to be developed and filed with Ecology for the water right application.

7.3 Ground Water Quality

The water quality for the parameters of most-interest to the project are summarized in the Table 5. In general, this water can be characterized as a soft, clear groundwater that would be readily amenable for use by the City after some treatment for methane. Methane removal can be conducted with simple aeration. Aeration would also have a beneficial impact on toluene as well as a change in the water pH/alkalinity. Finally, chloride was found to be slightly above the

secondary maximum contaminant level in one well (TW-3) but below the MCL in the second well (TW-1). The following section describes each of these parameters in greater detail.

Table 5. Water Quality Results from Test Wells

Parameter	Federal/State Limits	Federal/State Goals	Test Well No. 1	Test Well No. 3
Primary Contaminants – Regulated for health issues				
Arsenic	0.010	0	<0.001	<0.001
Toluene	1.0	1.0	<0.001	0.261
Secondary Contaminants – Regulated for color, taste, and odor aesthetics				
pH	6.5 – 8.5	Not applicable	8.32	8.46
Iron	1.0	Not applicable	0.036	0.2
Manganese	0.050	Not applicable	0.0025	0.0317
Sulfide	None	Not applicable	<1	<1
Chloride	250	Not applicable	170	290
Other Contaminants				
Methane	See text	10	23	20
Alkalinity (as $CaCO_3$)	None	Not applicable	63	63
Hardness (as $CaCO_3$)	None	Not applicable	20	39

Notes:
1. All units in mg/L except pH.
2. All measurements obtained in lab from samples with zero air headspace.
3. Accuracy of pH and alkalinity values may be suspect due to long hold times.
4. All other values either below method detection limits or are not significant for treatment.

Methane

Methane was found in the range of 20 – 30 mg/L in collected samples from the test well. Methane is not a regulated contaminant by the United States Environmental Protection Agency nor by the Washington Department of Health. However, methane is considered a health hazard as it can readily be released from the water and collect into pockets of explosive gas inside plumbing, especially water heaters. The United States Office of Surface Mining Reclamation and Enforcement has published the guidance manual *Technical Measures for the Investigation and Mitigation of Fugitive Methane Hazards in Areas of Coal Mining* (2001). This manual includes recommendations for action based on the dissolved methane concentration in the water. Table 6 reproduces the recommendations table from that document. The document further notes that the concentrations associated with the action levels is based upon the potential for methane to off-gas and accumulate within confined spaces (especially water heaters, showers, and washing machines) to explosive atmospheric levels.

Table 6. Recommended Action Levels for Methane

Dissolved Methane Concentration (mg/L)	Recommended Action
>28	Immediate action
10 – 28	Warning and investigation
<10	No immediate action required
Source: Table 9 of Technical Measures for the Investigation and Mitigation of Fugitive Methane Hazards in Areas of Coal Mining (Office of Surface Mining Reclamation and Enforcement, 2001)	

Based upon the levels found in the test well samples, 50+% methane removal would be required to meet the upper limit of the no immediate action level. As a general recommendation, HDR would propose a greater removal rate be the treatment goal in order to provide operational flexibility and cushion in case of water quality and treatment performance variations. The upper limit for removal will be dictated by treatment costs as greater removal results in higher capital and operational costs as well as changes to water pH and alkalinity, which is discussed later in this section.

The recommended treatment option for methane is aeration in order to strip the dissolved methane out of the water prior other treatment steps. Aeration enhances methane's natural tendency to off-gas in controlled method using ambient air, and no other chemicals.

Toluene

Toluene was the one primary contaminant detected in the test sample from Well No. 3, but the concentration was substantially less than the 1.0 mg/L regulatory limit and USEPA recommended treatment goal. Toluene is also readily removed by the same aeration step used for methane, with the end result being that the toluene in groundwater would be even further below the regulatory requirements and goals for treatment. The proposed aeration treatment can not remove toluene to below non-detectable or state reporting levels without being prohibitively expensive to build and operate.

Chloride

The chloride concentration in TW-3 (290 mg/l) slightly exceeds the secondary limit (250 mg/l) and the chloride concentration in TW-1 (170 mg/l) is slightly below the limit. The chloride is likely due to older ground water with residual chloride levels. The chloride is not from salt water intrusion, because the brackish salt water zone of tidal influence is at least several miles to the south. High chloride (≥250 mg/L) is regulated as a secondary contaminant due to perceptions of salty taste by some drinking water consumers. The extent and perceived detriment of high chloride is very person-specific as everyone's perceptions of taste are different. The City should be aware that this is a public perception issue that may be noted by some taste-sensitive individuals. Treatment for chlorides requires reverse osmosis, which is

expensive to install and operate and is not recommended for the City's specific situation. Blending with surface water may reduce the chloride concentrations.

7.4 Conveyance and Treatment Infrastructure

This section presents a concept design to convey water from one or more production wells to an aeration treatment system and into the City's treatment plant. Based upon comments received from the City during the HDR site visit on July 28, 2010, the City's initial approach was to have the groundwater introduced to the front of the existing surface water direct filtration treatment plant to assist in blending down untreated river water turbidity. The conceptual design of that facility involves the installation of a packed aeration tower that treats the groundwater. The treated groundwater is then blended with river water in a new vault prior to the raw water pump station.

An alternate design suggested during the site visit was to have the treated groundwater discharge to the clearwell instead. Such a design would mean that the filter plant does not blend down turbidity but rather reduces operation. This design is equally viable but would need further consideration during the next phase the project.

8.0 CONCEPTUAL OPINION OF PROBABLE COSTS

8.1 Cost Estimate for Phase III- Design and Install Production Wells

A cost estimate was requested from Arcadia Drilling in June 2010 to install up to two 16-inch diameter production wells with 12-inch diameter well screens to a depth of approximately 200 feet and completed in the deep confined aquifer. The cost estimate from Arcadia includes pump installation and setup for two aquifer pumping test. The Arcadia cost estimate (**Appendix E**) is $325,000 to install and pump test two production wells. This cost estimate would be reduced by about one-half if only one production well is installed. The Arcadia cost estimate is reproduced below. The professional engineering fees to install two production wells and to complete the hydrogeologic and water quality testing for the project is estimated to range between $75,000 to $125,000, depending on the actual requirements of the project and the degree of complexity of the hydrogeologic analysis and whether ground water modeling is needed.

Phase III Cost Estimate- Design and Install Production Wells

Description	Cost Estimate
Install and Test One to Two Production Wells- Arcadia Drilling	$195,000 to $325,000
Professional Engineering and Testing	$75,000 to $125,000
Total	$270,000 to $450,000

8.2 Cost Estimate for Phase IV - Design and Construct Conveyance and Treatment Infrastructure

The table in **Appendix E** lists the conceptual opinion of probable construction costs for pumps and electrical controls for the production wells, conveyance piping and an aeration system that treats groundwater and discharges it to a blending chamber prior to the raw water pump station. A treatment system that involves discharging the treated water to clearwell could be of comparable costs but further evaluation is required. Finally, a treatment system that has the ability to discharge treated groundwater both prior to the raw water pump station and into the clearwell would have higher costs than those shown in the table in **Appendix E**. The infrastructure design and construction cost estimate ranges from $2.2 to 3.3 million.

9.0 CONCLUSIONS AND NEXT STEPS

Three test wells were installed and tested at the City water treatment plant property. The results of aquifer and water quality testing indicate that a confined aquifer is present with a ground water flow direction from the north to the south and a hydraulic conductivity ranging from 30 to 94 ft/day. Full-scale production wells may yield in the range of 500 gpm or more. However, multi-day aquifer pumping tests on a large-diameter, fully-penetrating production well are needed to test and evaluate the aquifer yield potential.

Water quality testing indicated that inorganic compounds (such as iron and manganese) are below the Federal drinking water limits and guidelines. Methane was detected in the range of 20-30 mg/l. Methane is a flammable gas that comes out of solution when ground water is pumped to the surface. Even though there are is no Federal drinking water standard for methane, treatment by aeration would be needed to reduce the explosive hazard. Toluene is a volatile organic compound detected at 261 µg/l in TW-3 that is likely a by-product from the production of methane in the aquifer. The Federal drinking water standard for toluene is 1,000 µg/l. Treatment by aeration for methane would also likely significantly reduce toluene concentrations. Chloride concentrations were 170 mg/l in TW-1 and 290 mg/l in TW-3. The secondary Federal drinking water standard for chloride is 250 mg/l. Treatment for chloride would require reverse osmosis which is likely infeasible due to cost considerations. However, the chloride concentrations could be reduced by blending with surface water or ground water if necessary. The water quality at production wells may vary from the test well results described above.

A phased approach to installing production wells at the site will facilitate testing out the aquifer performance at full-scale pumping. A large-scale production well could be drilled with a 16-inch diameter casing and a 12-inch diameter well screen completed at a depth of about 200 feet into the deep confined aquifer. A 3-4 day pumping test may be needed to evaluate long-term aquifer performance. Based on the results of this test, a second production well may be possible.

Based upon comments received from the City during the HDR site visit on July 28, 2010, the City's initial approach was to have the groundwater introduced to the front of the existing surface water direct filtration treatment plant to assist in blending down untreated river water turbidity. The conceptual design of that facility involves the installation of a packed aeration tower that treats the groundwater. The treated groundwater is then blended with river water in a new vault prior to the raw water pump station.

An alternate design suggested during the site visit was to have the treated groundwater discharge to the clearwell instead. Such a design would mean that the filter plant does not blend down turbidity but rather reduces operation. This design is equally viable but would need further consideration during the next phase the project.

The planning-level costs to install and test two 16-inch diameter production wells is about $325,000 and the cost for hydrogeologic analysis, field monitoring, water quality testing and analysis and report preparation is estimated at $75,000 to $125,000. The median planning-level cost estimate for submersible pumps, controls, conveyance pipeline, aeration treatment and alterations to the current treatment plant is about $2,209,000 with about $150,000 in engineering and permitting costs.

10.0 REFERENCES

Eddy, P.A., 1966. Preliminary Investigation of the Geology and Ground Water resources of the Lower Chehalis River Valley and Adjacent Areas, Grays Harbor County, Washington, Water Supply Bulletin 30, Washington State Division of Water Resources, Olympia, Washington.

HDR, Inc., 2009. City of Hoquiam, Phase I Ground Water Supply Investigation, In: Water Supply Strategy Report. Prepared for City of Hoquiam, Washington.

Moore, J.L., 1965. Surficial Geology of the Southwestern Olympic Peninsula. University of Washington Master of Science Thesis, Seattle, Washington.

Rau, W., 1986. Geologic Map of the Humptulips Quadrangle and Adjacent Areas, Grays Harbor County, Washington. Washington Department of Natural Resources, Olympia, Washington.

Tetra Tech, 2003. 2002 Chehalis Basin Instream Flow Study, Technical Appendix. Prepared for Chehalis Basin Partnership.

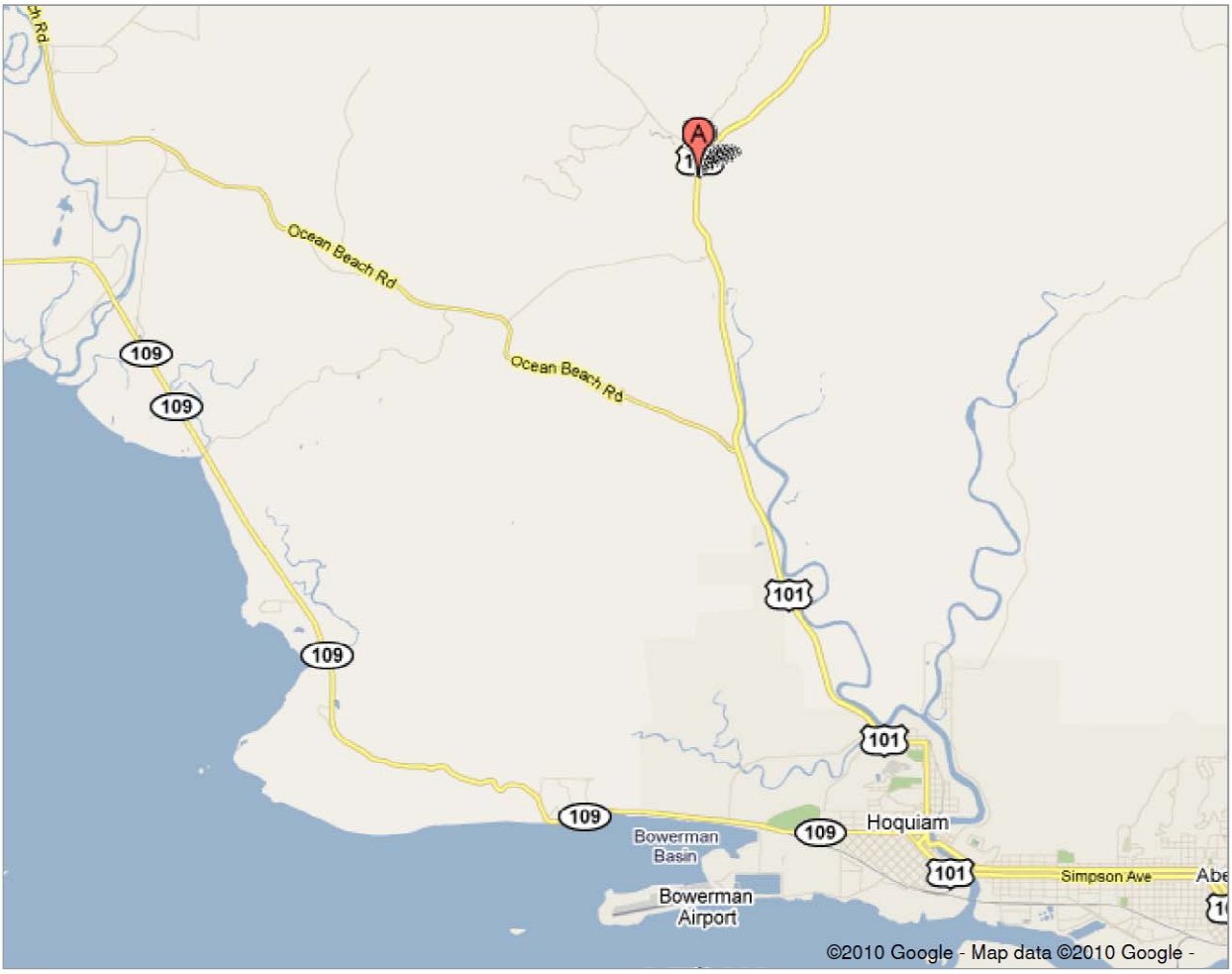


Figure 1. Location of City of Hoquiam water treatment plant property.

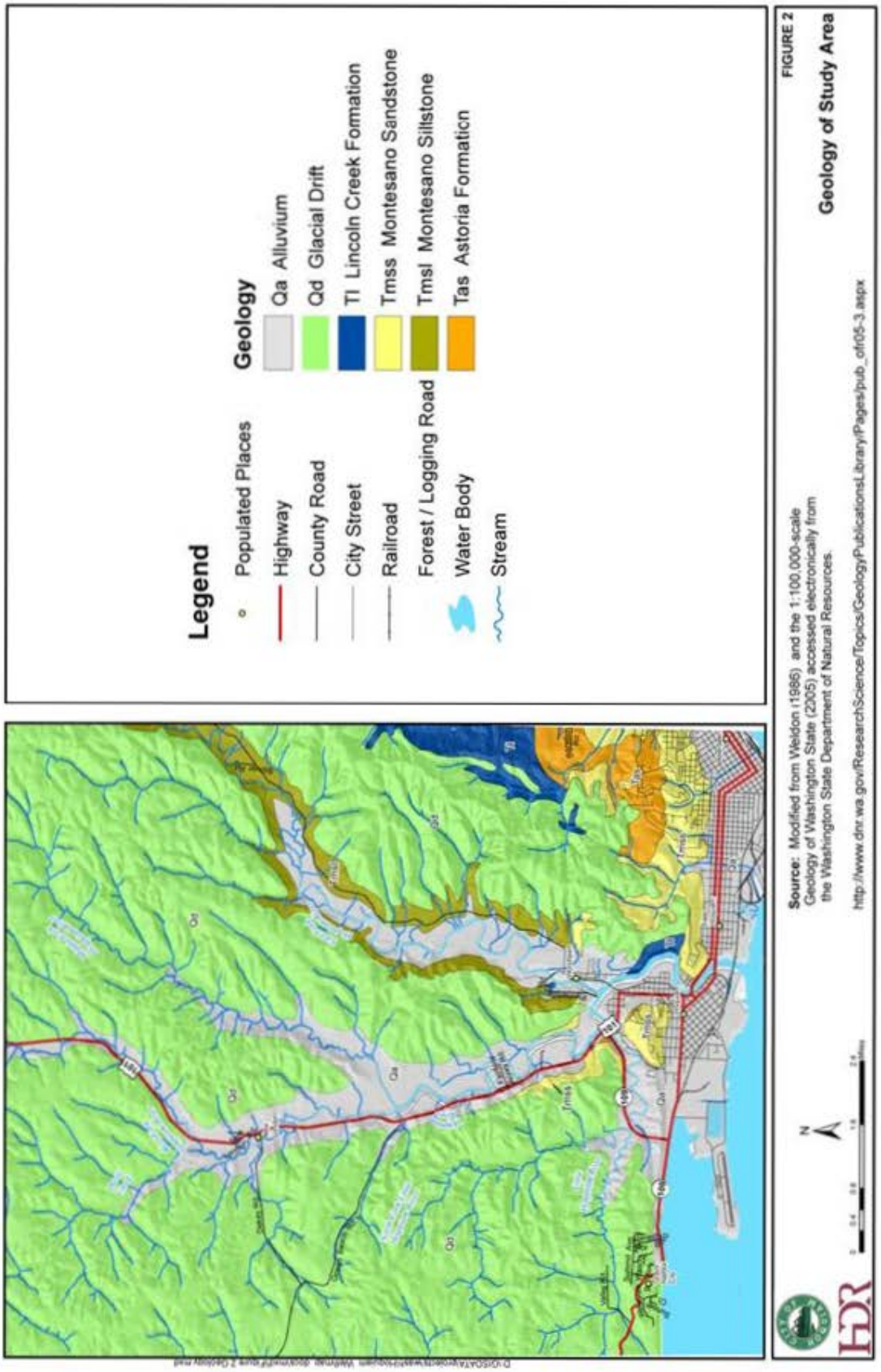


Figure 2. Geology of study area.

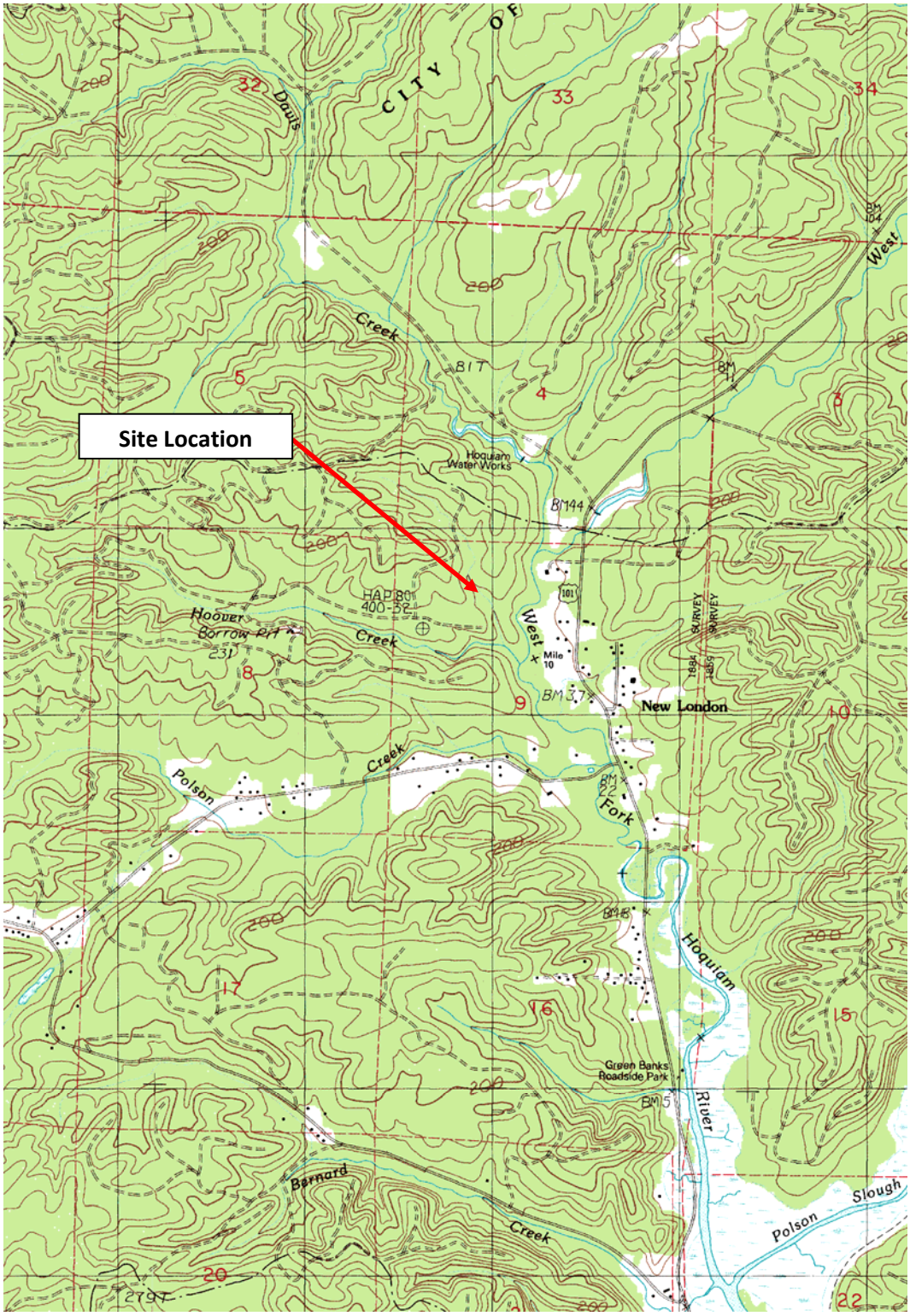


Figure 3. Topographic map of area surrounding project site.

Figure 4. Photograph of sand and gravel deposits exposed in the scarp north of the City water treatment plant along the left bank of the West Fork Hoquiam River. Siltstone and conglomerate is present at the base of the scarp and in the bed of the river.

