

Environmental  
Resources  
Management

1218 Third Avenue  
Suite 1412  
Seattle, WA 98101  
(425) 462-8591  
(425) 455-3573 (fax)

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MAY 09 2016

DEPT OF ECOLOGY  
TCP - NWRO

2 May 2016

Mr. Dale Myers  
Washington State Department of Ecology  
Northwest Regional Office  
3190 160<sup>th</sup> Avenue SE  
Bellevue, Washington 98008-5452



Re: Response to Opinion on Site Characterization Report for K2  
Facility (VCP #NW2894)  
Vashon, Washington

Dear Mr. Myers:

Environmental Resources Management (ERM) prepared this letter on behalf of K2 in response to the Washington State Department of Ecology (Ecology) opinion letter dated 23 November 2015 for the Site Characterization Report for the K2 facility at 19215 Vashon Highway Southwest, Vashon, Washington (the "Site"). A Site Location Map is provided as Figure 1.

K2 and ERM appreciate your review, comments, and opinion on the Site Characterization Report. We understand that the only material data gap in the Site Characterization Report identified by Ecology in its opinion letter is the vertical extent of trichloroethene (TCE) in groundwater at the Site. The specific comment in the opinion letter is presented below:

*From analysis of Site ground water for TCE and Cross Section A-A' (Figure 9), it is apparent that the vertical extent of TCE in ground water has not been defined. The Site is within the 5-year travel time of Vashon Island Wellhead Protection Zones for Water District 19 (WD19). Ground water intakes for WD19's wells 1, 2, and 4 are at roughly 567, 640, and 598 feet below ground surface, respectively. Therefore Ecology is requiring that the vertical extent of the TCE plume be fully characterized. Additionally, Ecology is requiring that all data from this investigation be forwarded to WD19.*

This letter presents the proposed approach to address the characterization of the vertical extent of the TCE plume in groundwater at the Site, and a summary of the pertinent background information from which the rationale for the plan was developed.

## ***PROPOSED APPROACH***

K2 proposes to characterize the vertical extent of the TCE plume in groundwater at the Site by installing a single deep monitoring well downgradient of the maximum known concentrations of TCE in shallow groundwater at the Site. The well will be installed with a screen set across the next-deepest water-bearing interval beyond the depth of the current monitoring well network. The depth of the water-bearing unit and the well screen interval will be determined based on observations during drilling. An ERM geologist will provide oversight of the drilling and make adjustments in the field, as necessary. The proposed well will be installed in the Vashon glacial till unit (Qvt) and advancement during drilling will be closely monitored to avoid penetrating the Vashon Advance Outwash unit (Qva). The drilling will not proceed past 50 feet below ground surface (bgs) to ensure the Vashon advance outwash is not intersected. The proposed location of the deep monitoring well as well as a cross-section depicting Site geology are shown on the attached Figure 2 and Figure 3, respectively.

A groundwater sample will be collected from the deep well and analyzed for TCE. If the TCE concentration in groundwater is less than the Model Toxics Control Act regulation (MTCA) Method A groundwater cleanup standard of 5 micrograms per liter ( $\mu\text{g/L}$ ), no further evaluation of vertical extent of TCE would be recommended, as the vertical migration of TCE in the Vashon till in the immediate vicinity of the Site will be adequately assessed. Based on the extremely low vertical hydraulic conductivity of the Vashon till, vertical migration of TCE impacts is unlikely. Therefore, if analytical data for groundwater from the proposed well indicates that TCE concentrations at depth are less than the MTCA Method A it can be concluded that protection of the groundwater extraction aquifer for Vashon Water District #19 is appropriately evaluated. If TCE is detected in the deep well at concentrations greater than the applicable MTCA Method A groundwater cleanup standard, additional characterization will be evaluated.

The monitoring well will be installed and constructed using procedures described in Section 4.2 of the Site Characterization Work Plan and Sampling and Analysis Plan by ERM dated December 2014 (Work Plan). The only exception from the Work Plan will be that the well screen will be installed fully submerged in groundwater rather than in a manner

that intersects that water table surface. Well development, well surveying, water level measurement, groundwater sample collection will also be conducted as indicated in the Work Plan.