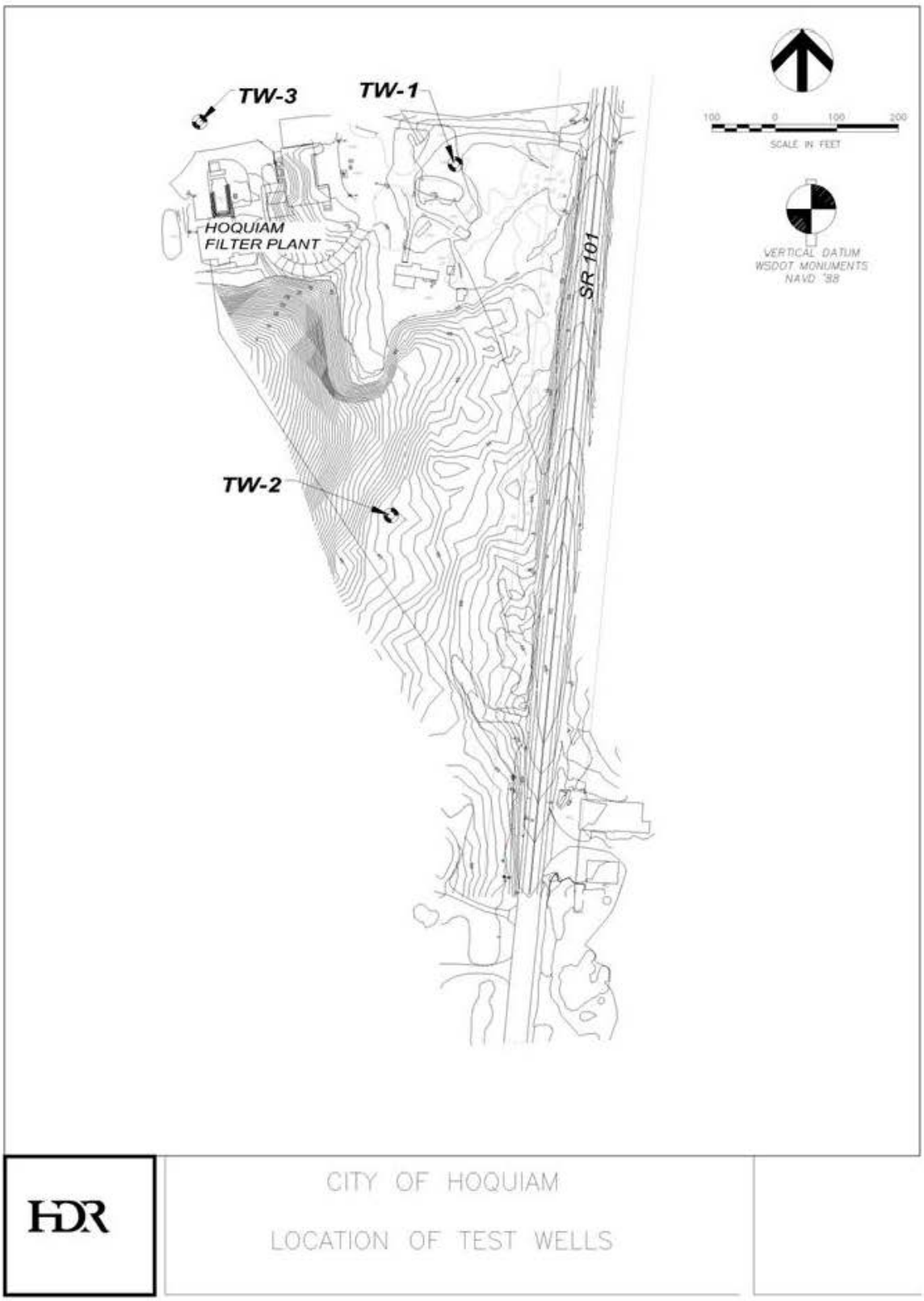


Figure 5. Location of TW-1, TW-2, TW-3 on Hoquiam water treatment plant property.

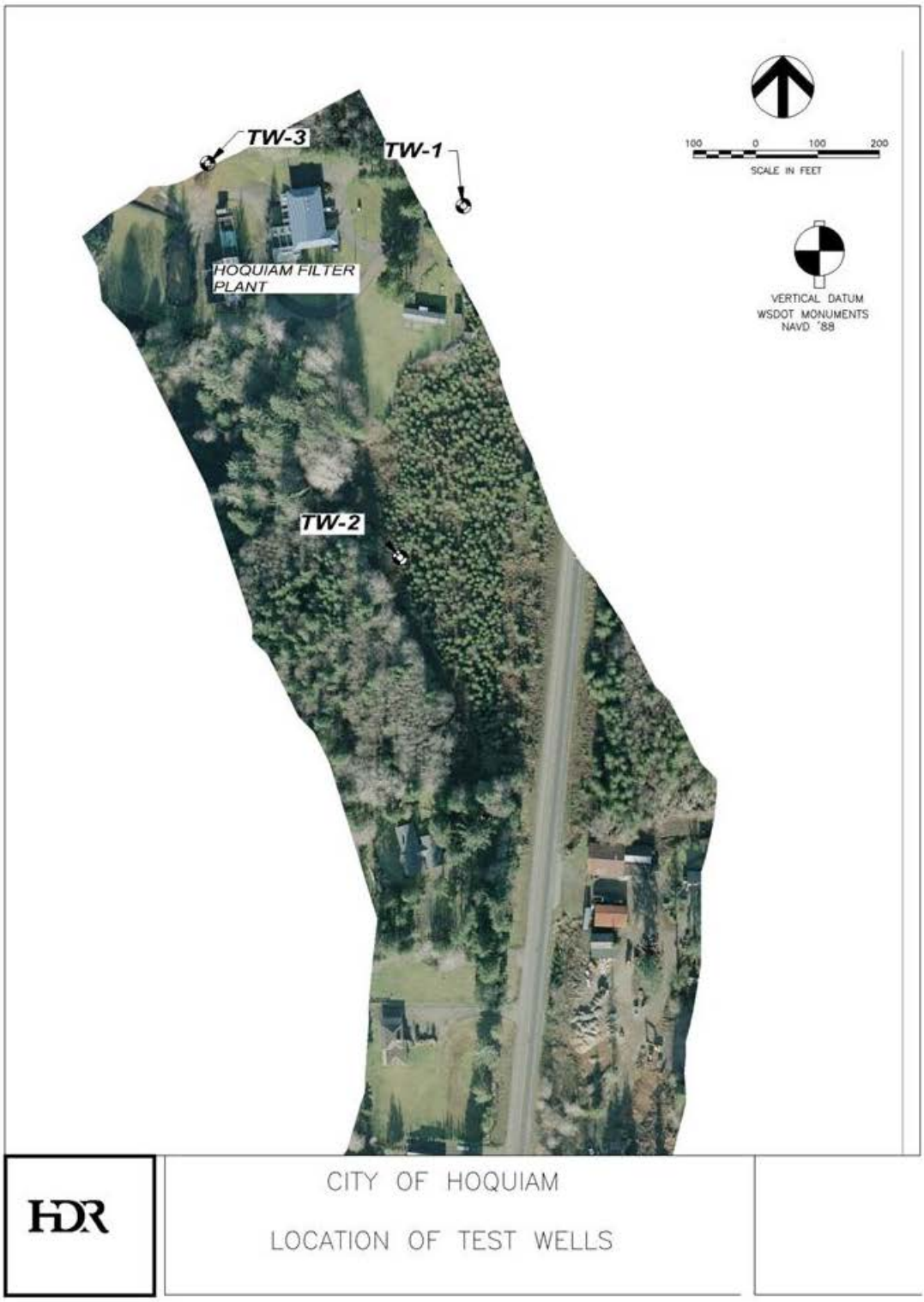


Figure 6. Location of TW-1, TW-2, TW-3 on Hoquiam water treatment plant property (aerial view).

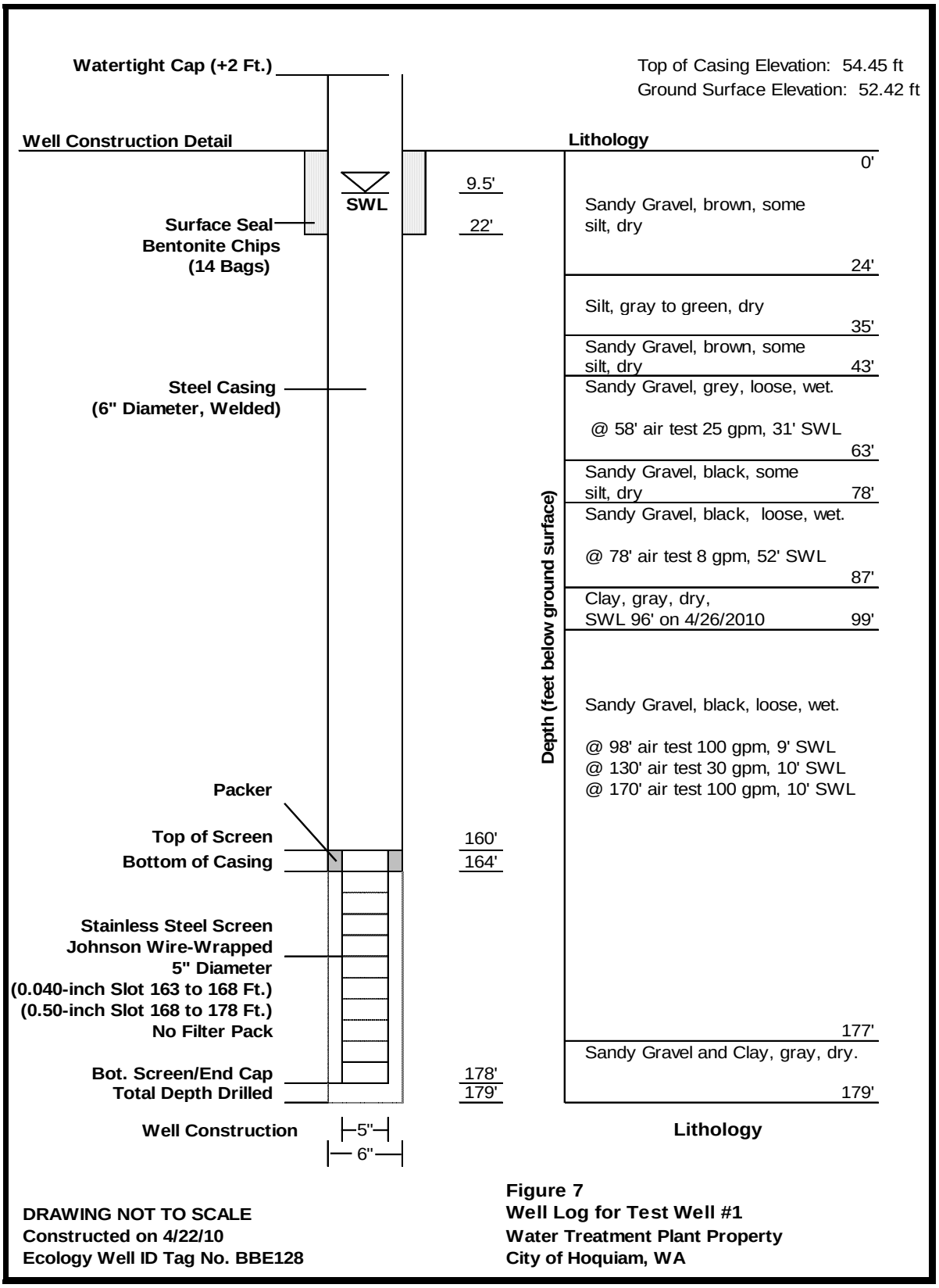


Figure 7. Well Log for Test Well #1.

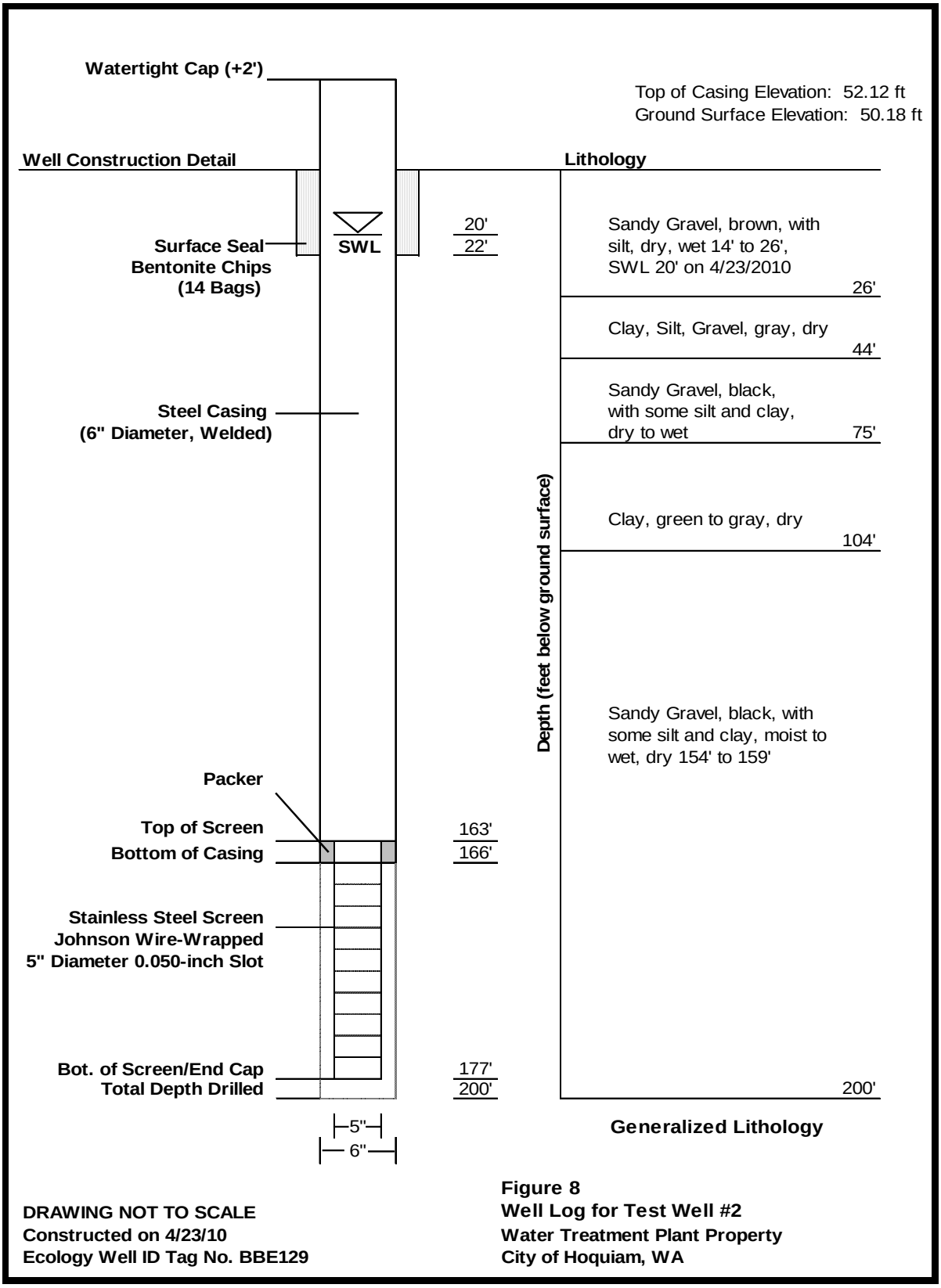


Figure 8. Well Log for Test Well #2.

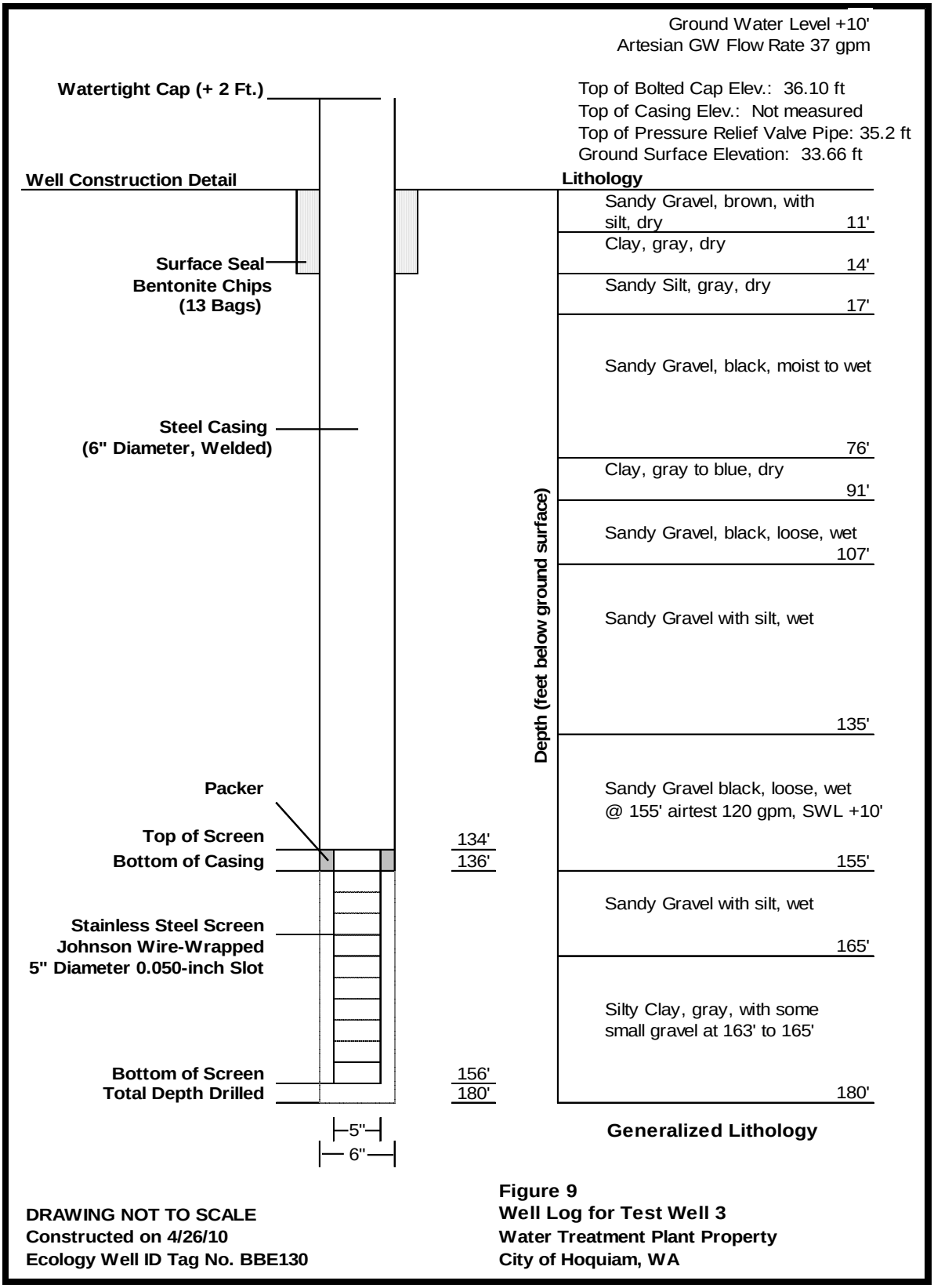


Figure 9. Well Log for Test Well #3.

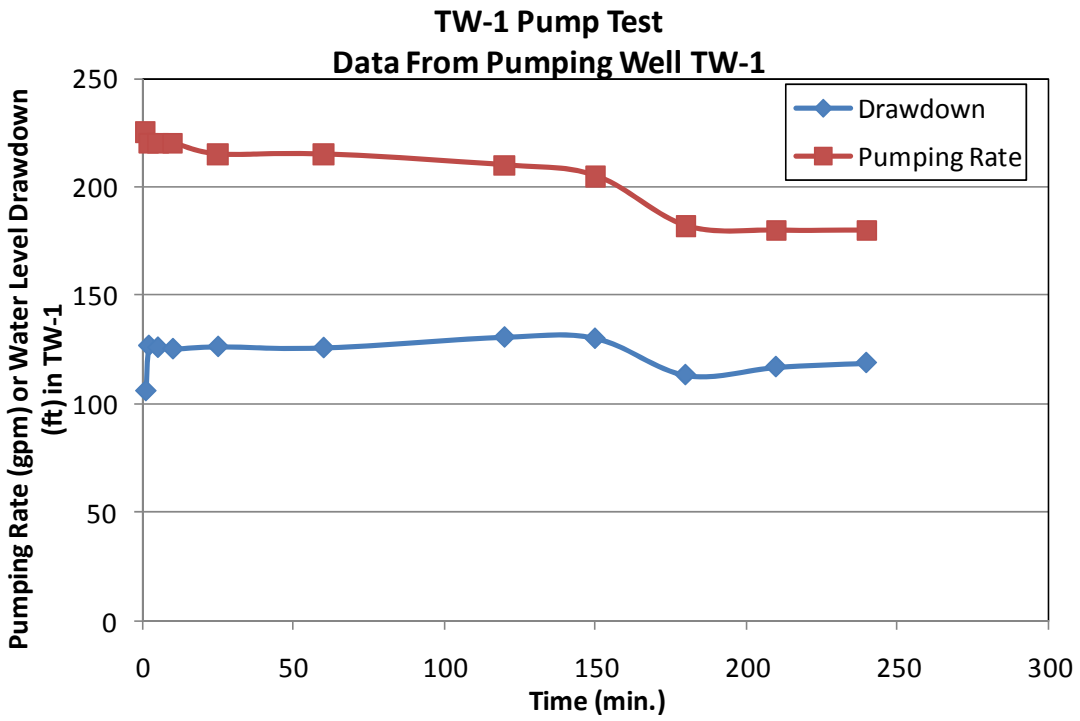


Figure 10. Drawdown and pumping data from TW-1 (pumping well) during TW-1 pump test.

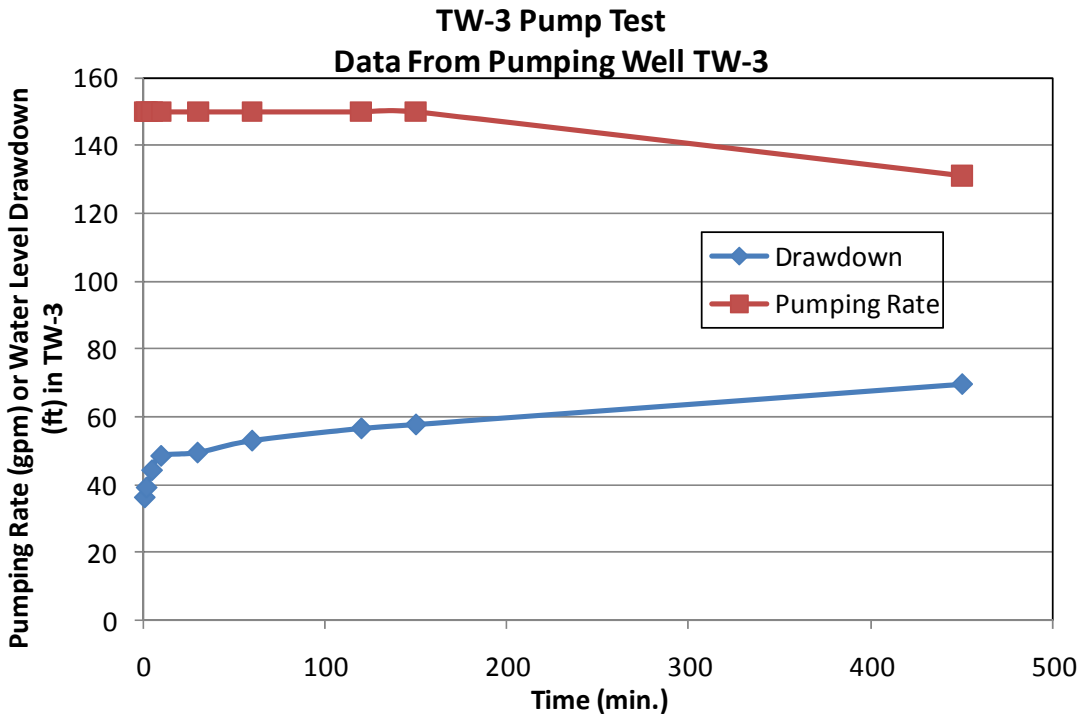


Figure 11. Drawdown and pumping data from TW-3 (pumping well) during TW-3 pump test.

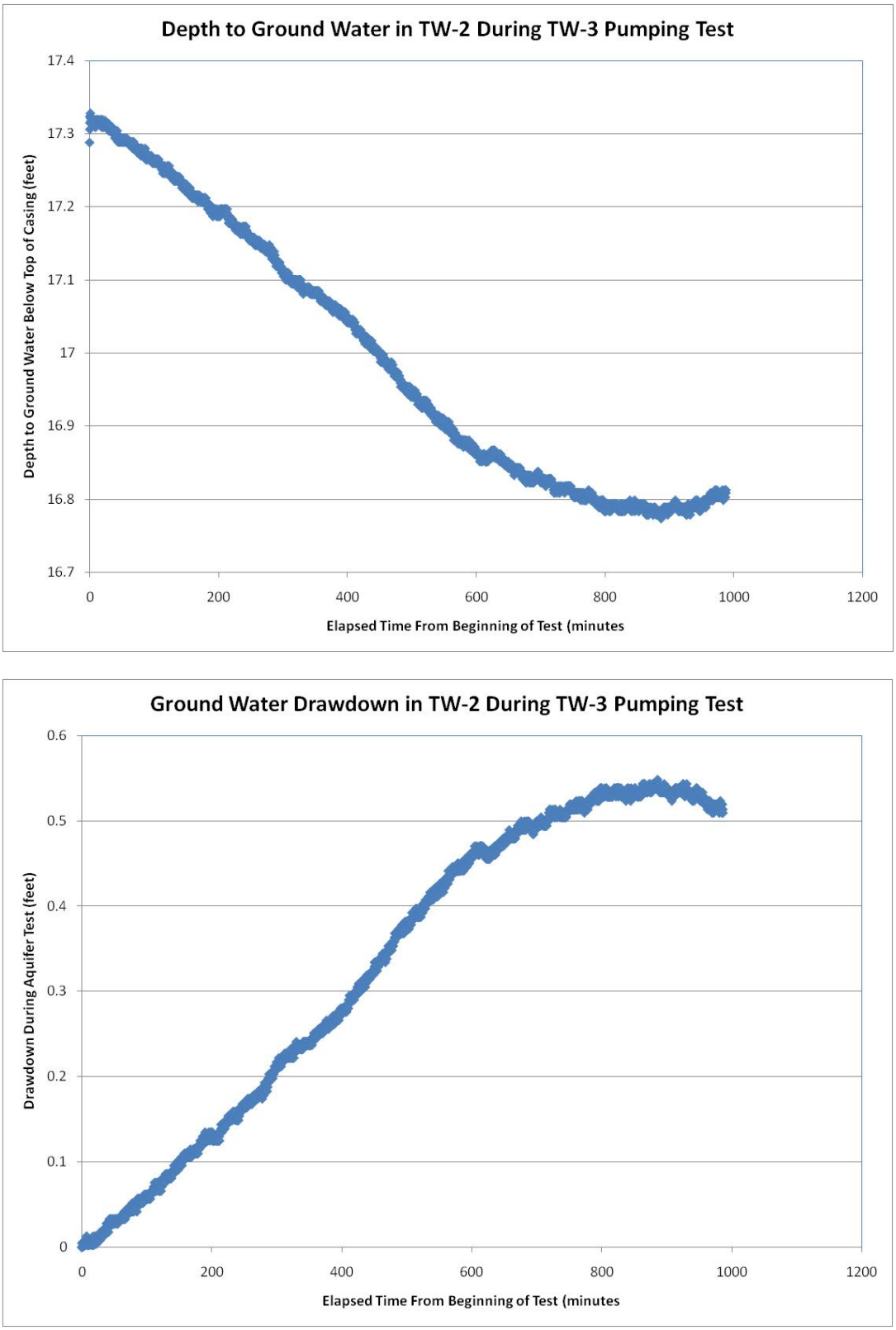


Figure 12. Depth to ground water and drawdown in TW-2 during TW-3 aquifer pumping test.

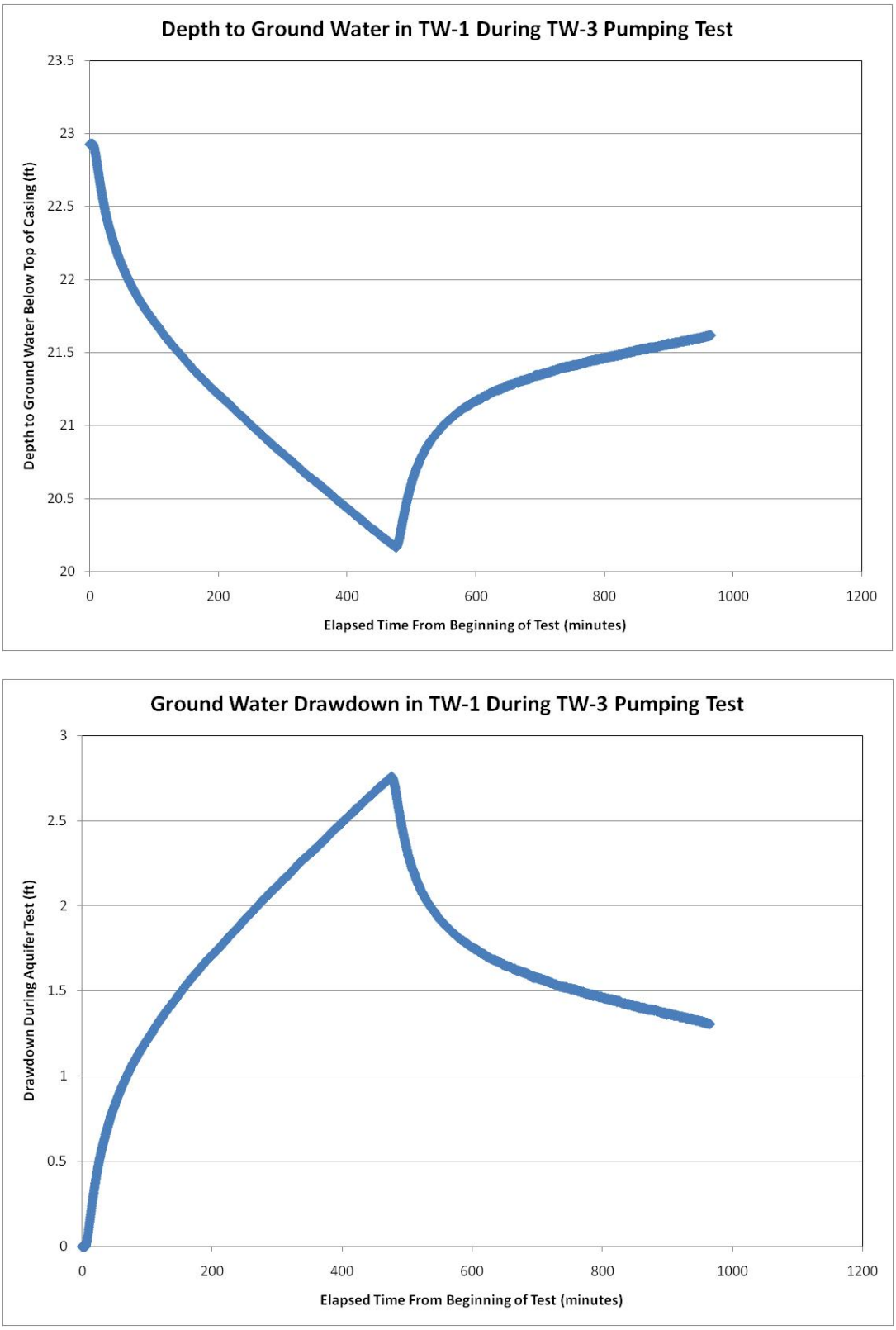


Figure 13. Depth to ground water and drawdown in TW-1 during TW-3 aquifer pumping test.

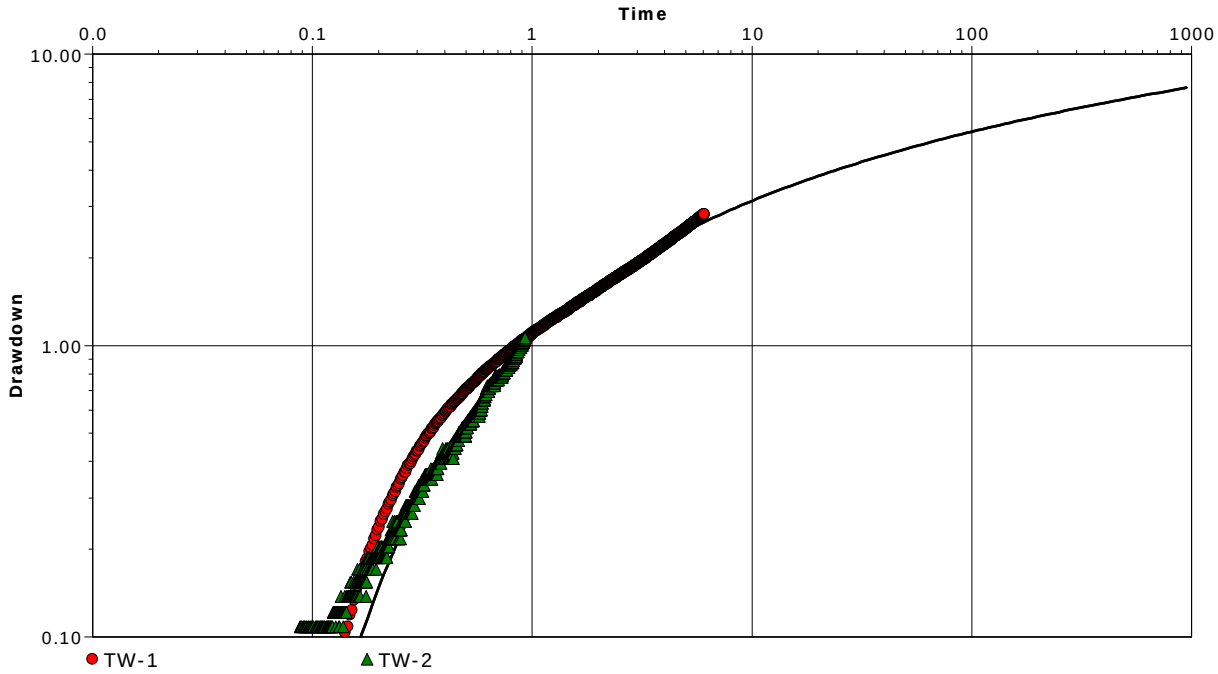


Figure 14. Results of aquifer pumping test analysis for TW-3 (pumping) and TW-1 and TW-2 (observation wells) using Theis equation type curve matching.

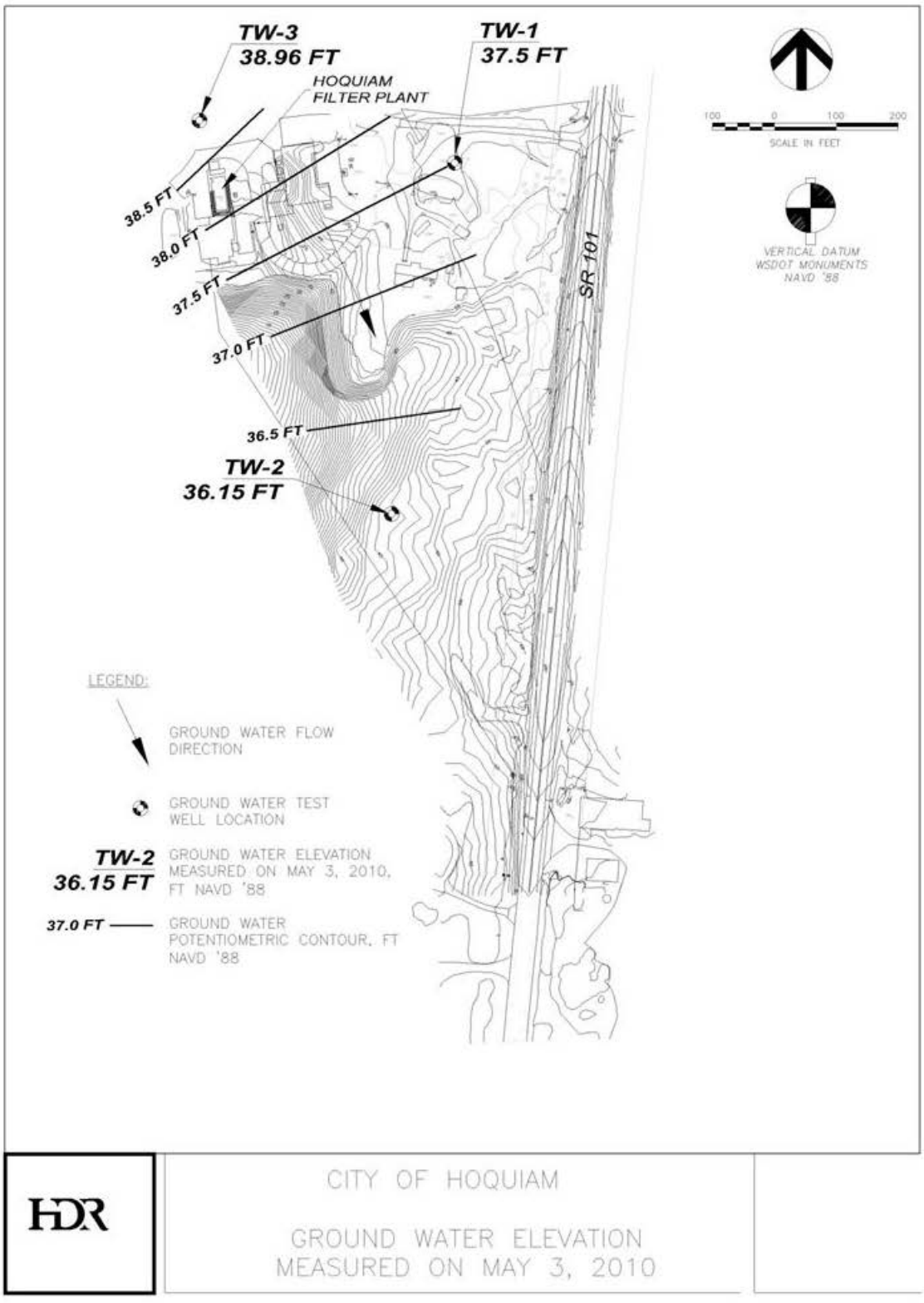


Figure 15. Ground water potentiometric surface and flow direction based on May 3, 2010 water level measurements.

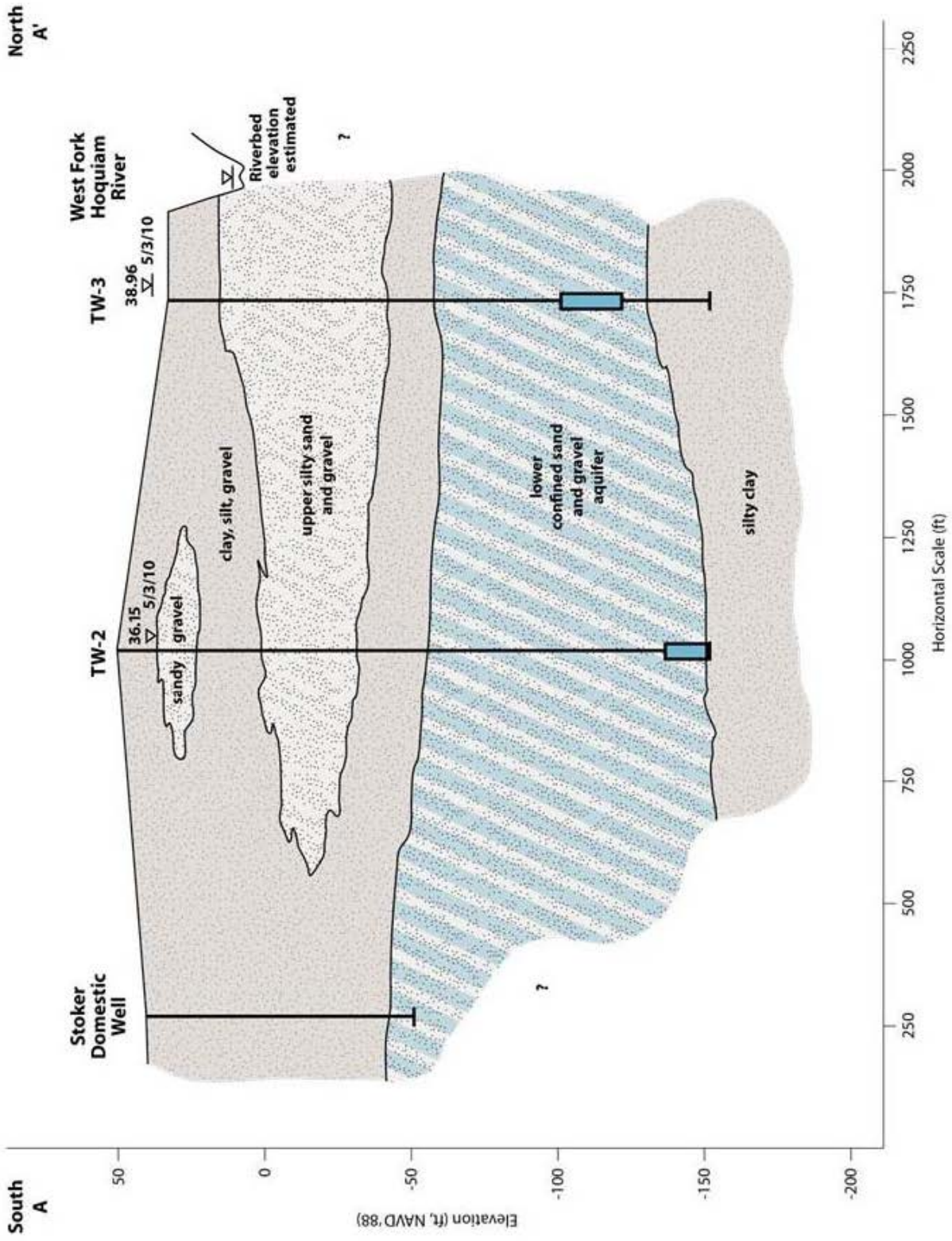


Figure 16. Hydrogeologic cross-section through project site from north to south.

APPENDIX A
WATER RIGHT INFORMATION

CITY OF HOQUIAM
609 8th St.
Hoquiam, WA 98550
www.cityofhoquiam.com

August 7, 2009

City Hall Departments
(360)532-5700

. Mayor, Ext. 219
Fax (360)532-4031

. City Administrator, Ext. 243
Fax (360)538-0938

. City Attorney, Ext. 231
Fax (360)532-4031

. Finance Dept., Ext. 0
Fax (360)532-2306

. Municipal Court, Ext. 235
Fax (360)533-3602

. Community Services, Parks & Cemetery, Ext. 240
Fax (360)538-0938

. Public Works, Ext. 240
- Building & Planning, Ext. 251
- Building, Ext. 223
- Planning & Code Enf., Ext. 211
Fax (360)538-0938

. Utilities
- Billing, Ext. 233 or 248
- Water Shop, Ext. 236
- Sewer Shop, Ext. 212
Fax (360)532-2306

Library (360)532-1710
420 7th St.
Hoquiam, WA 98550
Fax (360)538-9608

Police Dept. (360)532-0892
215 10th St.
Hoquiam, WA 98550
Fax (360)532-0899

Fire Department
(360)532-5700, Ext. 262
625 8th St.
Hoquiam, WA 98550
Fax (360)532-3340

Mr. Tom Loranger
Water Resources Section Manager
Department of Ecology
Southwest Regional Office
PO Box 47775
Olympia WA 98504-7775

Dear Mr. Loranger:

The City of Hoquiam would like to develop a ground water supply to either supplement or replace existing surface water supplies on the West Fork Hoquiam River and/or Davis Creek. We anticipate developing a ground water supply with a capacity of about 1,000 gpm. HDR, Inc. completed a Phase I investigation that identified a potential location for the ground water supply on City property near the current water treatment plant located about six miles north of the City. We are now prepared to complete a Phase II investigation to install test wells to evaluate the yield potential of the aquifer. Once the aquifer yield investigations are complete, we will know the potential supply capacity. Mr. John Koreny with HDR has discussed the project with Mr. Phil Crane at Ecology over the last several months and Mr. Crane advised that the next step is to file for a preliminary permit application. Mr. Koreny has submitted the Phase I investigation report and a copy of the scope for the Phase II study to Mr. Crane.

Enclosed is an application for change/transfer for two of our existing surface water rights, SW Certificate Nos. 82 and 7103 in the Hoquiam River watershed. Surface Water Certificate No. 82 is for 15 cubic feet per second (cfs) from Davis Creek and Surface Water Certificate No 7103 is for 2.2 cfs from the West Fork Hoquiam River. These change applications are to add a point/points of withdrawal for up to 1,000 gallons per minute (gpm) from a new well/well(s) in the vicinity of the City's water treatment plant located approximately one mile downstream of the two surface water diversions.

The following are also included to support these two applications:

- Surface Water Certificate No. 82
- Surface Water Certificate No. 7103
- Technical Memorandum Phase I Potential Hoquiam Groundwater Supply (submitted previously to Phil Crane)

- Proposed Scope of Work for Phase II Ground Water Supply Project (submitted previously to Phil Crane)
- A check for $100 for the application processing fee

The City is requesting a preliminary water right permit. The City has retained HDR, Inc. to perform the next phase of investigation, which includes installation of test wells to determine aquifer characteristics and productivity. We would appreciate Ecology's review and comment on the Phase II scope of services and information on other items that would be required to issue a water right for the 1,000 gpm ground water supply.

Please let me know if you need any additional information for processing this request.

Sincerely,

Brian Shay
City Administrator

Enclosures

Copy:

Phil Crane
Department of Ecology
Southwest Regional Office
PO Box 47775
Olympia WA 98504-7775

John Koreny
HDR, Inc.
500-108th Avenue NE
Suite 1200
Bellevue, WA 98004

DEPARTMENT OF ECOLOGY
State of Washington

STATE OF WASHINGTON

APPLICATION FOR CHANGE/TRANSFER OF WATER RIGHT

For filing with the Department of Ecology or with County Conservancy Boards

A NON-REFUNDABLE MINIMUM FEE OF $50.00 PAYABLE TO THE DEPARTMENT OF ECOLOGY MUST ACCOMPANY THIS APPLICATION

(Check all that apply.)