## **RATIONALE**

### ***Hydrostratigraphy and Groundwater Flow***

The description of the hydrostratigraphy and groundwater flow in the vicinity of the Site presented herein is based on:

- Conditions observed in the shallow aquifer during the Site characterization;
- Well logs for the WD19 wells and others in the area; and
- Information in the *Vashon-Maury Island Hydrologic Modeling Technical Report* prepared for King County by DHI Water and Environment, October 2009 (Vashon Model).

The uppermost groundwater at the Site is intersected in the Vashon glacial till unit (Qvt) at a depth of 2 to 10 bgs. As documented in the Site Characterization Report and indicated on the well logs for the WD19 production wells, the Qvt is approximately 60 feet to greater than 100 feet thick in the Site vicinity. The location of the Site with respect to the Vashon WD19 wells is depicted on Figure 1. A generalized regional geologic cross-section is provided on Figure 3. A representative WD19 well log from the well field northwest of the Site is included in Attachment A.

Groundwater flow in the Qvt at the Site is toward the south to southeast at a horizontal rate of 0.2 to 9 feet per year. Vertical groundwater flow rates are expected to be at least an order of magnitude slower due to aquifer anisotropy. The Vashon Model indicates a Qvt horizontal hydraulic conductivity (2.5 feet per day) that is 500 times greater the vertical conductivity (0.005 feet per day).

The next water-bearing unit beneath the Qvt in the Site vicinity is the uppermost sand unit of the Vashon advance outwash (Qva). Based on well logs for the WD19 production wells, the sand unit of the Qva is approximately 70 feet thick in the Site vicinity. Groundwater flow in the Qva is toward the southeast at the Site. Information from the Vashon

Model indicates that pumping at the WD19 wells near the Site is not affecting groundwater flow conditions in the Qvt and Qva groundwater units.

An aquitard consisting of approximately 400 feet of silty and clayey glacial and interglacial sediments (Qpff) is present between the bottom of the sand unit of the Qva and pre-Vashon glacial sediments below a depth of approximately 570 feet below ground surface, which is the next significant water-bearing unit. In the Vashon Model, the Qpff is represented as having a horizontal hydraulic conductivity of 0.01 feet per day, and vertical hydraulic conductivity of 0.001 feet per day.

The pre-Vashon glacial sediments form the aquifer from which the shallowest WD19 wells extract groundwater. The Vashon Model indicates that groundwater flow in the pre-Vashon glacial sediments near the Site is normally toward the east to southeast, but is locally affected by the pumping from the WD19 wells.

#### *Conceptual Contaminant Transport Model*

As discussed in Section 4.5.2 of the Site Characterization Report, the results of the Site investigation do not indicate that TCE is present as a dense non-aqueous-phase liquid (DNAPL) at the Site. The observed extent of the TCE plume exceeding the MTCA Method A cleanup standard in the Qvt water-bearing unit is likely limited to the footprint of the former K2 manufacturing building. However, if the TCE plume has migrated downward in the Qvt unit, it is unlikely that TCE concentrations exceeding the MTCA Method A groundwater cleanup standard would migrate through the lower Qvt unit into the Qva water-bearing unit.

#### *Consideration of Potential for Creation of Preferential Migration Pathways*

Installing a deep groundwater monitoring well within the footprint of an existing shallow TCE plume has the potential to create a preferential vertical migration pathway to deeper groundwater. This is of particular concern for contaminants that can migrate preferentially downward, such as TCE, because they have a density greater than water. Therefore, the proposed well will be installed using the best available techniques to limit the potential for introducing preferential pathways for shallow water to flow to deeper groundwater, such as casing off the borehole as

the boring is advanced. In addition, the boring will be advanced no further than 50 feet bgs to avoid intersecting the Vashon advance outwash (Qva).

**CLOSING**

As part of this project, K2 will upload all analytical data generated to the Washington Department of Ecology's Environmental Information Management System Database. If you have questions regarding this plan, please contact Mr. David Edwards at (425) 214-0452 or Ms. Lyndsey Colburn at (617) 646-7829.