- ☐ Change purpose(s) of use
- ☐ Add purpose(s) of use
- ☐ Change point(s) of diversion/withdrawal
- ☒ Add point(s) of diversion/withdrawal
- ☐ Change/transfer place of use
- ☐ Other (i.e. consolidation, intertie, trust water)

Explain:_____

FOR OFFICE USE ONLY

CHANGE No._____ WRIA_____

DATE ACCEPTED____/____/____ BY_____

FEE $_____ REC'D ____/____/____

CHECK No. _____

ECY Coding: 001-002-WR10285-000011

SEPA: ☐ Exempt ☐ Not exempt

IF MORE SPACE IS NEEDED, ATTACH ADDITIONAL SHEETS (PLEASE PRINT OR TYPE CLEARLY)*

1. Applicant Information:

APPLICANT/BUSINESS NAME	PHONE NO.	FAX NO.
City of Hoquiam	(360) 532-5700	(360) 538-0938
ADDRESS 609 8th Street		
CITY Hoquiam	STATE WA	ZIP CODE 98550

CONTACT NAME (IF DIFFERENT FROM ABOVE)	PHONE NO.	FAX NO.
Brian Shay, City Administrator	( )	( )
ADDRESS		
CITY	STATE	ZIP CODE

2. Water Right Information:

WATER RIGHT OR CLAIM NUMBER	RECORDED NAME(S)
Surface Water Certificate No. 82	Hoquiam Water Company
DO YOU OWN THE RIGHT TO BE CHANGED? ☒ YES ☐ NO IF NO, PROVIDE OWNER(S) NAME and ADDRESS:	
HAS THE WATER BEEN PUT TO BENEFICIAL USE IN THE LAST FIVE (5) YEARS? ☒ YES ☐ NO	

Please attach copies of any documentation that demonstrates consistent, historical use of water since the right was established. Also, if you have a water system plan or conservation plan, please include a copy with your application.

FOR OFFICE USE ONLY

APP. NO._____ PERMIT NO. _____ CERT. NO._____ CERT. OF CHANGE NO._____

3. Point(s) of Diversion/Withdrawal:

A. Existing

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
Davis Creek				4	18N	10W		NA

B. Proposed

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
Davis Creek				4	18N	10W		NA
Well or Wells Well or Wells				4 1	18N	10W		

DO YOU OWN THE EXISTING AND PROPOSED POINT(S) OF DIVERSION/WITHDRAWAL?

EXISTING: ☒ YES ☐ NO PROPOSED: ☒ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Please include copies of all water well reports involved with this proposal. Also, if you know the distances from the nearest section corner to the above point(s) of diversion/withdrawal, please include that information in Item No. 6 (remarks) or as an attachment.

4. Purpose of Use:

A. Existing

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE
Municipal	15 cfs	NA	Continuously

B. Proposed

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE

5. Place of Use:

A. Existing

LEGAL DESCRIPTION OF LANDS WHERE WATER IS PRESENTLY USED:

Area Served by the City of Hoquiam, as described in the most recent Water System Plan approved by the Washington State Department of Health for the City of Hoquiam.

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES
		NA	NA	NA	Grays Harbor		

DO YOU OWN ALL THE LANDS IN THE EXISTING PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

B. Proposed

LEGAL DESCRIPTION OF LANDS WHERE NEW USE IS PROPOSED:

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES

DO YOU OWN ALL THE LANDS IN THE PROPOSED PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Attach a detailed map of your proposed change/transfer. The map should show existing and proposed point(s) of diversion/withdrawal, place of use and any other features involved with this application. If platted property, please include a certified copy of the plat map.

Are there any ADDITIONAL WATER rights OR CLAIMS RELATED to the same property as the ONE PROPOSED FOR CHANGE/TRANSFER?
☒ YES ☐ NO – IF YES, PROVIDE THE WATER RIGHT/CLAIM NUMBER(S): SW Certificate No. 7103, Water Right Claim No. 119139

6. Remarks and Other Relevant Information:

The purpose of this application is to add a point of withdrawal for a well or wells in the New London area in the vicinity of the City's existing water treatment plant to withdraw up to 1,000 gallons per minute, to be used in addition to the existing right to pump up to 15 cfs from Davis Creek, with the total from the existing surface water source and the proposed ground water sources not to exceed the existing surface water right of 15 cfs.

IF FOR SEASONAL OR TEMPORARY, START DATE __/__/____ END DATE __/__/____

Certain applications may incur a Real Estate Excise Tax liability for the seller of the water rights. The Department of Revenue has requested notification of potential taxable water right related actions and therefore may be provided with a copy of this request.

Please contact the State Department of Revenue for further information. The phone number is (360) 570-3265. The address is: Department of Revenue, Real Estate Excise Tax, PO Box 47477, Olympia, WA 98504-7477.

7. Signatures:

I certify that the information above is true and accurate to the best of my knowledge. I understand that in order to process my application, I am hereby granting staff from the Department of Ecology or the County Conservancy Board access to the above site(s) for inspection and monitoring purposes. If assisted in the preparation of the above application, I understand that all responsibility for the accuracy of the information rests with me.

Brian J Shay (Applicant) 8/17/2009 (Date)

(Water Right Holder) / / (Date)

(Land Owner(s) of Existing Place of Use) / / (Date)

IMPORTANT! APPLICATION FILING INFORMATION IS PROVIDED ON THE NEXT PAGE.

WE ARE RETURNING YOUR APPLICATION FOR THE FOLLOWING REASON(S):

☐ APPLICATION FEE NOT ENCLOSED ☐ MAP NOT INCLUDED or INCOMPLETE

☐ ADDITIONAL SIGNATURES REQUIRED ☐ SECTION _____ IS INCOMPLETE

☐ OTHER/EXPLANATION:_____

STAFF: _____ ***DATE:*** ____/____/____

ATTACHMENT FOR

APPLICATION FOR CHANGE

Point(s) of Diversion/Withdrawal - ☐ Existing ☐ Proposed:

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #

DO YOU OWN THE ABOVE POINT(S) OF DIVERSION/WITHDRAWAL? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Purpose(s) of Use - ☐ Existing ☐ Proposed:

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE

Place of Use - ☐ Existing ☐ Proposed:

LEGAL DESCRIPTION OF LANDS

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES

DO YOU OWN ALL THE LANDS IN ABOVE PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

DEPARTMENT OF ECOLOGY
State of Washington

STATE OF WASHINGTON

APPLICATION FOR CHANGE/TRANSFER OF WATER RIGHT

For filing with the Department of Ecology or with County Conservancy Boards

A NON-REFUNDABLE MINIMUM FEE OF $50.00 PAYABLE TO THE DEPARTMENT OF ECOLOGY MUST ACCOMPANY THIS APPLICATION

(Check all that apply.)

- ☐ Change purpose(s) of use
- ☐ Add purpose(s) of use
- ☐ Change point(s) of diversion/withdrawal
- ☒ Add point(s) of diversion/withdrawal
- ☐ Change/transfer place of use
- ☐ Other (i.e. consolidation, intertie, trust water)

Explain:_____

FOR OFFICE USE ONLY

CHANGE No._____ **WRIA**_____

DATE ACCEPTED____/____/____ **BY**_____

FEE $_____ **REC'D** ____/____/____

CHECK No. _____

ECY Coding: 001-002-WR10285-000011

SEPA: ☐ **Exempt** ☐ **Not exempt**

*****IF MORE SPACE IS NEEDED, ATTACH ADDITIONAL SHEETS (PLEASE PRINT OR TYPE CLEARLY)*****

1. Applicant Information:

APPLICANT/BUSINESS NAME	PHONE NO.	FAX NO.
City of Hoquiam	(360) 532-5700	(360) 538-0938
ADDRESS 609 8th Street		
CITY Hoquiam	STATE WA	ZIP CODE 98550

CONTACT NAME (IF DIFFERENT FROM ABOVE)	PHONE NO.	FAX NO.
Brian Shay, City Administrator	( )	( )
ADDRESS		
CITY	STATE	ZIP CODE

2. Water Right Information:

WATER RIGHT OR CLAIM NUMBER	RECORDED NAME(S)
Surface Water Certificate No. 7103	City of Hoquiam
DO YOU OWN THE RIGHT TO BE CHANGED? ☒ YES ☐ NO IF NO, PROVIDE OWNER(S) NAME and ADDRESS:	
HAS THE WATER BEEN PUT TO BENEFICIAL USE IN THE LAST FIVE (5) YEARS? ☒ YES ☐ NO	

Please attach copies of any documentation that demonstrates consistent, historical use of water since the right was established. Also, if you have a water system plan or conservation plan, please include a copy with your application.

FOR OFFICE USE ONLY

APP. NO._____ PERMIT NO. _____ CERT. NO._____ CERT. OF CHANGE NO._____

3. Point(s) of Diversion/Withdrawal:

A. Existing

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
West Fork Hoquiam R.		**NE**	**SE**	**4**	**18N**	**10W**		NA

B. Proposed

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
West Fork Hoquiam R		**NE**	**SE**	**4**	**18N**	**10W**		NA
Well or Wells Well or Wells				**4** **1**	**18N**	**10W**		

DO YOU OWN THE EXISTING AND PROPOSED POINT(S) OF DIVERSION/WITHDRAWAL?

EXISTING: ☒ YES ☐ NO PROPOSED: ☒ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Please include copies of all water well reports involved with this proposal. Also, if you know the distances from the nearest section corner to the above point(s) of diversion/withdrawal, please include that information in Item No. 6 (remarks) or as an attachment.

4. Purpose of Use:

A. Existing

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE
Municipal	2.2 cfs	NA	Continuously

B. Proposed

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE

5. Place of Use:

A. Existing

LEGAL DESCRIPTION OF LANDS WHERE WATER IS PRESENTLY USED:

Area Served by the City of Hoquiam, as described in the most recent Water System Plan approved by the Washington State Department of Health for the City of Hoquiam.

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES
		NA	NA	NA	Grays Harbor		

DO YOU OWN ALL THE LANDS IN THE EXISTING PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

B. Proposed

LEGAL DESCRIPTION OF LANDS WHERE NEW USE IS PROPOSED:

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES

DO YOU OWN ALL THE LANDS IN THE PROPOSED PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Attach a detailed map of your proposed change/transfer. The map should show existing and proposed point(s) of diversion/withdrawal, place of use and any other features involved with this application. If platted property, please include a certified copy of the plat map.

Are there any ADDITIONAL WATER rights OR CLAIMS RELATED to the same property as the ONE PROPOSED FOR CHANGE/TRANSFER?
☒ YES ☐ NO – IF YES, PROVIDE THE WATER RIGHT/CLAIM NUMBER(S): SW Cert 82, Water Right Claim No. 119139

6. Remarks and Other Relevant Information:

The purpose of this application is to add a point of withdrawal for a well or wells in the New London area in the vicinity of the City's existing water treatment plant to withdraw up to 990 gallons per minute, to be used in addition to the existing right to pump up to 2.2 cfs from W. Fork Hoquiam River, with the total from the existing surface water source and the proposed ground water sources not to exceed the existing surface water right of 2.2 cfs.

IF FOR SEASONAL OR TEMPORARY, START DATE ___/___/_____ END DATE ___/___/_____

Certain applications may incur a Real Estate Excise Tax liability for the seller of the water rights. The Department of Revenue has requested notification of potential taxable water right related actions and therefore may be provided with a copy of this request.

Please contact the State Department of Revenue for further information. The phone number is (360) 570-3265. The address is: Department of Revenue, Real Estate Excise Tax, PO Box 47477, Olympia, WA 98504-7477.

7. Signatures:

I certify that the information above is true and accurate to the best of my knowledge. I understand that in order to process my application, I am hereby granting staff from the Department of Ecology or the County Conservancy Board access to the above site(s) for inspection and monitoring purposes. If assisted in the preparation of the above application, I understand that all responsibility for the accuracy of the information rests with me.

Brian J. Shay *(Applicant)* 8/7/09 *(Date)*

(Water Right Holder) / / *(Date)*

(Land Owner(s) of Existing Place of Use) / / *(Date)*

IMPORTANT! APPLICATION FILING INFORMATION IS PROVIDED ON THE NEXT PAGE.

WE ARE RETURNING YOUR APPLICATION FOR THE FOLLOWING REASON(S):

☐ APPLICATION FEE NOT ENCLOSED ☐ MAP NOT INCLUDED or INCOMPLETE

☐ ADDITIONAL SIGNATURES REQUIRED ☐ SECTION _____ IS INCOMPLETE

☐ OTHER/EXPLANATION:_____

STAFF: _____ ***DATE:*** ____/____/____

ATTACHMENT FOR
APPLICATION FOR CHANGE

Point(s) of Diversion/Withdrawal - ☐ Existing ☐ Proposed:

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #

DO YOU OWN THE ABOVE POINT(S) OF DIVERSION/WITHDRAWAL? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Purpose(s) of Use - ☐ Existing ☐ Proposed:

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE

Place of Use - ☐ Existing ☐ Proposed:

LEGAL DESCRIPTION OF LANDS

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES

DO YOU OWN ALL THE LANDS IN ABOVE PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

CERTIFICATE RECORD No. One, PAGE No. 82

STATE OF WASHINGTON, COUNTY OF Grays Harbor

CERTIFICATE OF WATER RIGHT

(For rights perfected under original, enlargement or secondary permits.)
(In accordance with the provisions of Chapter 117, Laws of Washington for 1917, and the regulations of the State Hydraulic Engineer thereunder.)

This is to certify, that Hoquiam Water Company, *of* Hoquiam, *State of* Washington, *has made proof to the satisfaction of the State Supervisor of Hydraulics of Washington, of a right to the use of the waters of* Davis Creek, *a tributary of* a branch of Hoquiam River *for the purposes of* Municipal supply for the city of Hoquiam *under* Appropriation *Permit No.* 428, *of the State Supervisor of Hydraulics, and that said right to the use of said waters has been perfected in accordance with the laws of Washington, and is hereby confirmed by the State Supervisor of Hydraulics of Washington and entered of record in Volume* One, *at Page* 82, *on the* 7th *day of* November, 19 25; *that the right hereby confirmed dates from* June 19, 19 24; *that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed* 15 *cubic feet per second.*

A description of the lands under such right, and to which the water hereby confirmed is appurtenant, or if for other purposes, the place where such water is put to beneficial use, is as follows:

Township	Range	Section	Forty-Acre Tract	No. Acres Described in Permit	No. Acres Actually Irrigated
Municipal supply for the City of Hoquiam					

The right to the use of the water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in Section 39, Chapter 117, Session Laws 1917.

WITNESS the seal and signature of the State Supervisor of Hydraulics affixed this 7th *day of* November, 19 25

R. K. Tiffany
State Supervisor of Hydraulics

CERTIFICATE RECORD No. 15, PAGE No. 7202

STATE OF WASHINGTON, COUNTY OF Grays Harbor

CERTIFICATE OF SURFACE WATER RIGHT

(In accordance with the provisions of Chapter 117, Laws of Washington for 1917, and amendments thereto, and the rules and regulations of the State Supervisor of Water Resources thereunder.)

This is to certify that CITY OF HOQUIAM

of Hoquiam, State of Washington, has made proof to the satisfaction of the State Supervisor of Water Resources of Washington, of a right to the use of the waters of Wash Fk. Hoquiam River, a tributary of Hoquiam River, with point or points of diversion within the NW¼ SE¼ Sec. 4, Twp. 18 N., R. 10 W. W. M., under and subject to provisions contained in Appropriation Permit No. 10119 issued by the State Supervisor of Water Resources, and that said right to the use of said waters has been perfected in accordance with the laws of Washington, and is hereby confirmed by the State Supervisor of Water Resources of Washington and entered of record in Volume 15, at Page 7202, on the 19th day of February, 19 50; that the priority date of the right hereby confirmed is June 10, 1933; that the amount of water under the right hereby confirmed, for the following purposes is limited to an amount actually beneficially used and shall not exceed

2.2 cubic feet per second for the purpose of municipal supply.

A description of the lands under such right to which the water right is appurtenant, and the place where such water is put to beneficial use, is as follows:

City of Hoquiam
Grays Harbor County, Washington

The right to the use of the water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in Sections 6 and 7, Chapter 122, Laws of 1929.

WITNESS the seal and signature of the State Supervisor of Water Resources affixed this 19th day of February, 1950.

M B Walker
State Supervisor of Water Resources.

ENGINEERING DATA

CERTIFIED MAIL

September 23, 2009

City of Hoquiam
609 West 8th Street
Hoquiam, WA 98550

Attn: Brian Shay, City Administrator

Dear Mr. Shay:

Re: **PRELIMINARY PERMIT to drill and test wells for Ground Water Applications CS2-SWC82 and CS2-SWC7103**

Applications CS2-SWC82 and CS2-SWC7103 request to withdraw public groundwater at the rate of 1000 gallons per minute (gpm) for municipal supply from an unknown number of test wells completed in the Sand and Gravel Aquifer. The proposed well site is in Sections 1 and 4, T 18 N, R 10 W- WM, situated in the West Fork Hoquiam River Valley, north of New London in Grays Harbor County.

Under the authority of RCW 90.03.290, Ecology can issue a Preliminary Permit for a water right applicant to conduct studies, surveys, and investigations to gather information to assess a water right application. This Preliminary Permit allows temporary groundwater withdrawals for testing purposes.

Ecology needs information that evaluates your proposed withdrawal before your application can be processed. Impacts to area users and regulated surface water need to be evaluated. Ecology reserves the right to ask for more information before making a final decision on the application, if necessary.

The requirements of this Preliminary Permit must be met within the deadline or applications CS2-SWC82 and CS2-SWC7103 will automatically be canceled. This Preliminary Permit does not commit Ecology to approve the water right for your project. Other uses needing a water right permit are not allowed unless approved.

Ecology has determined the activities authorized under this Preliminary Permit are categorically exempt from SEPA review under WAC 197-11-800(17).

Please make sure that your consultant receives a copy of this Preliminary Permit to ensure they comply with all requirements. If adverse impacts to senior water right holders occur during any portion of the test, the test must be stopped immediately. Once testing is complete, the well must be capped so it does not pose a safety hazard.

This Preliminary Permit will remain in effect until **October 29, 2010**, unless revoked sooner by Ecology. The City of Hoquiam will assume all expenses, risks, and liabilities incurred in response to this Preliminary Permit.

This Preliminary Permit is subject to existing rights and the following requirements:

Requirements for drilling new wells:

- ✓ All water wells constructed must meet the minimum standards for construction and maintenance. Chapter 18.104 RCW (Washington Water Well Construction Act of 1971) and Chapter 173-160 WAC (Minimum Standards for Construction and Maintenance of Water Wells) discuss well construction requirements.

> *Check with the County Health Department to see if well site approval is required before well construction.*

- ✓ Wells must be at least 100 feet away from potential sources of contamination, such as a sewer, septic tank, privy as specified in WAC 173-160-171. Wells must also be at least 1,000 feet away from solid waste landfills. These minimum distances must also comply with state and local health laws.

- ✓ The well must have a well-maintained access port. A backflow check-valve must also be installed. This valve will prevent water from flowing back into the well when pumping stops so data collected during recovery is accurate.

- ✓ The well driller must submit a well report for the new wells to Ecology within 30 days after drilling.

Requirements for test observation wells:

- ✓ At least one observation well must be monitored for drawdown, recovery, and water quality during the aquifer test.

- ✓ Observation wells must be completed in the same aquifer as the pumping well and not be actively pumping during the test.

- ✓ Wells should be selected where they will best evaluate impacts to surface water, and effects on nearby wells.

Requirements for pumping test:

> *The Washington State Department of Health (DOH) Water System Design Manual (DOH #331-123, June 99), Appendix E provides guidelines for designing and conducting aquifer tests (available at www.doh.wa.gov/ehp/dw). DOH guidelines are minimum requirements. Failure to follow correct methods may require the tests to be repeated.*

- ✓ A Washington Licensed Hydrogeologist or Registered Engineer, specializing in groundwater evaluation, must supervise the test and perform data analysis.

- ✓ Each well must be tested at a constant rate not less than the maximum design rate.

- ✓ The test **must be designed to provide the following information:**
  - Distance and time drawdown response in the producing aquifer.
  - Aquifer transmissivity.
  - Aquifer storage coefficient and specific yield.
  - Aquitard leakage.
  - Effects on surface water.
  - Effects to area users.

> *Select accurate water level devices, such as transducers, or electric tape, to measure water levels. All watches and clocks used for timing should be synchronized so that each measurement can be referenced to the exact time since pumping began.*

- ✓ The pumping portion of the test must be at least 24 hours long OR until the water level in the pumping well has been stable for at least four (4) hours, whichever occurs last.

> *Water levels are stable if they drop less than 0.1 foot in an hour while the well is pumping. Measuring points for water levels must be accurately located within 10 feet horizontally and 1 foot vertically.*

- ✓ Water pumped during the test should be discharged so it will not recharge the drawdown cone or influence monitoring during the test.

- ✓ Recovery data must be collected from all wells until the water level in the pumped well nears pre-pumping conditions and the water-level recovery rate is less than 0.1 foot per hour.

- ✓ Data collected must be corrected for influences of barometric pressure and tides, if necessary.

> *Ecology recommends measuring water levels in the test and observation well every hour at least 48 hours before the start of the aquifer test. This will help evaluate aquifer response to external stresses such as precipitation and well interference. Barometric pressure should also be monitored on similar schedule, particularly for confined aquifers, so corrections for barometric influences can be made.*

Requirements for reporting:

The City of Hoquiam must file a report with Ecology when aquifer testing is complete. This information must provide Ecology with the information needed to evaluate results of the study. Ecology may request any of this information in an electronic format.

The report should contain the following information:

- ✓ Maps showing locations of wells used in pump test (pumping and observation wells) and surface water bodies.

- ✓ Pumping well information.
  - o Construction diagrams.
  - o Well report
  - o Lithology description of units.
  - o Pump intake depth.
  - o Wellhead elevation and way measured.
  - o Identification of measuring point.

- ✓ Monitoring well information.
  - o Well reports (if available).
  - o Well information and way it was determined (if no well report).
  - o Wellhead elevations and way measured.
  - o Total well depth and way determined.
  - o Screened interval and way determined.
  - o Identification of measuring point.

> *All water level and water quality data must be presented in both tabular form and on data plots.*

- ✓ Distances between pumping well(s) and observation well(s).

- ✓ Testing information.
  - o Pumping rates.
  - o Duration of pumping and recovery.

- Water level information.
- Raw data and corrected measurements.
- Corrections made for Tidal influences.
- Discussion of the methods and calculations used to determine aquifer characteristics.
- Copies of the all field data sheets related to the testing.

✓ Hydrogeology information.
- Hydrogeologic cross-sections.
- Description of the hydrogeologic system.
- Water quality testing information.
- Copies of all laboratory data sheets.

Your right to appeal

You have a right to appeal this ORDER. To appeal this you must:

- File your appeal with the Pollution Control Hearings Board within 30 days of the "date of receipt" of this document. Filing means actual receipt by the Board during regular office hours.
- Serve your appeal on the Department of Ecology within 30 days of the "date of receipt" of this document. Service may be accomplished by any of the procedures identified in Chapter 371-08-305(10) WAC. "Date of receipt" is defined at Chapter 43.21B.001(2) RCW.

Be sure to do the following:

- Include a copy of this document that you are appealing with your Notice of Appeal.
- Serve and file your appeal in paper form; electronic copies are not accepted.