Sincerely,

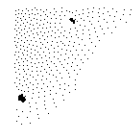


Lyndsey Colburn  
*Principal Consultant*



David P. Edwards  
*Partner*

Attachments



*Figures*

CAD File: G:\0345365\01\034536501-01.dwg

Drawn By: R. Olson  
Date: 04/05/16  
Project No. 0345365.01



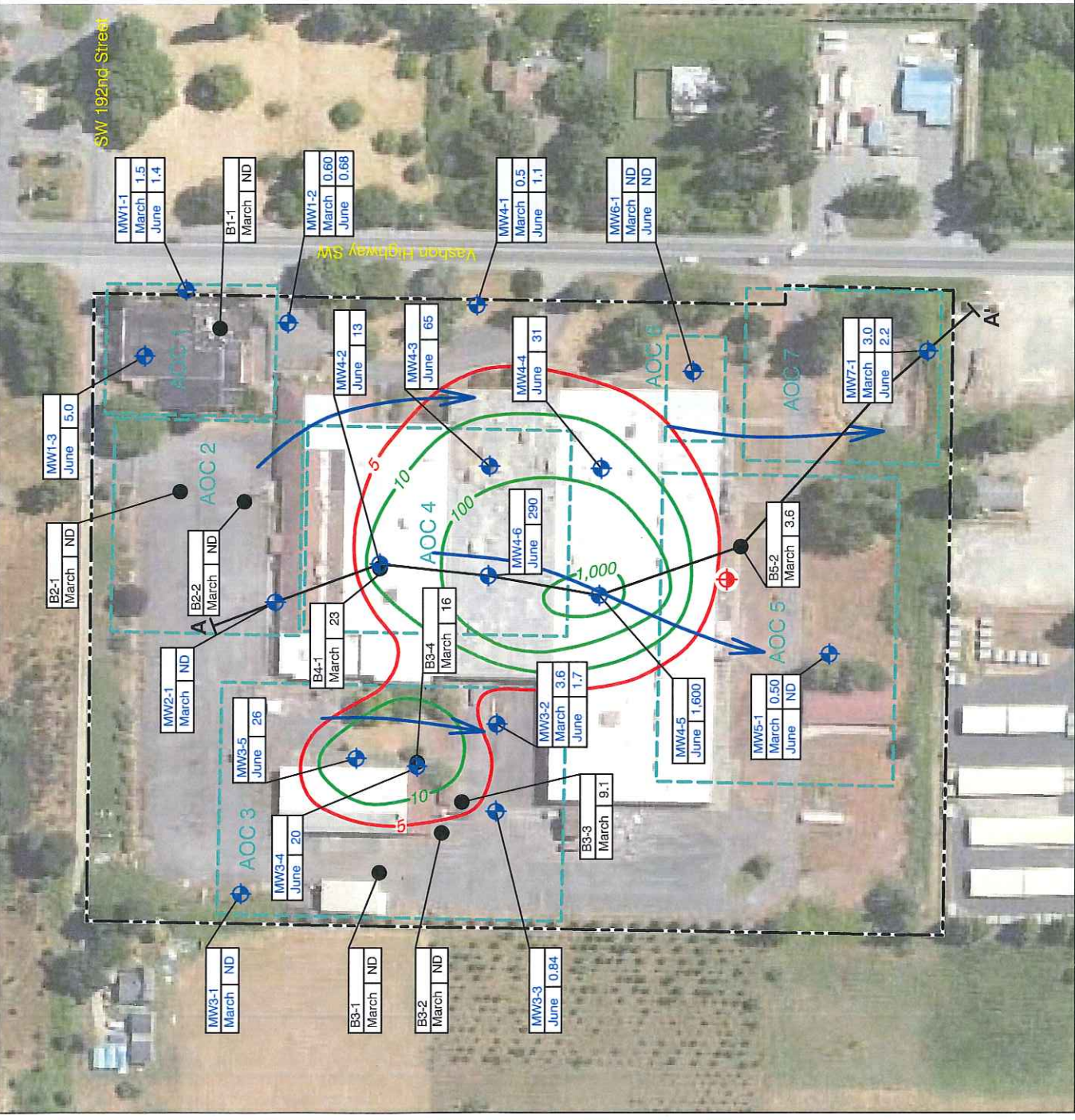
LEGEND

Property Boundary

Aerial Photo Source: © 2012 Google Earth Pro Ver 7.0.2.8415



Figure 1  
Site Location and Site Plan  
K2 Site Investigation  
Vashon Highway SW  
Vashon, Washington