1. To file your appeal with the Pollution Control Hearings Board

Mail appeal to:		Deliver your appeal to:
Pollution Control Hearings Board PO Box 40903 Olympia, Washington 98504-0903	OR	Pollution Control Hearings Board 4224 – 6th Ave SE Rowe Six, Bldg 2 Lacey, Washington 98503

2. To serve your appeal on the Department of Ecology

Mail your appeal to:		Deliver your appeal in person to:
Department of Ecology Appeals Coordinator PO Box 47608 Olympia, Washington 98504-7608	OR	Department of Ecology Appeals Coordinator 300 Desmond Drive SE Lacey, WA 98503

3. And send a copy of your appeal to:

Tom Loranger, Section Manger
Department of Ecology, SWRO
PO Box 47775
Lacey, WA 98504-7775

If you have any questions regarding this Preliminary Permit please contact Mike Gallagher at (360) 407-6918.
Sincerely,

_____

Tom Loranger
Section Manager
Water Resources Program
Southwest Region Office

TJL:mjg

DEPARTMENT OF ECOLOGY
State of Washington

STATE OF WASHINGTON

APPLICATION FOR CHANGE/TRANSFER OF WATER RIGHT

For filing with the Department of Ecology or with County Conservancy Boards

A NON-REFUNDABLE MINIMUM FEE OF $50.00 PAYABLE TO THE DEPARTMENT OF ECOLOGY MUST ACCOMPANY THIS APPLICATION

(Check all that apply.)

- ☐ Change purpose(s) of use
- ☐ Add purpose(s) of use
- ☐ Change point(s) of diversion/withdrawal
- ☒ Add point(s) of diversion/withdrawal
- ☐ Change/transfer place of use
- ☐ Other (i.e. consolidation, intertie, trust water)

Explain:_____

FOR OFFICE USE ONLY

CHANGE No._____ **WRIA**_____

DATE ACCEPTED_____/_____/_____ **BY**_____

FEE $_____ **REC'D** _____/_____/_____

CHECK No. _____

ECY Coding: 001-002-WR10285-000011

SEPA: ☐ **Exempt** ☐ **Not exempt**

*****IF MORE SPACE IS NEEDED, ATTACH ADDITIONAL SHEETS (PLEASE PRINT OR TYPE CLEARLY)*****

1. Applicant Information:

APPLICANT/BUSINESS NAME	PHONE NO.	FAX NO.
City of Hoquiam	(360) 532-5700	(360) 538-0938
ADDRESS 609 8th Street		
CITY Hoquiam	STATE WA	ZIP CODE 98550

CONTACT NAME (IF DIFFERENT FROM ABOVE)	PHONE NO.	FAX NO.
Brian Shay, City Administrator	( )	( )
ADDRESS		
CITY	STATE	ZIP CODE

2. Water Right Information:

WATER RIGHT OR CLAIM NUMBER	RECORDED NAME(S)
Surface Water Certificate No. 82	Hoquiam Water Company
DO YOU OWN THE RIGHT TO BE CHANGED? ☒ YES ☐ NO IF NO, PROVIDE OWNER(S) NAME and ADDRESS:	
HAS THE WATER BEEN PUT TO BENEFICIAL USE IN THE LAST FIVE (5) YEARS? ☒ YES ☐ NO	

Please attach copies of any documentation that demonstrates consistent, historical use of water since the right was established. Also, if you have a water system plan or conservation plan, please include a copy with your application.

FOR OFFICE USE ONLY

APP. NO._____ PERMIT NO. _____ CERT. NO._____ CERT. OF CHANGE NO._____

3. Point(s) of Diversion/Withdrawal:

A. Existing

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
Davis Creek				4	18N	10W		NA

B. Proposed

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
Davis Creek				4	18N	10W		NA
Well or Wells Well or Wells				4 1	18N	10W		

DO YOU OWN THE EXISTING AND PROPOSED POINT(S) OF DIVERSION/WITHDRAWAL?

EXISTING: ☒ YES ☐ NO PROPOSED: ☒ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Please include copies of all water well reports involved with this proposal. Also, if you know the distances from the nearest section corner to the above point(s) of diversion/withdrawal, please include that information in Item No. 6 (remarks) or as an attachment.

4. Purpose of Use:

A. Existing

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE
Municipal	15 cfs	NA	Continuously

B. Proposed

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE

5. Place of Use:

A. Existing

LEGAL DESCRIPTION OF LANDS WHERE WATER IS PRESENTLY USED:							
Area Served by the City of Hoquiam, as described in the most recent Water System Plan approved by the Washington State Department of Health for the City of Hoquiam.							
¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES
		NA	NA	NA	Grays Harbor		

DO YOU OWN ALL THE LANDS IN THE EXISTING PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

B. Proposed

LEGAL DESCRIPTION OF LANDS WHERE NEW USE IS PROPOSED:							
¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES

DO YOU OWN ALL THE LANDS IN THE PROPOSED PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Attach a detailed map of your proposed change/transfer. The map should show existing and proposed point(s) of diversion/withdrawal, place of use and any other features involved with this application. If platted property, please include a certified copy of the plat map.

Are there any ADDITIONAL WATER rights OR CLAIMS RELATED to the same property as the ONE PROPOSED FOR CHANGE/TRANSFER?
☒ YES ☐ NO – IF YES, PROVIDE THE WATER RIGHT/CLAIM NUMBER(S): SW Certificate No. 7103, Water Right Claim No. 119139

6. Remarks and Other Relevant Information:

The purpose of this application is to add a point of withdrawal for a well or wells in the New London area in the vicinity of the City's existing water treatment plant to withdraw up to 1,000 gallons per minute, to be used in addition to the existing right to pump up to 15 cfs from Davis Creek, with the total from the existing surface water source and the proposed ground water sources not to exceed the existing surface water right of 15 cfs.

IF FOR SEASONAL OR TEMPORARY, START DATE ___/___/_____ END DATE ___/___/_____

Certain applications may incur a Real Estate Excise Tax liability for the seller of the water rights. The Department of Revenue has requested notification of potential taxable water right related actions and therefore may be provided with a copy of this request.

Please contact the State Department of Revenue for further information. The phone number is (360) 570-3265. The address is: Department of Revenue, Real Estate Excise Tax, PO Box 47477, Olympia, WA 98504-7477.

7. Signatures:

I certify that the information above is true and accurate to the best of my knowledge. I understand that in order to process my application, I am hereby granting staff from the Department of Ecology or the County Conservancy Board access to the above site(s) for inspection and monitoring purposes. If assisted in the preparation of the above application, I understand that all responsibility for the accuracy of the information rests with me.

(Applicant) **/ /** ***(Date)***

(Water Right Holder) **/ /** ***(Date)***

(Land Owner(s) of Existing Place of Use) **/ /** ***(Date)***

IMPORTANT! APPLICATION FILING INFORMATION IS PROVIDED ON THE NEXT PAGE.

WE ARE RETURNING YOUR APPLICATION FOR THE FOLLOWING REASON(S):

☐ APPLICATION FEE NOT ENCLOSED ☐ MAP NOT INCLUDED or INCOMPLETE

☐ ADDITIONAL SIGNATURES REQUIRED ☐ SECTION _____ IS INCOMPLETE

☐ OTHER/EXPLANATION:_____

STAFF: _____ ***DATE:*** _____/_____/_____

ATTACHMENT FOR

APPLICATION FOR CHANGE

Point(s) of Diversion/Withdrawal - ☐ Existing ☐ Proposed:

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #

DO YOU OWN THE ABOVE POINT(S) OF DIVERSION/WITHDRAWAL? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Purpose(s) of Use - ☐ Existing ☐ Proposed:

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE

Place of Use - ☐ Existing ☐ Proposed:

LEGAL DESCRIPTION OF LANDS

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES

DO YOU OWN ALL THE LANDS IN ABOVE PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

DEPARTMENT OF ECOLOGY
State of Washington

Instructions for Completing an Application for Change or Transfer of a Water Right

Please type or print clearly in ink

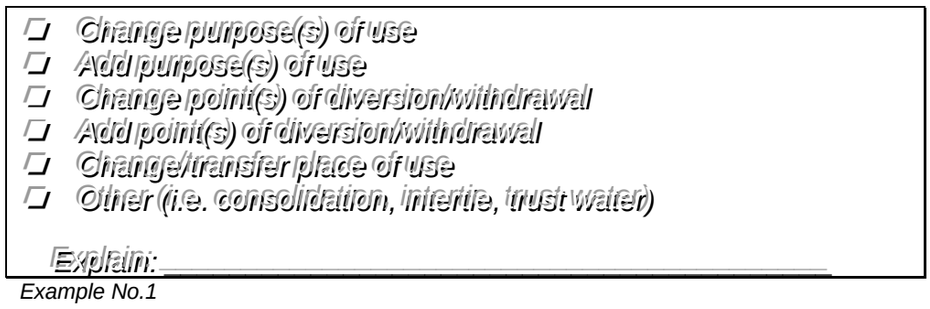
Introduction: An application for change or transfer of water right and a non-refundable minimum fee of $50.00, is required by Ecology to propose certain changes to an existing water right or claim. Additional fees may be required if the application is filed with a County Conservancy Board. General information about the process and considerations involved in making changes to water rights is available from each Ecology region office. Once an application is filed, a public notice is prepared for publication in at least one designated newspaper at your cost and the application is made available for review. The information requested upon this application, as it relates to your proposed change, **must** be provided or the application will be returned to you for completion. Spaces bordered with a dark outline are for office staff use in processing the application, please do not mark within those spaces. If additional space is required, you may attach additional sheets of paper or use the Application Attachment Form that is available at any Ecology regional office or from any County Conservancy Board.

A County Conservancy Board is a board established by the County Commissioners and authorized by Ecology to accept and make recommendations for approval or denial of an application for Change or Transfer of a Water Right. Statutory authority for County Conservancy Boards can be found within Chapter 90.80 RCW.

This application requests information about your actual water use and the changes you propose to make. Please **do not** simply copy information about your water use from a water right document. Inaccurate information about your water use may cause substantial delays in processing a decision on your application.

Applications for Change of Water Right are subject to the State Environmental Policy Act, Chapter 43.21C Revised Code of Washington and Chapter 197-11, Washington Administrative Code.

Check the type of change proposed: For your convenience, boxes are located within the upper left-hand corner on the first page of the application form. The following are instructions for completing the boxes that indicate the type of changes that are proposed. The boxes found on the application form are shown in example no. 1.


☐ Change purpose(s) of use
☐ Add purpose(s) of use
☐ Change point(s) of diversion/withdrawal
☐ Add point(s) of diversion/withdrawal
☐ Change/transfer place of use
☐ Other (i.e. consolidation, intertie, trust water)

Explain: _____

Example No.1

Check the boxes to indicate the changes that are proposed. <u>You may mark as many types of changes as are appropriate, but you must mark at least one box.</u> If none of the boxes provided appear to represent the change or transfer that you wish to propose, please contact the appropriate region office shown on the last page of the form for assistance. If you mark "**other,**" you **must** describe the change that you propose. Possible explanations are that the change proposes "**consolidation**" of a water use that was exempt from a groundwater permit with a water system for which a certificate of water right has issued, that the application proposes to "**intertie**" two or more public water supplies, or that you propose to enter a "**trust water program**." The space for explanation may also be used to further explain any proposed change. If additional space is needed to fully explain the intent of the application you may add attachments.

The number preceding the instruction refers to the corresponding section of the application.

1. Applicant Information: Provide the name in which the application is being filed and the mailing address and telephone number(s) through which the applicant may be reached. The address and phone number provided (or as later amended) will be the only address that will be used to contact the applicant.

Provide the name of the person(s) that should be contacted regarding the application, if contact should be made to someone other than the applicant listed above. If a contact person(s) is identified, provide their mailing address and telephone number. All mail concerning the application will be directed to the contact person unless amended by the applicant.

2. Water Right Information: You **must** identify a water right or water right claim to be changed.

2. WATER RIGHT INFORMATION:

WATER RIGHT OR CLAIM NUMBER *Certificate No. G1-26483C*	RECORDED NAME(S) ***The person(s) name appearing on the water right document***
DO YOU HOLD LEGAL TITLE TO THE RIGHT TO BE CHANGED? YES NO IF NO, PROVIDE OWNER(S) NAME and ADDRESS:	
HAS THE WATER BEEN PUT TO BENEFICIAL USE IN THE LAST FIVE (5) YEARS? YES NO	

Example No. 2

Identify the water right document that describes the water right. For instance, provide a water right certificate number or water right claim number. Provide the name of the person(s) under which the document was filed or recorded.

Indicate whether the applicant is the current owner of the water right proposed to be changed or transferred by marking the appropriate box. If the current owner of the right is different than the applicant, provide the name and address of the water right owner.

Indicate, by marking the appropriate box whether the water right to be changed has been in beneficial use at any time during the most recent five-year period. If you check "no," you may wish to describe past use of the right on a separate attachment.

Please attach copies of any documentation or records that support the consistent, historical use of water since the right was established. Examples of documents or records that may assist in supporting historic use of water include electric bills for a pumping station, receipt for purchase of water system equipment, dated aerial photographs, and affidavit(s) of persons familiar with water use under the water right. Also, if you have a water system plan or conservation plan written for your water use, please include a copy with your application.

3. Point(s) of Diversion/Withdrawal:

Existing: You **must** describe the existing point(s) of diversion/withdrawal on your application. The point(s) of diversion/withdrawal is the location that you take water from a public water body (a lake, stream, etc.) for use of the water right proposed to be changed.

A. EXISTING

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
well	*1*	*NW*	*SW*	*10*	*15 E*	*25*	*854321-237*	*043986*
Wilson Well	*2*	*SE*	*SW*	*10*	*15 E*	*25*	*854321-238*	*043987*

Example No. 3

Identify the name of the source of water that is used under your water right. If the source is surface water and has no name write "unnamed." If the source is a well and has no name, write "well." If you refer to the listed water sources by number, provide the number.

The spaces for ¼¼, SEC., TWP., AND RGE are provided for identifying the general location of the point(s) of diversion/withdrawal. The SEC., TWP., AND RGE refer to the section, township and range that the diversion/withdrawal is (are) located. The ¼¼ spaces refer to (from right to left) the quarter of the identified section and then to the quarter of the identified quarter section in which the point(s) of diversion/withdrawal are located. If you do not understand this geographic location system, please contact the appropriate Ecology region office, County Conservancy Board, or seek professional assistance in completing your application.

Parcel #. You must provide the county assigned parcel identification number for each parcel containing your point of diversion. This number may be obtained from the County Assessor's office for the county containing the point(s) of diversion/withdrawal.

Well Tag #. Every well within the State of Washington is required to have a well tag number displayed. The well tag number is a unique number assigned at the time of construction or upon request by the well owner to the Water Resources Program, Department of Ecology. Please see section 173-160-311, What are the well tagging requirements? , Washington Administrative Code, for specific requirements. If no well tag number is prominently displayed on your well head, you may assume that no number has been assigned and may leave this space blank. Upon verification that no number has been assigned, Ecology will assign a number and provide a tag for permanent installation upon the well.

DO YOU OWN THE EXISTING AND PROPOSED POINT(S) OF DIVERSION/WITHDRAWAL?

EXISTING: ☐ YES ☐ NO PROPOSED: ☐ YES ☐ NO ☐ IF NO, PROVIDE OWNER(S) NAME: _____

Example No. 4

Ownership: Below part 3B. of the application, state whether you own the land(s) that contains the existing point(s) of diversion/withdrawal. If you do not own the land, provide the owner's name.

B. Proposed Point(s) of diversion/withdrawal:
Complete this section of the application **only** if you propose to change or add points of diversion/withdrawal to your water right. Follow the instructions provided above for Part A to describe the point(s) you wish to add or change. Include water well reports for any constructed wells you have described and any information that describes the precise location of the point of diversion/withdrawal.

4. Purpose of Use:

Existing

*You **must** complete Part 4 A., existing purpose of use, to have your application accepted.*

A. EXISTING

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE
3 domestic uses	*45*	*3*	*throughout the year*
irrigation	*150*	*45*	*April 1 to September 15*

Example No. 5

In the spaces provided on the application, identify **all** the uses you currently make of the water taken under the water right that you propose to change.

Purpose of Use: List each purpose of use currently made of your water right. For example, "irrigation," "stockwater," and "municipal supply" are typical uses. If you are proposing a domestic use other than for a municipality, include the number of units to be served in the description of the purpose of use. For example, if you propose to serve 10 homes, indicate this by entering "10 domestic uses" in the space provided.

GPM or CFS: State the rate of water actually used for each listed purpose. You **must** indicate whether the rate you have stated is in units of gallons per minute (GPM) or cubic feet per second (CFS).

Acre-Feet/Yr: State the volume of water that is used during a calendar year in the unit of acre-feet for each listed purpose. One acre-foot is equal to 325,851 gallons or 43,560 cubic feet of water.

The volume of water that is reasonably required for beneficial use is highly variable from one water right to another. The acre-feet required is dependent upon the type of beneficial use, the geographic location of use, soil types, slope, and other case specific factors. The following are suggestions that may assist in estimating the volume of water used for purposes of filing your application. As part of the decision making process, Ecology will make a tentative determination of the extent of your water right that will include the number of acre-feet of water that you are authorized per year.

For small domestic water supplies, a reasonable estimate of use is 0.25 to 2 acre-feet per connection.

Uses that are continuous throughout a day of use at or near the maximum rate of diversion/withdrawal, may be estimated by multiplying the rate of diversion you have provided in GPM or CFS by the number of days that water is actually used during the period of use:

_____ (GPM or CFS) multiplied by _____ number of days of actual water use during the period of use

Multiply your answer by 2 if you've stated your diversion in CFS

Multiply your answer by 0.005 if you've stated your diversion is GPM.

For water uses that are in continuous use during an entire day, your answer will be a rough estimate of the number of acre-feet of water you currently use based upon your water use practices.

Period of Use: Identify the timeframe from the beginning month and day of use to the ending month and day of use, in which water is actually used for each listed purpose.

B. Proposed

Complete Part B. of Section 4, Purpose of Use, **only** if you are proposing to change or add uses of water authorized by your water right. If you are proposing to change the purpose of use, you **must** list **all** purposes for which you wish to use water. Follow the instructions provided by Part A of Section 4 to describe each intended water use through the change application.

5. Place of Use:

The place of use is the lands on which water is actually used. You **must** describe the existing place of water use and, if you proposed a change/transfer of place of use or to add place of use, you must describe the proposed place of use. Follow the instructions below to complete Section 5 of the application:

A. EXISTING

LEGAL DESCRIPTION OF LANDS WHERE WATER IS PRESENTLY USED:							
The south 500 feet of the north 600 feet of the:							
¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES
NW	*SW*	*10*	*15*	*25 E*	*Grant*	*854321-237*	*15*
DO YOU OWN ALL THE LANDS IN THE EXISTING PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:							

Example No. 6

Print or type a complete description of the area of existing water use. You may find a description of your property on a property deed. Exclude from your description any lands you own that do not have a water use under the right you are changing. If necessary, you may attach a description of the place of use as a separate attachment.

The spaces for *¼¼*, *SEC*., *TWP*., AND *RGE* are provided for identifying the general location of the place(s) of use. The *SEC*., *TWP*., AND *RGE* refer to the section, township and range containing the place(s) of use. The "¼" (of the) "¼" spaces refer to (from right to left) the quarter of the identified section and then to the quarter of the identified quarter section of the place(s) of use. The following illustration shows how a section of land is divided into ¼¼ sections:

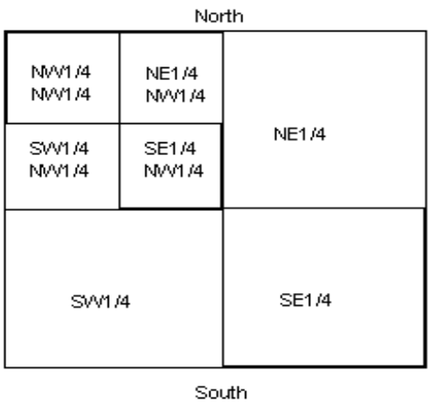


Illustration No. 1

If you do not understand this geographic location system, please contact the appropriate Ecology region office, County Conservancy Board, or seek professional assistance in completing your application.

County: Identify every county that contains any portion of the existing place of water use.

Parcel #. Please provide the county assigned identification number for each parcel containing your place of use. If the proposed place of use contains many separate parcels of property, please indicate this by writing "multiple" in the space provided for Parcel #. The parcel number may be obtained from the County Assessor's office for the county containing the place of use.

# of Acres: If you have identified irrigation as a purpose of use, you must state the number of acres that you are irrigating.

You must indicate whether you own the lands associated with the proposed change. If not, provide the landowner's name.

Map: In addition to describing the point(s) of diversion/withdrawal and place(s) of water use on the application, attach a detailed map. The map **must** have reference to the Township, Range and Section of the area illustrated. Indicate on the map: a) the lands upon which water is used for each purpose of water use; b) the points from which water is taken from the water source; c) any lands to which the water use is proposed to be changed; d) any new points from which water is proposed to be taken d) show a reference point such as a section corner e) show the location of structures, the water system and other features relevant to your proposed change/transfer. It is recommended that you base your map on a published map of your area. If your place of use is platted property, you **must** include a certified copy of the plat.

B. Proposed Place of Use: If you are proposing to add place of use or change/transfer place of use then you **must** complete Part 5B. of the application. Follow the instructions for Part 5A. to describe the new lands that you propose is associated with your water right.

Other rights: Below Part 5B. in a separate border is the following question:

ARE THERE ANY ADDITIONAL WATER RIGHTS OR CLAIMS RELATED TO THE SAME PROPERTY AS THE ONE PROPOSED FOR CHANGE/TRANSFER? ☐ YES ☐ NO – IF YES, PROVIDE THE WATER RIGHT/CLAIM NUMBER(S):

Example No. 7

If you are aware of other rights associated with any of the property you have describe on the application, please indicate so by marking the "yes" box provided and provide the identifying document number.

6. Remarks and Other Relevant Information: Your application will be reviewed by several interested agencies and is available to the public for inspection. You may use this space to provide additional information or an explanation for your change proposal. Your remarks or explanation may include any information that you believe should be considered in the review of your application. You may also explain the reasons that you are proposing the change/transfer, for example, that you are updating your water distribution system or relocating a water well.

Please note: If your application is being submitted for a seasonal or temporary change in water right, whether or not in conjunction with a permanent change or transfer, you **must** indicate the date that you desire the change/ transfer to be effective and the date that you desire the change/transfer to terminate. It is recommended that you submit your application as far in advance of the date you wish the change/transfer to be effective as possible.

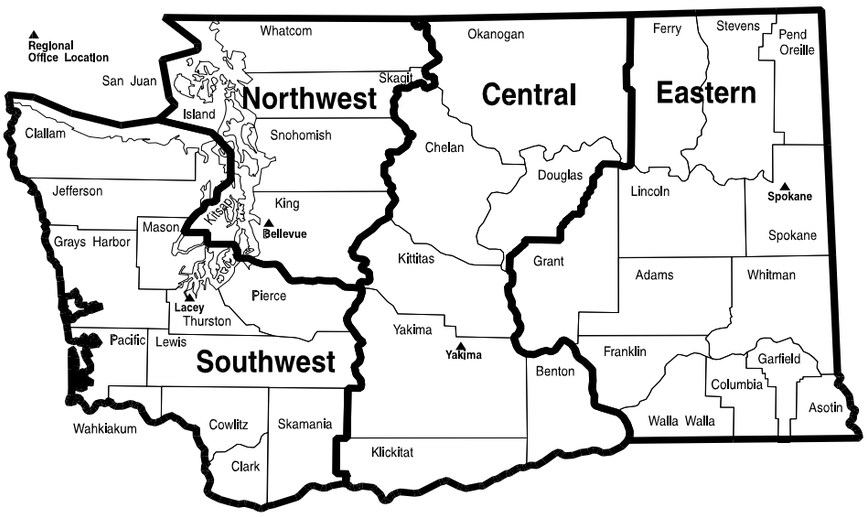
7. Signature and Date: The applicant must sign and date the application. In addition, the owner of the water right and the owner of the existing place of use must sign and date the application if different than the applicant.

IMPORTANT!

Submit your application to Ecology at:

DEPARTMENT OF ECOLOGY
CASHIERING UNIT
PO BOX 47611
OLYMPIA, WA 98504-7611

Alternatively, you may submit your application at a Conservancy Board with jurisdiction. Below is a map of the State of Washington, with outlines of the four Ecology regional offices. If you have questions about your application or whether a County Conservancy Board with jurisdiction exists, contact the Water Resources program at the regional office in which your project is located.



Please check the regional office in which your project is located.

☐ Central Regional Office
15 W Yakima Avenue, Suite 200
Yakima, WA 98902
(509) 575-2490

☐ Eastern Regional Office
4601 N. Monroe
Spokane, WA 99205-1295
(509) 329-3400

☐ Northwest Regional Office
3190 – 160th Avenue SE
Bellevue, WA 98008-5452
(425) 649-7000

☒ Southwest Regional Office
PO Box 47775
Olympia, WA 98504-7775
(360) 407-6300

DEPARTMENT OF ECOLOGY
State of Washington

STATE OF WASHINGTON

APPLICATION FOR CHANGE/TRANSFER OF WATER RIGHT

For filing with the Department of Ecology or with County Conservancy Boards

A NON-REFUNDABLE MINIMUM FEE OF $50.00 PAYABLE TO THE DEPARTMENT OF ECOLOGY MUST ACCOMPANY THIS APPLICATION

(Check all that apply.)

- ☐ Change purpose(s) of use
- ☐ Add purpose(s) of use
- ☐ Change point(s) of diversion/withdrawal
- ☒ Add point(s) of diversion/withdrawal
- ☐ Change/transfer place of use
- ☐ Other (i.e. consolidation, intertie, trust water)

Explain:_____

FOR OFFICE USE ONLY

CHANGE No._____ **WRIA**_____

DATE ACCEPTED_____/_____/_____ **BY**_____

FEE $_____ **REC'D** _____/_____/_____

CHECK No. _____

ECY Coding: 001-002-WR10285-000011

SEPA: ☐ **Exempt** ☐ **Not exempt**

*****IF MORE SPACE IS NEEDED, ATTACH ADDITIONAL SHEETS (PLEASE PRINT OR TYPE CLEARLY)*****

1. Applicant Information:

APPLICANT/BUSINESS NAME	PHONE NO.	FAX NO.
City of Hoquiam	(360) 532-5700	(360) 538-0938
ADDRESS 609 8th Street		
CITY Hoquiam	STATE WA	ZIP CODE 98550

CONTACT NAME (IF DIFFERENT FROM ABOVE)	PHONE NO.	FAX NO.
Brian Shay, City Administrator	( )	( )
ADDRESS		
CITY	STATE	ZIP CODE

2. Water Right Information:

WATER RIGHT OR CLAIM NUMBER	RECORDED NAME(S)
Surface Water Certificate No. 7103	City of Hoquiam
DO YOU OWN THE RIGHT TO BE CHANGED? ☒ YES ☐ NO IF NO, PROVIDE OWNER(S) NAME and ADDRESS:	
HAS THE WATER BEEN PUT TO BENEFICIAL USE IN THE LAST FIVE (5) YEARS? ☒ YES ☐ NO	

Please attach copies of any documentation that demonstrates consistent, historical use of water since the right was established. Also, if you have a water system plan or conservation plan, please include a copy with your application.

FOR OFFICE USE ONLY

APP. NO._____ PERMIT NO. _____ CERT. NO._____ CERT. OF CHANGE NO._____

3. Point(s) of Diversion/Withdrawal:

A. Existing

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
West Fork Hoquiam R.		NE	SE	4	18N	10W		NA

B. Proposed

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
West Fork Hoquiam R		NE	SE	4	18N	10W		NA
Well or Wells Well or Wells				4 1	18N	10W		

DO YOU OWN THE EXISTING AND PROPOSED POINT(S) OF DIVERSION/WITHDRAWAL?

EXISTING: ☒ YES ☐ NO PROPOSED: ☒ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Please include copies of all water well reports involved with this proposal. Also, if you know the distances from the nearest section corner to the above point(s) of diversion/withdrawal, please include that information in Item No. 6 (remarks) or as an attachment.

4. Purpose of Use:

A. Existing

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE
Municipal	2.2 cfs	NA	Continuously

B. Proposed

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE

5. Place of Use:

A. Existing

LEGAL DESCRIPTION OF LANDS WHERE WATER IS PRESENTLY USED:							
Area Served by the City of Hoquiam, as described in the most recent Water System Plan approved by the Washington State Department of Health for the City of Hoquiam.							
¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES
		NA	NA	NA	Grays Harbor		

DO YOU OWN ALL THE LANDS IN THE EXISTING PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

B. Proposed

LEGAL DESCRIPTION OF LANDS WHERE NEW USE IS PROPOSED:							
¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES

DO YOU OWN ALL THE LANDS IN THE PROPOSED PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Attach a detailed map of your proposed change/transfer. The map should show existing and proposed point(s) of diversion/withdrawal, place of use and any other features involved with this application. If platted property, please include a certified copy of the plat map.

Are there any ADDITIONAL WATER rights OR CLAIMS RELATED to the same property as the ONE PROPOSED FOR CHANGE/TRANSFER?
☒ YES ☐ NO – IF YES, PROVIDE THE WATER RIGHT/CLAIM NUMBER(S): SW Cert 82, Water Right Claim No. 119139

6. Remarks and Other Relevant Information:

The purpose of this application is to add a point of withdrawal for a well or wells in the New London area in the vicinity of the City's existing water treatment plant to withdraw up to 990 gallons per minute, to be used in addition to the existing right to pump up to 2.2 cfs from Davis Creek, with the total from the existing surface water source and the proposed ground water sources not to exceed the existing surface water right of 2.2 cfs.

IF FOR SEASONAL OR TEMPORARY, START DATE ___/___/_____ END DATE ___/___/_____

Certain applications may incur a Real Estate Excise Tax liability for the seller of the water rights. The Department of Revenue has requested notification of potential taxable water right related actions and therefore may be provided with a copy of this request.

Please contact the State Department of Revenue for further information. The phone number is (360) 570-3265. The address is: Department of Revenue, Real Estate Excise Tax, PO Box 47477, Olympia, WA 98504-7477.

7. Signatures:

I certify that the information above is true and accurate to the best of my knowledge. I understand that in order to process my application, I am hereby granting staff from the Department of Ecology or the County Conservancy Board access to the above site(s) for inspection and monitoring purposes. If assisted in the preparation of the above application, I understand that all responsibility for the accuracy of the information rests with me.

(Applicant) **/ /** ***(Date)***

(Water Right Holder) **/ /** ***(Date)***

(Land Owner(s) of Existing Place of Use) **/ /** ***(Date)***

IMPORTANT! APPLICATION FILING INFORMATION IS PROVIDED ON THE NEXT PAGE.

WE ARE RETURNING YOUR APPLICATION FOR THE FOLLOWING REASON(S):

☐ APPLICATION FEE NOT ENCLOSED ☐ MAP NOT INCLUDED or INCOMPLETE

☐ ADDITIONAL SIGNATURES REQUIRED ☐ SECTION _____ IS INCOMPLETE

☐ OTHER/EXPLANATION:_____

STAFF: _____ ***DATE:*** _____/_____/_____

ATTACHMENT FOR

APPLICATION FOR CHANGE

Point(s) of Diversion/Withdrawal - ☐ Existing ☐ Proposed:

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #

DO YOU OWN THE ABOVE POINT(S) OF DIVERSION/WITHDRAWAL? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

Purpose(s) of Use - ☐ Existing ☐ Proposed:

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE

Place of Use - ☐ Existing ☐ Proposed:

LEGAL DESCRIPTION OF LANDS

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES

DO YOU OWN ALL THE LANDS IN ABOVE PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:

DEPARTMENT OF ECOLOGY
State of Washington

Instructions for Completing an Application for Change or Transfer of a Water Right

Please type or print clearly in ink

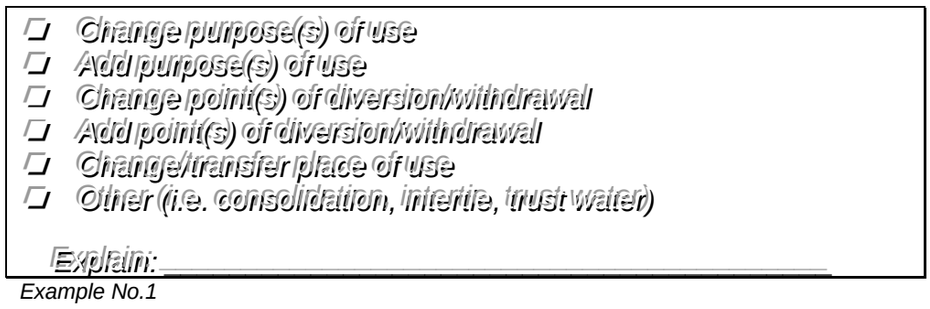
Introduction: An application for change or transfer of water right and a non-refundable minimum fee of $50.00, is required by Ecology to propose certain changes to an existing water right or claim. Additional fees may be required if the application is filed with a County Conservancy Board. General information about the process and considerations involved in making changes to water rights is available from each Ecology region office. Once an application is filed, a public notice is prepared for publication in at least one designated newspaper at your cost and the application is made available for review. The information requested upon this application, as it relates to your proposed change, **must** be provided or the application will be returned to you for completion. Spaces bordered with a dark outline are for office staff use in processing the application, please do not mark within those spaces. If additional space is required, you may attach additional sheets of paper or use the Application Attachment Form that is available at any Ecology regional office or from any County Conservancy Board.

A County Conservancy Board is a board established by the County Commissioners and authorized by Ecology to accept and make recommendations for approval or denial of an application for Change or Transfer of a Water Right. Statutory authority for County Conservancy Boards can be found within Chapter 90.80 RCW.

This application requests information about your actual water use and the changes you propose to make. Please **do not** simply copy information about your water use from a water right document. Inaccurate information about your water use may cause substantial delays in processing a decision on your application.

Applications for Change of Water Right are subject to the State Environmental Policy Act, Chapter 43.21C Revised Code of Washington and Chapter 197-11, Washington Administrative Code.

Check the type of change proposed: For your convenience, boxes are located within the upper left-hand corner on the first page of the application form. The following are instructions for completing the boxes that indicate the type of changes that are proposed. The boxes found on the application form are shown in example no. 1.


☐ Change purpose(s) of use
☐ Add purpose(s) of use
☐ Change point(s) of diversion/withdrawal
☐ Add point(s) of diversion/withdrawal
☐ Change/transfer place of use
☐ Other (i.e. consolidation, intertie, trust water)

Explain: _____

Example No.1

Check the boxes to indicate the changes that are proposed. <u>You may mark as many types of changes as are appropriate, but you must mark at least one box.</u> If none of the boxes provided appear to represent the change or transfer that you wish to propose, please contact the appropriate region office shown on the last page of the form for assistance. If you mark "**other,**" you **must** describe the change that you propose. Possible explanations are that the change proposes "**consolidation**" of a water use that was exempt from a groundwater permit with a water system for which a certificate of water right has issued, that the application proposes to "**intertie**" two or more public water supplies, or that you propose to enter a "**trust water program**." The space for explanation may also be used to further explain any proposed change. If additional space is needed to fully explain the intent of the application you may add attachments.

The number preceding the instruction refers to the corresponding section of the application.

1. Applicant Information: Provide the name in which the application is being filed and the mailing address and telephone number(s) through which the applicant may be reached. The address and phone number provided (or as later amended) will be the only address that will be used to contact the applicant.

Provide the name of the person(s) that should be contacted regarding the application, if contact should be made to someone other than the applicant listed above. If a contact person(s) is identified, provide their mailing address and telephone number. All mail concerning the application will be directed to the contact person unless amended by the applicant.

2. Water Right Information: You **must** identify a water right or water right claim to be changed.

2. WATER RIGHT INFORMATION:

WATER RIGHT OR CLAIM NUMBER *Certificate No. G1-26483C*	RECORDED NAME(S) ***The person(s) name appearing on the water right document***
DO YOU HOLD LEGAL TITLE TO THE RIGHT TO BE CHANGED? YES NO IF NO, PROVIDE OWNER(S) NAME and ADDRESS:	
HAS THE WATER BEEN PUT TO BENEFICIAL USE IN THE LAST FIVE (5) YEARS? YES NO	

Example No. 2

Identify the water right document that describes the water right. For instance, provide a water right certificate number or water right claim number. Provide the name of the person(s) under which the document was filed or recorded.

Indicate whether the applicant is the current owner of the water right proposed to be changed or transferred by marking the appropriate box. If the current owner of the right is different than the applicant, provide the name and address of the water right owner.

Indicate, by marking the appropriate box whether the water right to be changed has been in beneficial use at any time during the most recent five-year period. If you check "no," you may wish to describe past use of the right on a separate attachment.

Please attach copies of any documentation or records that support the consistent, historical use of water since the right was established. Examples of documents or records that may assist in supporting historic use of water include electric bills for a pumping station, receipt for purchase of water system equipment, dated aerial photographs, and affidavit(s) of persons familiar with water use under the water right. Also, if you have a water system plan or conservation plan written for your water use, please include a copy with your application.

3. Point(s) of Diversion/Withdrawal:

Existing: You **must** describe the existing point(s) of diversion/withdrawal on your application. The point(s) of diversion/withdrawal is the location that you take water from a public water body (a lake, stream, etc.) for use of the water right proposed to be changed.

A. EXISTING

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
well	*1*	*NW*	*SW*	*10*	*15 E*	*25*	*854321-237*	*043986*
Wilson Well	*2*	*SE*	*SW*	*10*	*15 E*	*25*	*854321-238*	*043987*

Example No. 3

Identify the name of the source of water that is used under your water right. If the source is surface water and has no name write "unnamed." If the source is a well and has no name, write "well." If you refer to the listed water sources by number, provide the number.

The spaces for ¼¼, SEC., TWP., AND RGE are provided for identifying the general location of the point(s) of diversion/withdrawal. The SEC., TWP., AND RGE refer to the section, township and range that the diversion/withdrawal is (are) located. The ¼¼ spaces refer to (from right to left) the quarter of the identified section and then to the quarter of the identified quarter section in which the point(s) of diversion/withdrawal are located. If you do not understand this geographic location system, please contact the appropriate Ecology region office, County Conservancy Board, or seek professional assistance in completing your application.

Parcel #. You must provide the county assigned parcel identification number for each parcel containing your point of diversion. This number may be obtained from the County Assessor's office for the county containing the point(s) of diversion/withdrawal.

Well Tag #. Every well within the State of Washington is required to have a well tag number displayed. The well tag number is a unique number assigned at the time of construction or upon request by the well owner to the Water Resources Program, Department of Ecology. Please see section 173-160-311, What are the well tagging requirements? , Washington Administrative Code, for specific requirements. If no well tag number is prominently displayed on your well head, you may assume that no number has been assigned and may leave this space blank. Upon verification that no number has been assigned, Ecology will assign a number and provide a tag for permanent installation upon the well.

DO YOU OWN THE EXISTING AND PROPOSED POINT(S) OF DIVERSION/WITHDRAWAL?

EXISTING: ☐ YES ☐ NO PROPOSED: ☐ YES ☐ NO ☐ IF NO, PROVIDE OWNER(S) NAME: _____

Example No. 4

Ownership: Below part 3B. of the application, state whether you own the land(s) that contains the existing point(s) of diversion/withdrawal. If you do not own the land, provide the owner's name.

B. Proposed Point(s) of diversion/withdrawal:
Complete this section of the application **only** if you propose to change or add points of diversion/withdrawal to your water right. Follow the instructions provided above for Part A to describe the point(s) you wish to add or change. Include water well reports for any constructed wells you have described and any information that describes the precise location of the point of diversion/withdrawal.

4. Purpose of Use:

Existing

*You **must** complete Part 4 A., existing purpose of use, to have your application accepted.*

A. EXISTING

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE
3 domestic uses	*45*	*3*	*throughout the year*
irrigation	*150*	*45*	*April 1 to September 15*

Example No. 5

In the spaces provided on the application, identify **all** the uses you currently make of the water taken under the water right that you propose to change.

Purpose of Use: List each purpose of use currently made of your water right. For example, "irrigation," "stockwater," and "municipal supply" are typical uses. If you are proposing a domestic use other than for a municipality, include the number of units to be served in the description of the purpose of use. For example, if you propose to serve 10 homes, indicate this by entering "10 domestic uses" in the space provided.

GPM or CFS: State the rate of water actually used for each listed purpose. You **must** indicate whether the rate you have stated is in units of gallons per minute (GPM) or cubic feet per second (CFS).

Acre-Feet/Yr: State the volume of water that is used during a calendar year in the unit of acre-feet for each listed purpose. One acre-foot is equal to 325,851 gallons or 43,560 cubic feet of water.

The volume of water that is reasonably required for beneficial use is highly variable from one water right to another. The acre-feet required is dependent upon the type of beneficial use, the geographic location of use, soil types, slope, and other case specific factors. The following are suggestions that may assist in estimating the volume of water used for purposes of filing your application. As part of the decision making process, Ecology will make a tentative determination of the extent of your water right that will include the number of acre-feet of water that you are authorized per year.

For small domestic water supplies, a reasonable estimate of use is 0.25 to 2 acre-feet per connection.

Uses that are continuous throughout a day of use at or near the maximum rate of diversion/withdrawal, may be estimated by multiplying the rate of diversion you have provided in GPM or CFS by the number of days that water is actually used during the period of use:

_____ (GPM or CFS) multiplied by _____ number of days of actual water use during the period of use

Multiply your answer by 2 if you've stated your diversion in CFS

Multiply your answer by 0.005 if you've stated your diversion is GPM.

For water uses that are in continuous use during an entire day, your answer will be a rough estimate of the number of acre-feet of water you currently use based upon your water use practices.

Period of Use: Identify the timeframe from the beginning month and day of use to the ending month and day of use, in which water is actually used for each listed purpose.

B. Proposed

Complete Part B. of Section 4, Purpose of Use, **only** if you are proposing to change or add uses of water authorized by your water right. If you are proposing to change the purpose of use, you **must** list **all** purposes for which you wish to use water. Follow the instructions provided by Part A of Section 4 to describe each intended water use through the change application.

5. Place of Use:

The place of use is the lands on which water is actually used. You **must** describe the existing place of water use and, if you proposed a change/transfer of place of use or to add place of use, you must describe the proposed place of use. Follow the instructions below to complete Section 5 of the application:

A. EXISTING

LEGAL DESCRIPTION OF LANDS WHERE WATER IS PRESENTLY USED:							
The south 500 feet of the north 600 feet of the:							
¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES
NW	*SW*	*10*	*15*	*25 E*	*Grant*	*854321-237*	*15*
DO YOU OWN ALL THE LANDS IN THE EXISTING PLACE OF USE? ☐ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME:							

Example No. 6

Print or type a complete description of the area of existing water use. You may find a description of your property on a property deed. Exclude from your description any lands you own that do not have a water use under the right you are changing. If necessary, you may attach a description of the place of use as a separate attachment.

The spaces for *¼¼*, *SEC*., *TWP*., AND *RGE* are provided for identifying the general location of the place(s) of use. The *SEC*., *TWP*., AND *RGE* refer to the section, township and range containing the place(s) of use. The "¼" (of the) "¼" spaces refer to (from right to left) the quarter of the identified section and then to the quarter of the identified quarter section of the place(s) of use. The following illustration shows how a section of land is divided into ¼¼ sections:

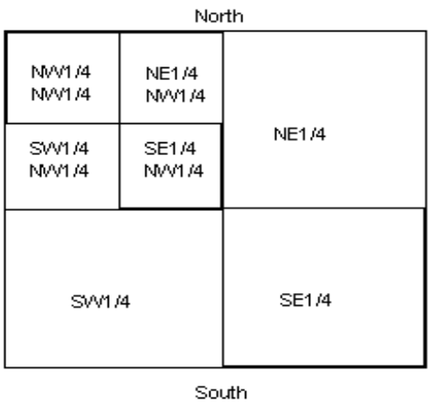


Illustration No. 1

If you do not understand this geographic location system, please contact the appropriate Ecology region office, County Conservancy Board, or seek professional assistance in completing your application.

County: Identify every county that contains any portion of the existing place of water use.

Parcel #. Please provide the county assigned identification number for each parcel containing your place of use. If the proposed place of use contains many separate parcels of property, please indicate this by writing "multiple" in the space provided for Parcel #. The parcel number may be obtained from the County Assessor's office for the county containing the place of use.

# of Acres: If you have identified irrigation as a purpose of use, you must state the number of acres that you are irrigating.

You must indicate whether you own the lands associated with the proposed change. If not, provide the landowner's name.

Map: In addition to describing the point(s) of diversion/withdrawal and place(s) of water use on the application, attach a detailed map. The map **must** have reference to the Township, Range and Section of the area illustrated. Indicate on the map: a) the lands upon which water is used for each purpose of water use; b) the points from which water is taken from the water source; c) any lands to which the water use is proposed to be changed; d) any new points from which water is proposed to be taken d) show a reference point such as a section corner e) show the location of structures, the water system and other features relevant to your proposed change/transfer. It is recommended that you base your map on a published map of your area. If your place of use is platted property, you **must** include a certified copy of the plat.

B. Proposed Place of Use: If you are proposing to add place of use or change/transfer place of use then you **must** complete Part 5B. of the application. Follow the instructions for Part 5A. to describe the new lands that you propose is associated with your water right.

Other rights: Below Part 5B. in a separate border is the following question:

ARE THERE ANY ADDITIONAL WATER RIGHTS OR CLAIMS RELATED TO THE SAME PROPERTY AS THE ONE PROPOSED FOR CHANGE/TRANSFER? ☐ YES ☐ NO – IF YES, PROVIDE THE WATER RIGHT/CLAIM NUMBER(S):

Example No. 7

If you are aware of other rights associated with any of the property you have describe on the application, please indicate so by marking the "yes" box provided and provide the identifying document number.

6. Remarks and Other Relevant Information: Your application will be reviewed by several interested agencies and is available to the public for inspection. You may use this space to provide additional information or an explanation for your change proposal. Your remarks or explanation may include any information that you believe should be considered in the review of your application. You may also explain the reasons that you are proposing the change/transfer, for example, that you are updating your water distribution system or relocating a water well.

Please note: If your application is being submitted for a seasonal or temporary change in water right, whether or not in conjunction with a permanent change or transfer, you **must** indicate the date that you desire the change/ transfer to be effective and the date that you desire the change/transfer to terminate. It is recommended that you submit your application as far in advance of the date you wish the change/transfer to be effective as possible.

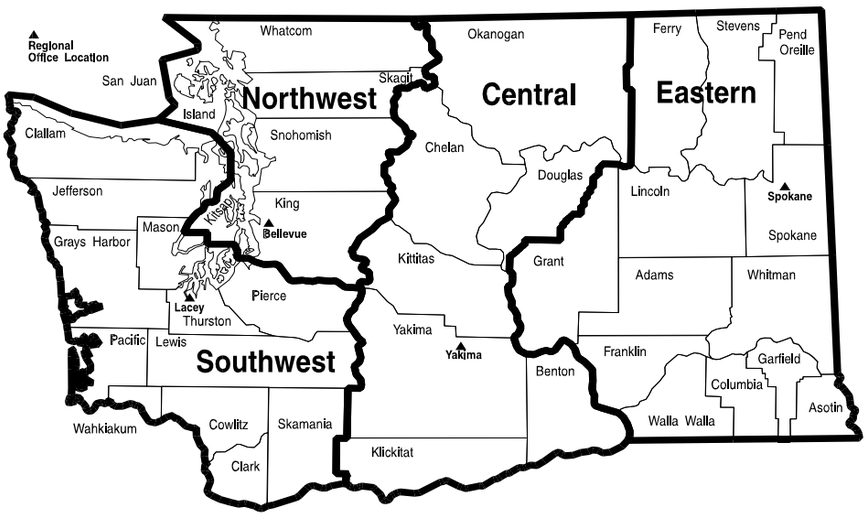
7. Signature and Date: The applicant must sign and date the application. In addition, the owner of the water right and the owner of the existing place of use must sign and date the application if different than the applicant.

IMPORTANT!

Submit your application to Ecology at:

DEPARTMENT OF ECOLOGY
CASHIERING UNIT
PO BOX 47611
OLYMPIA, WA 98504-7611

Alternatively, you may submit your application at a Conservancy Board with jurisdiction. Below is a map of the State of Washington, with outlines of the four Ecology regional offices. If you have questions about your application or whether a County Conservancy Board with jurisdiction exists, contact the Water Resources program at the regional office in which your project is located.



Please check the regional office in which your project is located.

☐ Central Regional Office
15 W Yakima Avenue, Suite 200
Yakima, WA 98902
(509) 575-2490

☐ Eastern Regional Office
4601 N. Monroe
Spokane, WA 99205-1295
(509) 329-3400

☐ Northwest Regional Office
3190 – 160th Avenue SE
Bellevue, WA 98008-5452
(425) 649-7000

☒ Southwest Regional Office
PO Box 47775
Olympia, WA 98504-7775
(360) 407-6300

APPENDIX B
WEST FORK HOQUIAM RIVER FLOW DATA

Source: Chehalis Basin Partnership 2002 Chehalis Basin Instream Flow Study Report by Tetra Tech dated June 2003.

FW. Fork Hoquiam River Flow Gage at Dekay Road, 2002 Data

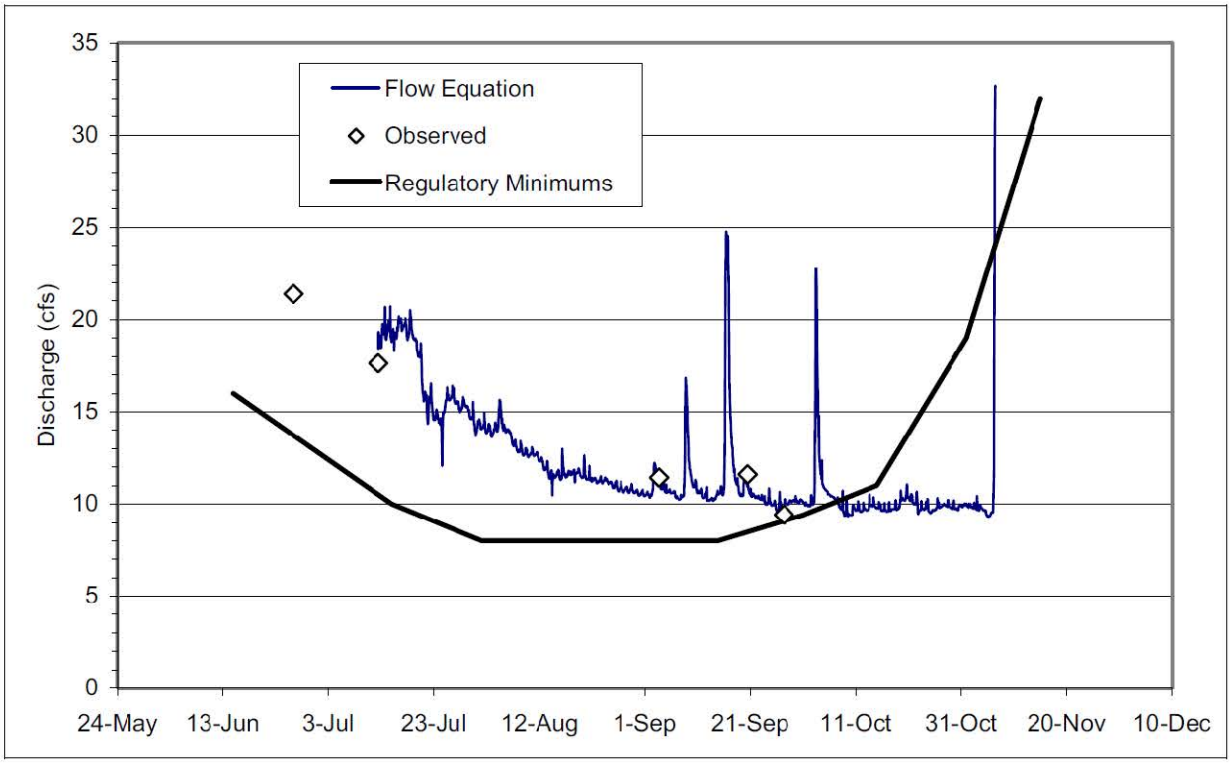


Figure 4-30. Discharge Hydrograph, West Fork Hoquiam River

TABLE 4-13.
COMPARISON OF MISCELLANEOUS CURRENT-METER MEASUREMENTS TO 2002 GAUGED FLOWS, WEST FORK HOQUIAM RIVER

	Average Flow[a] (cfs)			
	July	August	September	October
Historical	16.5	10.4	8.5	32.1
2002 Gauging Program	16.9	12.1	11.1	10.2
Difference (%)	2.4	16.3	30.6	-68.2

a. Historical values are the mean of all measurements taken for that month. 2002 Flows are mean monthly flows.

APPENDIX C
LABORATORY ANALYTICAL REPORT

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664
www.amtestlab.com

Professional Analytical Services

ANALYSIS REPORT

HDR Engineering, Inc.
500 108th Ave NE
Bellevue, WA 98004-5538
Attention: John Koreny
PO Number: 112419
All results reported on an as received basis.

Date Received: 05/20/10
Date Reported: 6/ 7/10

AMTEST Identification Number **10-A008085**
Client Identification **TW-1**
Sampling Date **05/18/10, 16:15**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	8.32	unit	*		EPA 150.1	PT	05/21/10
Total Cyanide	0.020	mg/l		0.005	EPA 335.4	TS	05/24/10
Sulfide	< 1	mg/l		1.00	EPA 376.1	KK	05/24/10

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	190	mg/l		0.10	EPA 300.0	MO	05/25/10
Fluoride	< 0.3	mg/l		0.10	EPA 300.0	MO	05/20/10

Total Metals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Silver	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Aluminum	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Arsenic-GF	< 0.001	mg/l		0.001	EPA 200.9	HL	05/26/10
Barium	0.0007	mg/l		0.0005	EPA 200.7	HL	05/25/10
Beryllium	< 0.0005	mg/l		0.0005	EPA 200.7	HL	05/25/10
Cadmium	< 0.0005	mg/l		0.0005	EPA 200.7	HL	05/25/10
Chromium	< 0.001	mg/l		0.001	EPA 200.7	HL	05/25/10
Copper	< 0.001	mg/l		0.001	EPA 200.7	HL	05/25/10
Iron	0.036	mg/l		0.005	EPA 200.7	HL	05/25/10
Mercury	< 0.0001	mg/l		0.0001	EPA 245.1	AY	06/03/10
Manganese	0.0025	mg/l		0.0005	EPA 200.7	HL	05/25/10
Lead-GF	< 0.001	mg/l		0.001	EPA 200.9	HL	05/28/10
Antimony	< 0.001	mg/l		0.001	EPA 204.2	HL	05/26/10
Selenium	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Thallium	< 0.001	mg/l		0.001	EPA 279.2	HL	05/26/10
Zinc	0.008	mg/l		0.001	EPA 200.7	HL	05/25/10

Volatile Organic Analysis (VOA's)

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Vinyl Chloride	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Chloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Trichlorofluoromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1-Dichloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Acetone	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Carbon Disulfide	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Methyl Iodide	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Methylene Chloride	< 2	ug/l		2.0	EPA 624	CG	05/28/10
Trans-1,2-Dichloroethene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Cis-1,2-Dichloroethene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1-Dichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Vinyl Acetate	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Acrylonitrile	< 5	ug/l		5.0	EPA 624	CG	05/28/10
2-Butanone (MEK)	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Chloroform	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,1-Trichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Carbon Tetrachloride	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Benzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Trichloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromodichloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromochloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dibromoethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Dibromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dichloropropane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
4-Methyl-2-Pentanone MIBK	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Toluene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Cis-1,3-Dichloropropene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,2-Trichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Tetrachloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
2-Hexanone	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Chlorodibromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Chlorobenzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Ethyl Benzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
m,p Xylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
o-Xylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Styrene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromoform	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,2,2-Tetrachloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,1,2-Tetrachloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10

Volatile Organic Analysis (VOA's) continued...

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Trans-1,3-Dichloropropene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,4-Dichlorobenzene	< 4	ug/l		4.0	EPA 624	CG	05/28/10
1,2-Dichlorobenzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dibromo3Chloropropane	< 5	ug/l		5.0	EPA 624	CG	05/28/10
trans-1,4-Dichloro2butene	< 5	ug/l		5.0	EPA 624	CG	05/28/10
1,2,3-Trichloropropane	< 1	ug/l		1.0	EPA 624	CG	05/28/10

VOA Surrogates

ANALYTE	% RECOVERY
D4-1,2,-Dichloroethane	105. %
D8-Toluene	105. %
4-Bromofluorobenzene	101. %

Semi-Volatiles

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
N-Nitrosodimethylamine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Aniline	< 1	ug/l		1.0	EPA 625	Anatek	05/26/10
Phenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroethyl)ether	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Chlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,3-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,4-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzyl Alcohol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Methylphenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroisopropyl)eth	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Methylphenol (P.Cresol)	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
N-Nitroso-di-n-propylamin	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachloroethane	< 1	ug/l		1.0	EPA 625	Anatek	05/26/10
Nitrobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Isophorone	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Nitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dimethylphenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroethoxy)methan	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2,4-Trichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chloroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorobutadiene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chloro-3-methylphenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1-Methyl Naphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorocyclopentadiene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4,6-Trichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4,5-Trichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Chloronaphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dimethylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,6-Dinitrotoluene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
3-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dinitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Nitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dibenzofuran	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dinitrotoluene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Diethylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chlorophenyl-phenyl eth	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4,6-Dinitro-2-methylpheno	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
N-nitrosodiphenylamine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10

Semi-Volatiles continued...

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
4-Bromophenyl-phenyl ethe	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pentachlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Carbazole	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Di-n-butylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzidine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Butylbenzylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
3,3-Dichlorobenzidine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Ethylhexyl)phthalat	17.	ug/l		2.0	EPA 625	Anatek	05/26/10
Di-n-octylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2-Diphenylhydrazine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pyridine	< 2	ug/L		2.0	EPA 625	Anatek	05/26/10

Polynuclear Aromatic Hydrocarbons (PAH)

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Acenaphthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Acenaphthylene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(a)anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(b)fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(k)fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(g,h,i)perylene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(a)pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Chrysene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dibenzo(a,h)anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Fluorene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Indeno(1,2,3-cd)pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Phenanthrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Naphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Methylnaphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10

Semi-Volatile Surrogates

ANALYTE	% RECOVERY
2-Fluorophenol	83.4 %
D6-Phenol	91.6 %
D5-Nitrobenzene	95.5 %
2-Fluorobiphenyl	83.7 %
2,4,6-Tribromophenol	85.4 %
D14-Terphenyl	104. %

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Methane	23000	ug/L		1.3	RSK 175	Sublet	05/25/10

AMTEST Identification Number **10-A008086**
Client Identification **TW-3**
Sampling Date **05/18/10, 16:15**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	8.46	unit	*		EPA 150.1	PT	05/21/10
Total Cyanide	0.015	mg/l		0.005	EPA 335.4	TS	05/24/10
Sulfide	< 1	mg/l		1.00	EPA 376.1	KK	05/24/10

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	290	mg/l		0.10	EPA 300.0	MO	05/25/10
Fluoride	< 0.3	mg/l		0.10	EPA 300.0	MO	05/20/10

Total Metals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Silver	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Aluminum	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Arsenic-GF	< 0.001	mg/l		0.001	EPA 200.9	HL	05/26/10
Barium	0.0007	mg/l		0.0005	EPA 200.7	HL	05/25/10
Beryllium	< 0.0005	mg/l		0.0005	EPA 200.7	HL	05/25/10
Cadmium	< 0.0005	mg/l		0.0005	EPA 200.7	HL	05/25/10
Chromium	< 0.001	mg/l		0.001	EPA 200.7	HL	05/25/10
Copper	< 0.001	mg/l		0.001	EPA 200.7	HL	05/25/10
Iron	0.200	mg/l		0.005	EPA 200.7	HL	05/25/10
Mercury	< 0.0001	mg/l		0.0001	EPA 245.1	AY	06/03/10
Manganese	0.0317	mg/l		0.0005	EPA 200.7	HL	05/25/10
Lead-GF	< 0.001	mg/l		0.001	EPA 200.9	HL	05/28/10
Antimony	< 0.001	mg/l		0.001	EPA 204.2	HL	05/26/10
Selenium	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Thallium	< 0.001	mg/l		0.001	EPA 279.2	HL	05/26/10
Zinc	0.004	mg/l		0.001	EPA 200.7	HL	05/25/10

Volatile Organic Analysis (VOA's)

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Vinyl Chloride	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Chloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Trichlorofluoromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1-Dichloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Acetone	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Carbon Disulfide	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Methyl Iodide	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Methylene Chloride	< 2	ug/l		2.0	EPA 624	CG	05/28/10
Trans-1,2-Dichloroethene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Cis-1,2-Dichloroethene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1-Dichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Vinyl Acetate	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Acrylonitrile	< 5	ug/l		5.0	EPA 624	CG	05/28/10
2-Butanone (MEK)	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Chloroform	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,1-Trichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Carbon Tetrachloride	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Benzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Trichloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromodichloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10

Volatile Organic Analysis (VOA's) continued...

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Bromochloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dibromoethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Dibromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dichloropropane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
4-Methyl-2-Pentanone MIBK	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Toluene	261.	ug/l	E	1.0	EPA 624	CG	05/28/10
Cis-1,3-Dichloropropene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,2-Trichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Tetrachloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
2-Hexanone	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Chlorodibromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Chlorobenzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Ethyl Benzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
m,p Xylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
o-Xylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Styrene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromoform	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,2,2-Tetrachloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,1,2-Tetrachloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Trans-1,3-Dichloropropene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,4-Dichlorobenzene	< 4	ug/l		4.0	EPA 624	CG	05/28/10
1,2-Dichlorobenzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dibromo3Chloropropane	< 5	ug/l		5.0	EPA 624	CG	05/28/10
trans-1,4-Dichloro2butene	< 5	ug/l		5.0	EPA 624	CG	05/28/10
1,2,3-Trichloropropane	< 1	ug/l		1.0	EPA 624	CG	05/28/10

VOA Surrogates

ANALYTE	% RECOVERY
D4-1,2,-Dichloroethane	104. %
D8-Toluene	100. %
4-Bromofluorobenzene	98.9 %

Semi-Volatiles

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
N-Nitrosodimethylamine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Aniline	< 1	ug/l		1.0	EPA 625	Anatek	05/26/10
Phenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroethyl)ether	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Chlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,3-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,4-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzyl Alcohol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Methylphenol	2.2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroisopropyl)eth	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Methylphenol (P.Cresol)	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
N-Nitroso-di-n-propylamin	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachloroethane	< 1	ug/l		1.0	EPA 625	Anatek	05/26/10
Nitrobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Isophorone	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Nitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dimethylphenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroethoxy)methan	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2,4-Trichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chloroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorobutadiene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chloro-3-methylphenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1-Methyl Naphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorocyclopentadiene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4,6-Trichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4,5-Trichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Chloronaphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dimethylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,6-Dinitrotoluene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
3-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dinitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Nitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dibenzofuran	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dinitrotoluene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Diethylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chlorophenyl-phenyl eth	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4,6-Dinitro-2-methylpheno	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
N-nitrosodiphenylamine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10

Semi-Volatiles continued...

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
4-Bromophenyl-phenyl ethe	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pentachlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Carbazole	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Di-n-butylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzidine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Butylbenzylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
3,3-Dichlorobenzidine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Ethylhexyl)phthalat	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Di-n-octylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2-Diphenylhydrazine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pyridine	< 2	ug/L		2.0	EPA 625	Anatek	05/26/10

Polynuclear Aromatic Hydrocarbons (PAH)

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Acenaphthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Acenaphthylene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(a)anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(b)fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(k)fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(g,h,i)perylene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(a)pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Chrysene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dibenzo(a,h)anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Fluorene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Indeno(1,2,3-cd)pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Phenanthrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Naphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Methylnaphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10

Semi-Volatile Surrogates

ANALYTE	% RECOVERY
2-Fluorophenol	85.0 %
D6-Phenol	93.0 %
D5-Nitrobenzene	97.3 %
2-Fluorobiphenyl	88.6 %
2,4,6-Tribromophenol	89.8 %
D14-Terphenyl	103. %

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Methane	20000	ug/L		1.3	RSK 175	Sublet	05/25/10

AMTEST Identification Number **10-A008087**
Client Identification **TW-2**
Sampling Date **05/18/10, 16:15**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
pH	8.16	unit	*		EPA 150.1	PT	05/21/10
Total Cyanide	0.015	mg/l		0.005	EPA 335.4	TS	05/24/10
Sulfide	< 1	mg/l		1.00	EPA 376.1	KK	05/24/10

Minerals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloride	230	mg/l		0.10	EPA 300.0	MO	05/25/10
Fluoride	< 0.3	mg/l		0.10	EPA 300.0	MO	05/20/10

Total Metals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Silver	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Aluminum	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Arsenic-GF	< 0.001	mg/l		0.001	EPA 200.9	HL	05/26/10
Barium	0.0009	mg/l		0.0005	EPA 200.7	HL	05/25/10
Beryllium	< 0.0005	mg/l		0.0005	EPA 200.7	HL	05/25/10
Cadmium	< 0.0005	mg/l		0.0005	EPA 200.7	HL	05/25/10
Chromium	< 0.001	mg/l		0.001	EPA 200.7	HL	05/25/10
Copper	< 0.001	mg/l		0.001	EPA 200.7	HL	05/25/10
Iron	0.032	mg/l		0.005	EPA 200.7	HL	05/25/10
Mercury	< 0.0001	mg/l		0.0001	EPA 245.1	AY	06/03/10
Manganese	0.0025	mg/l		0.0005	EPA 200.7	HL	05/25/10
Lead-GF	< 0.001	mg/l		0.001	EPA 200.9	HL	05/28/10
Antimony	< 0.001	mg/l		0.001	EPA 204.2	HL	05/26/10
Selenium	< 0.01	mg/l		0.01	EPA 200.7	HL	05/25/10
Thallium	< 0.001	mg/l		0.001	EPA 279.2	HL	05/26/10
Zinc	0.005	mg/l		0.001	EPA 200.7	HL	05/25/10

Volatile Organic Analysis (VOA's)

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Chloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Vinyl Chloride	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Chloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Trichlorofluoromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1-Dichloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Acetone	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Carbon Disulfide	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Methyl Iodide	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Methylene Chloride	< 2	ug/l		2.0	EPA 624	CG	05/28/10
Trans-1,2-Dichloroethene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Cis-1,2-Dichloroethene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1-Dichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Vinyl Acetate	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Acrylonitrile	< 5	ug/l		5.0	EPA 624	CG	05/28/10
2-Butanone (MEK)	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Chloroform	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,1-Trichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Carbon Tetrachloride	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Benzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Trichloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromodichloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10

Volatile Organic Analysis (VOA's) continued...

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Bromochloromethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dibromoethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Dibromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dichloropropane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
4-Methyl-2-Pentanone MIBK	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Toluene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Cis-1,3-Dichloropropene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,2-Trichloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Tetrachloroethylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
2-Hexanone	< 5	ug/l		5.0	EPA 624	CG	05/28/10
Chlorodibromomethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Chlorobenzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Ethyl Benzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
m,p Xylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
o-Xylene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Styrene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Bromoform	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,2,2-Tetrachloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,1,1,2-Tetrachloroethane	< 1	ug/l		1.0	EPA 624	CG	05/28/10
Trans-1,3-Dichloropropene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,4-Dichlorobenzene	< 4	ug/l		4.0	EPA 624	CG	05/28/10
1,2-Dichlorobenzene	< 1	ug/l		1.0	EPA 624	CG	05/28/10
1,2-Dibromo3Chloropropane	< 5	ug/l		5.0	EPA 624	CG	05/28/10
trans-1,4-Dichloro2butene	< 5	ug/l		5.0	EPA 624	CG	05/28/10
1,2,3-Trichloropropane	< 1	ug/l		1.0	EPA 624	CG	05/28/10

VOA Surrogates

ANALYTE	% RECOVERY
D4-1,2,-Dichloroethane	104. %
D8-Toluene	107. %
4-Bromofluorobenzene	95.1 %

Semi-Volatiles

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
N-Nitrosodimethylamine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Aniline	< 1	ug/l		1.0	EPA 625	Anatek	05/26/10
Phenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroethyl)ether	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Chlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,3-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,4-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzyl Alcohol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2-Dichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Methylphenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroisopropyl)eth	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Methylphenol (P.Cresol)	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
N-Nitroso-di-n-propylamin	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachloroethane	< 1	ug/l		1.0	EPA 625	Anatek	05/26/10
Nitrobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Isophorone	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Nitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dimethylphenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Chloroethoxy)methan	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2,4-Trichlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chloroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorobutadiene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chloro-3-methylphenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1-Methyl Naphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorocyclopentadiene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4,6-Trichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4,5-Trichlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Chloronaphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dimethylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,6-Dinitrotoluene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
3-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dinitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Nitrophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dibenzofuran	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2,4-Dinitrotoluene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Diethylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Chlorophenyl-phenyl eth	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4-Nitroaniline	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
4,6-Dinitro-2-methylpheno	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
N-nitrosodiphenylamine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10

Semi-Volatiles continued...

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
4-Bromophenyl-phenyl ethe	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Hexachlorobenzene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pentachlorophenol	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Carbazole	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Di-n-butylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzidine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Butylbenzylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
3,3-Dichlorobenzidine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
bis(2-Ethylhexyl)phthalat	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Di-n-octylphthalate	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
1,2-Diphenylhydrazine	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pyridine	< 2	ug/L		2.0	EPA 625	Anatek	05/26/10

Polynuclear Aromatic Hydrocarbons (PAH)

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Acenaphthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Acenaphthylene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(a)anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(b)fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(k)fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(g,h,i)perylene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Benzo(a)pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Chrysene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Dibenzo(a,h)anthracene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Fluorene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Fluoranthene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Indeno(1,2,3-cd)pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Phenanthrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Naphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
Pyrene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10
2-Methylnaphthalene	< 2	ug/l		2.0	EPA 625	Anatek	05/26/10

Semi-Volatile Surrogates

ANALYTE	% RECOVERY
2-Fluorophenol	91.3 %
D6-Phenol	99.7 %
D5-Nitrobenzene	102. %
2-Fluorobiphenyl	89.0 %
2,4,6-Tribromophenol	97.8 %
D14-Terphenyl	106. %

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Methane	32000	ug/L		1.3	RSK 175	Sublet	05/25/10

* = The method specifies the test is to be performed in the field; therefore the result is an estimate.

E = The result is an estimated amount because the value exceeds the instrument calibration range.

Aaron W. Young
Laboratory Manager

APPENDIX D
ARTICLE ON METHANE IN GROUND WATER

The Consultants Collection is a new monthly WWJ feature. In its pages you'll hear from a rotating group of professional hydrogeologists on their favorite subject-ground water-in a way that will interest both drillers and hydrogeologists.

Our collection includes Don Keech, chief of the ground water quality control section of the Michigan Department of Public Health; William Skinner, hydrologist with Dames and Moore; Tyler Gass, president of Bennett & Gass and Brad Caswell, water resources director for Wright Pierce Architects/Engineers.

We hope you'll enjoy reading and learning from our new monthly offering for you.

CONSULTANTS COLLECTION

Methane in Water Wells

by Donald K. Keech and Michael S. Gaber

Methane gas can occur naturally in water wells and when it does, it presents unique problems for water well drilling contractors. The major concern relates to flammable and explosive hazards associated with methane gas (see Figure 1). However, with the treatment discussed in this article, methane and other dissolved gases can be effectively removed from the water system.

Methane (CH4) is the first member of the paraffin series of saturated hydrocarbons. Methane is a colorless, odorless gas and has an explosive limit between 5 to15 percent by volume in air. Since it is lighter than air it rises; in a fire, it will be at the ceiling. Methane stays in solution below 42^{0}F and evolves out of the water between 42 to 58^{0}F. Above 58^{0}F, methane is a gas and will not stay in solution. Methane is known as "fire damp" in the coal mining industry and presents an explosive hazard in underground mines. Methane can also be generated by the decomposition of carbonacious matter in swampy or marshy areas and is often called "marsh gas."

The gas that causes problems in water wells can occur in either bedrock or overburden wells. Methane is generated in source rock, then "stored" in a reservoir with some type of cap rock or impervious layer to contain the gas underground. In Michigan, these wells generally occur in areas underlain with Antrim or Coldwater shale formations of the late Devonian or early Mississippi period. These two shales are carbonacious in nature and serve as the source rock. Gas from these sources may contain methane or may be nearly all nitrogen. A high nitrogen content gas can cause problems in pump operations but it is not an explosive hazard.

Production type natural gas may also be occasionally encountered in water wells. This higher Btu gas may escape from an oil/gas well blowout or from a failure at an underground gas storage field.

Table 1 lists some characteristic analyses of dissolved gas from well water These analyses are all from wells in Michigan drilled no deeper than 120 feet and illustrates the variability in composition of dissolved gas that can be anticipated from a well with typical gas problems such as milky water, pulsations at the faucets or flammable conditions.

Sampling procedures

A simple qualitative test for methane can be done with the use of a plastic, narrow-mouthed milk carton and a book of matches. Use the following procedure:

1. Fill the gallon container up to the bottom of the narrow neck. Place hand over the mouth of the bottle. If methane is present, it will collect in the upper portion of the container.

Table 1
Gas Composition – Percent By Volume

Well Location	Methane	Ethane	Butane	Oxygen	Carbon Dioxide	Nitrogen	Hydrogen
Harrison Twp. - Macomb Co.	87.0	0.0	0.0	2.4	0.0	10.6	0.0
Pontiac Twp. - Oakland Co.	0.0	0.0	0.0	6.0	6.0	88.0	0.0
Wilson Twp. - Charlevoix Co.	30.1	0.0	0.0	11.3	0.1	57.8	0.3
Goodwell Twp. - Newaygo Co.	71.3	2.8	trace	trace	0.2	24.6	trace
Goodwell Twp. - Newaygo Co.	28.7	1.3	trace	2.5	0.7	66.8	trace
Whitewater Twp. - Grand Traverse Co.*	84.5	6.0	.6	trace	.23	4.69	

***Analysis also indicated traces of propane, isobutane, pentane, heptane and helium.**

2. Bring a lighted match to the mouth of the bottle and quickly move hand away. The presence of methane will result in a brief wisp of blue or yellow flame.

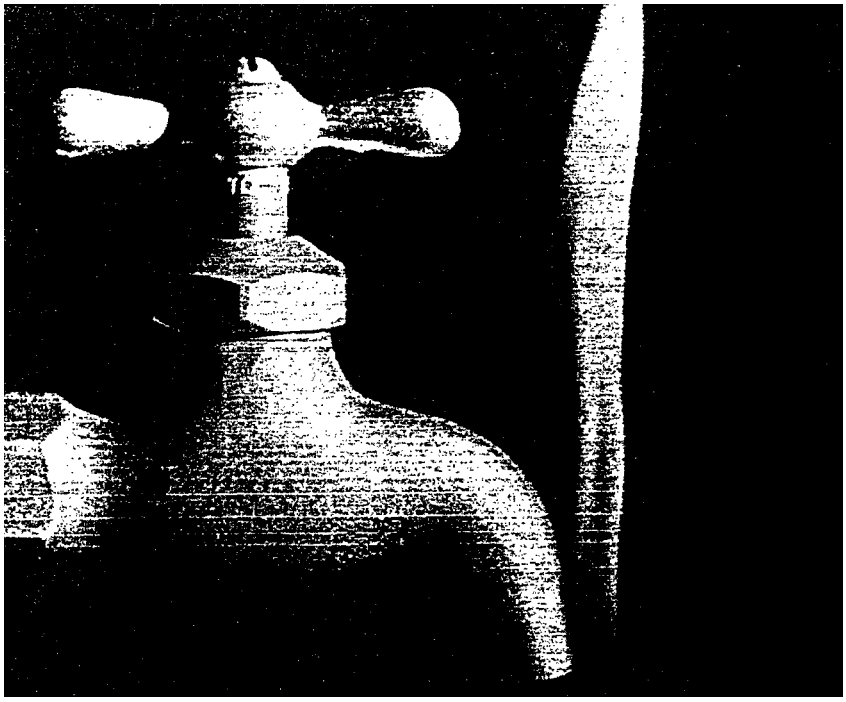
Note: It is important that a plastic container be used rather than glass because of possible breakage. This test should be performed outdoors and away from flammable materials.

The Michigan Department of Public Health uses the bubbler pail method for collecting gas samp-les from water supplies. The bubbler pail can be constructed easily from a small pail (see Figure 2). Water enters the pail through an inlet near the bottom of the pail and rises up through a standpipe. The pail is filled with water during the sample collection. A sample collection bottle is filled with water and inverted over the standpipe and gas will accumulate by displacing the water in the sample bottle.

By recording the flow rate, length of test and volume of gas collected, the percentage of gas-in-water can be determined. Labora-tory analysis of the gas is performed to determine composition and presence of methane or other combustible gases. Portable combustible gas meters can also be used for field determinations of methane levels. A percent meth-ane-in-water figure can then be established for the individual water supply. An example of calculations from a typical gas sample collection using the bubbler pail are as follows:

1. flow rate = 3 liters/minute
2. length of test = 5 minutes
3. total water volume sampled = 3 x 5 = 15 liters
4. gas volume collected = 750ml or 0.75 liters
5. percent gas in water = $\frac{0.75}{15}$ =0.05 = 5%
6. methane (CH_4) concentration in gas sample (determined by laboratory) = 30%
7. percent methane in water = 5% x 0.30 = 1.5%

The Michigan Department of Public Health, Occupational Health Division, considers less than 1 percent methane-in-water (by volume) as being safe from explosion hazards. If levels are above 1 percent, it is usually recommended that a methane removal system be installed on the water supply.



Gas in water-bearing formations is sometimes emitted directly from household faucets.

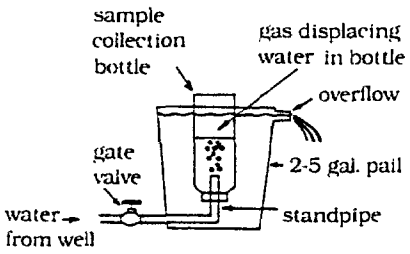


Figure2. Bubbler pail method for collectinggassamplesfrom water supplies

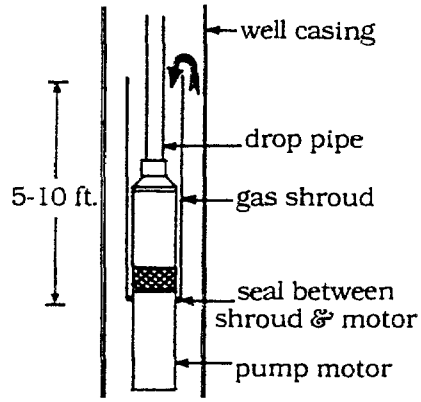


Figure 3. Details of gas shroud on submersible pump

Well venting

Proper venting at the well head is essential. Methane gas is lighter than air and will exit through a vented well cap. The upward movement of water in the casing when the well is recovering after pumping will push the accumulated methane gas out the top of the well. If large amounts of combustible gases (methane, ethane, butane, etc.) are present, the well vent should terminate above a person's head level to avoid ignition of the gases by lawn mowers, barbeque grills, cigarettes, etc.

Gas shrouds

One method which has been successful in several gaseous water wells involves the installation of a gas shroud on the submersible pump (see Figure 3). The shroud will usually eliminate substantial amounts of gas and help prevent air locking of the pump, which is a common problem in gas producing wells. In some cases, the installation

of a shroud on the pump has reduced the gas levels enough so that further treatment was not necessary.

The shroud seals to the top of the submersible pump motor, below the intake, and extends 5 to 10 feet above the top of the pump. The water must then travel upward and over the top of the shroud and downward to the pump intake. The dissolved gases will have a tendency to continue upward rather than following the water to the intake, allowing gases to escape from the well vent.

If the casing is 5 inches or larger with a 4-inch submersible pump, a gas shroud can be easily fabricated from 4-inch thin wall plastic pipe. A few submersible pump manufacturers have shrouds available for 4-inch wells. A 3-inch submersible pump with a thin wall plastic shroud can also be used in a 4-inch well. It is important that a tight seal be made between the pump motor and the bottom of the shroud since leakage will cause gaseous water to enter the pump intake. The bottom of the shroud must seal at the top of the motor to allow for proper motor cooling. Drillers have sealed the shroud to the motor by wrapping tape around the shroud or by slitting the thinwall plastic near the bottom and clamping the shroud to the motor.

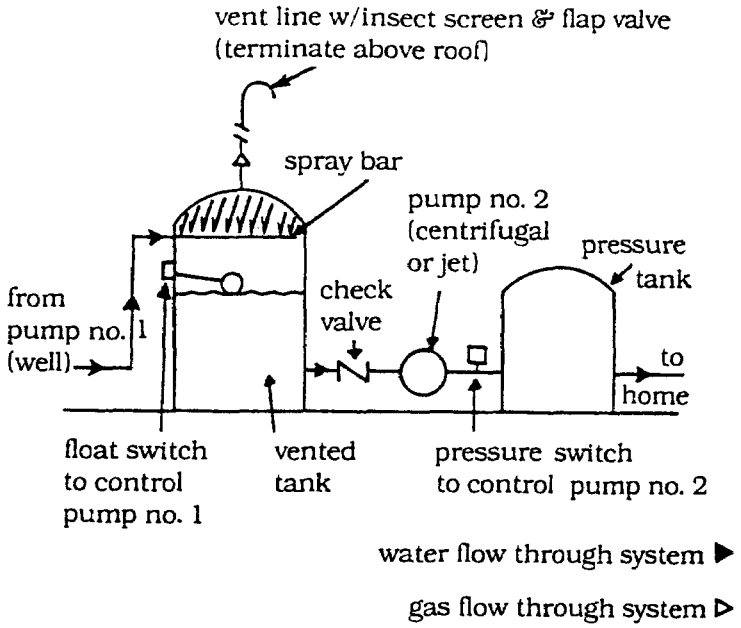


Figure4. Vented tank method for gas removal

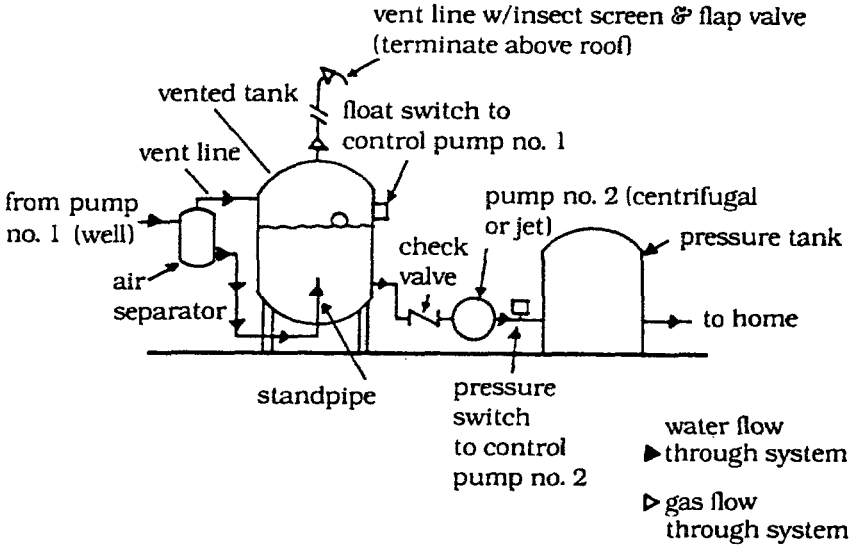


Figure 5. Air separator method for gas removal

Vented tank method

A gas removal system that has worked effectively on several installations in Michigan uses a vented storage tank with a spray bar mechanism (see Figure 4). The spray bar is a length of pipe with small holes drilled in it to disperse the water. Agricultural spray noz-zles may also be used for this purpose.

Water from the well is sprayed upward through the spray bar into the vented tank and gas is liberated and exits through a vent pipe at the top of the tank. A float switch is used in the vented tank to control the well pump. A shallow well jet or centrifugal pump is then used to pump water from the vented tank into a precharged pressure tank to provide pressure for the distribution system.

If methane or other combustible gases (e.g. ethane, butane, pentane, hexane) are present, the vent line which eliminates gas from the system should terminate above the roof line of the building. The vent should be screened and downturned to prevent insects and debris from entering. It is recommended that a flap-type check valve be installed on the vent line to allow the tank to vent to the outside only. This will minimize the intake of airborne bacteria, spores, pollen. etc., into the vent line. In addition, the check valve will place the tank under negative pressure when the second pump is operating, further increasing the liberation of gas from the water.

Water retention time in the vented tank is critical. The tank should be adequately sized to allow the water to remain in the tank for several minutes to optimize gas liberation. Also, the location of the tank inlet and outlet should prevent short circuiting of water flow through the tank.

Air release valve method

Another system involves the use of an air release valve on a galvanized storage tank. Gas is released from the air release valve when the liquid level is lowered to a predetermined point due to the accumulation of gas in the upper part of the tank. The vent line from the air release valve is terminated above the roof line of the building.

Since the tank remains pressurized, gas liberation does not occur as readily as in those systems using a vented tank. Several systems using air release valves tested by the Michigan Department of Public Health have not been effective in removing large amounts of gas.

Air separator method

In the summer of 1981, a newly constructed high school in northern Michigan was found to have more than 1 percent methane-in-water in its 6-inch, 165-foot, 150 gpm well. When the water supply was put into service, school personnel noted the effervescent, milky appearance of the water. One custodian reported that a flame shot across the room when he lit a match and opened a faucet simultaneously.

The Michigan Department of Public Health recommended that a methane removal system be installed. A local engineering firm designed a system utilizing a device called an air separator (see Figure 5). Air separators have been used for several years for removing air from hot water systems, but had never been used for removing gas from on-site water supplies. The system was installed in the fall of 1981.

The air separator is a cylindrical device with an inlet near the top, outlet near the bottom and air vent on top. Water flowing through the unit creates a centrifugal force which causes heavier, gas free water to move toward the outside. Lighter, gas-entrained water moves toward the center due to a low velocity vortex being created within the air separator. The gas rises and exits through a vent line into the top of a vented tank. A vent from the tank terminates about a foot above the roof line of the building.

Water from the air separator enters the bottom center of the vented tank through a smaller diameter standpipe. The smaller diameter of the standpipe lowers the pressure and increases water velocity and turbulence in the tank, which induces further gas-water separation.

A centrifugal pump is used to pump water from the vented tank into the school's pressure tanks. A float control on the vented tank controls the submersible pump in the well, and a standard pressure switch located downstream from the centrifugal pump controls the repumping operation.

The Michigan Department of Public Health evaluated the operation of the air separator methane removal system by collecting several gas samples from water before and after treatment. Raw water samples showed gas-in-water concentrations ranging from 7 to 9.8 percent and methane-in-water concentrations of 1.3 to 1.5 percent. Analyses of gas samples showed it to be 20 percent methane. Samples collected after treatment through the gas removal system showed a 95 percent decrease in gas and methane-in-water levels. The gas-in-water concentration fell to less than 1 percent and the methane-in-water concentration was less than one-tenth of 1 percent

Conclusion

Methane and other dissolved gases can be removed from water supplies; however, the additional equipment and space necessary may be prohibitive for small domestic systems. Whenever vented tanks are used, oxidation can cause turbidity problems in certain ground waters which may make further treatment necessary. Additional field research is needed in the area of methane removal so that low cost treatment methods can be developed.

Well drilling contractors, engineering firms or other regulatory agencies that have had experience with other methane removal systems are encouraged to share their experiences. Write to: Consultants Collection, c/o Water Well Journal, 500 W. Wilson Bridge Rd., Worthington, OH 43085.

Donald K Keech. P.E., Chief. Ground Water Quality Control Section. Michigan Department of Public Health, P.O. Box 30035, Lansing, MI 48909.

Michael S. Gaber. RS, Environmental Sanitarian, Ground Water Quality Control Section Michigan Department of Public Health P.O. Box30035, Lansing, MI 48909.

APPENDIX E
COST ESTIMATE DETAILS

Cost Estimate for Production Well Installation from Arcadia Drilling

Item#	Description	Quantity	Unit Price	Line Total
W-1	Surface Seal to 18 feet 20" diameter	2	$ 9,450.00	$ 18,900.00
W-2	16" Drive Shoe	2	$ 1,150.00	$ 2,300.00
W-3	16" Drilling	320	$ 225.00	$ 72,000.00
W-4	16" Casing	360	$ 78.00	$ 28,080.00
W-5	Shoe Cut	2	$ 3,995.00	$ 7,990.00
W-6	12" Screen with pack	160	$ 395.00	$ 63,200.00
W-7	Pack material	320	$ 24.00	$ 7,680.00
W-8	Mobilization Charge with casing Jacks for screen	2	$ 5,985.00	$ 11,970.00
W-Total			**Drilling Total:**	$ 212,120.00
P-1	Flowing Well Seal Weld on Flange	2	$ 1,850.00	$ 3,700.00
P-2	Set and remove test pump for both wells & simunltaneously	2	$ 26,000.00	$ 52,000.00
P-3	24 Hour pump test at 1500 gpm			$ -
P-4				$ -
P-5	Shroud for gas entering aquifer	2	$ 3,650.00	$ 7,300.00
P-6				$ -
P-7	SHROUD COST IS ESTIMATED - SHROUD TBD			$ -
P-8				$ -
P-9				$ -
P-10				$ -
P-Total			**Pump Total:**	$ 63,000.00
T-1	Hourly for screen installation and development & misc.	160	$ 165.00	$ 26,400.00
T-2	Department of Ecology Notice of Intent	2	$ 300.00	$ 600.00
T-3	3 Bollards and a concrete pad around well head	2	$ 2,250.00	$ 4,500.00
T-4				$ -
				$ -
T-Total			**Additional**	$ 31,500.00
			Sub Total	$ 306,620.00
			2% Discount (10 days)	$ 6,132.40
			Sub Sub Total:	$ 300,487.60
			Sales Tax 8.3%	$ 24,940.47
			Total	$ 325,428.07

This proposal is an estimated price to drill a well and/or install pumping equipment on the property identified above. The quantities and quoted equipment are estimates only. The actual depth of the well and the equipment required may be different than that proposed above. If you agree to contract Arcadia Drilling, Inc. to construct a well and/or install a pumping system based on the above prices, please sign and date this proposal and our standard contract. We will proceed with your project on a mutually acceptable construction schedule. **This proposal is invalid 30 days from date**

Class 4 Conceptual Opinion of Probable Construction Costs
(Assuming Groundwater Blending Prior to Raw Water Pump Station Only)

Description	Cost
Two Well Pumps, Well Houses, and Associated Piping One Packed Tower (10-feet dia., 25-feet high, sized for 2,000 gpm) Foundation for Packed Tower (20-feet x 20-feet, 12" concrete slab) One Blower One River/Groundwater Mixing Chamber Existing Raw Water PS Modifications Raw Water Intake and Valving modifications Misc. Mechanical and Site Piping Site Work Electrical Wiring and Power Supply Instrumentation and Controls	
Direct Construction Cost (DCC)	$1,145,000
Contractor's Field Overhead and Mob/Demob (7% of DCC)	$80,000
Sub-total Construction Cost (SCC)	$1,225,000
Contractor's Bond and Insurance (1.5% of SCC)	$18,000
Contractor's Fee (10% of SCC)	$123,000
Allowance for Undefined Equipment (50% of SCC)	$613,000
Sales Tax (8.4%)	$103,000
[A] Median Estimated Total Construction Cost in 2010	$2,082,000
3% Annual Inflation to 2012	$127,000
[B] Median Estimated Total Construction Cost in 2012 (Median TCC)	**$2,209,000**
[C] Low Estimated Total Construction Cost in 2012 (Median TCC - 30%)	**$1,546,000**
[D] High Estimated Total Construction Cost in 2012 (Median TCC + 50%)	**$3,314,000**

The developed values in the table are considered a Class 4 feasibility estimate. A Class 4 estimate, per the Association for the Advancement of Cost Engineering Manual 17R-97 *Cost Estimate Classification System,* is one based upon fairly limited information and typically only 1% to 15% of engineering analysis and design completed. Such an estimate has a corresponding level of cost accuracy of -30% to +50%.