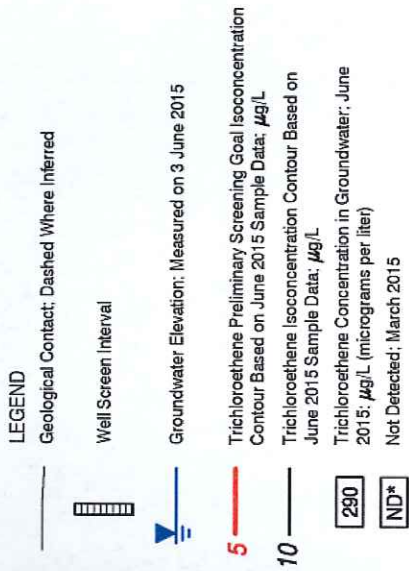
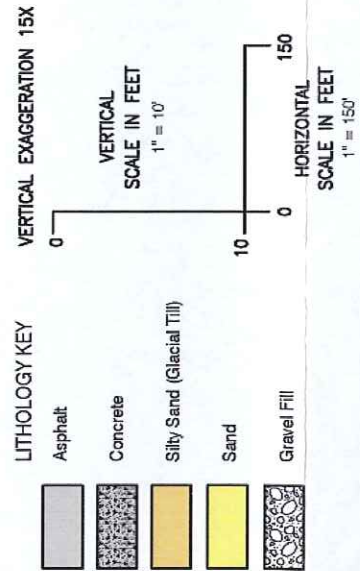
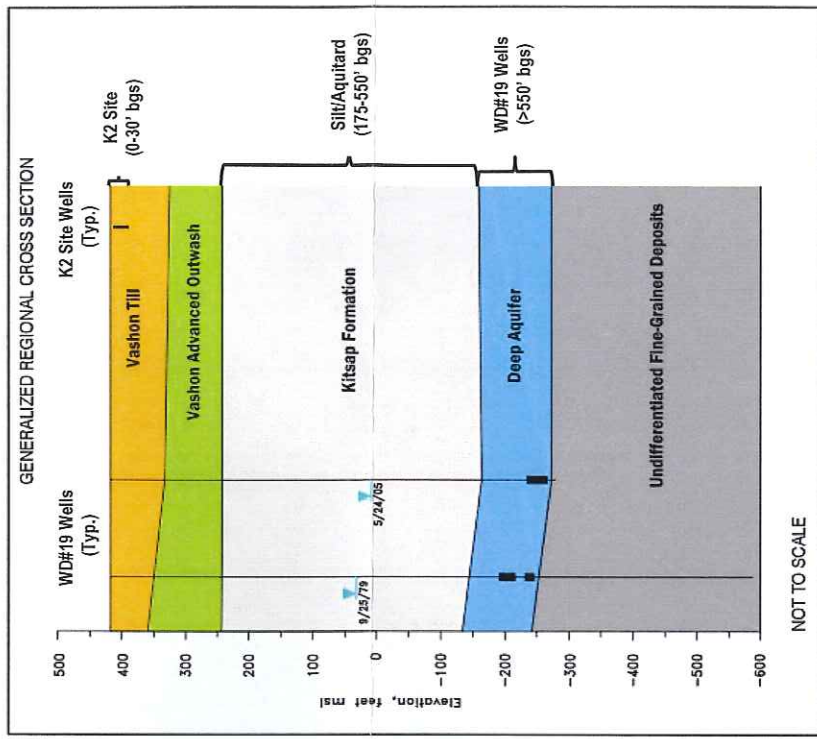
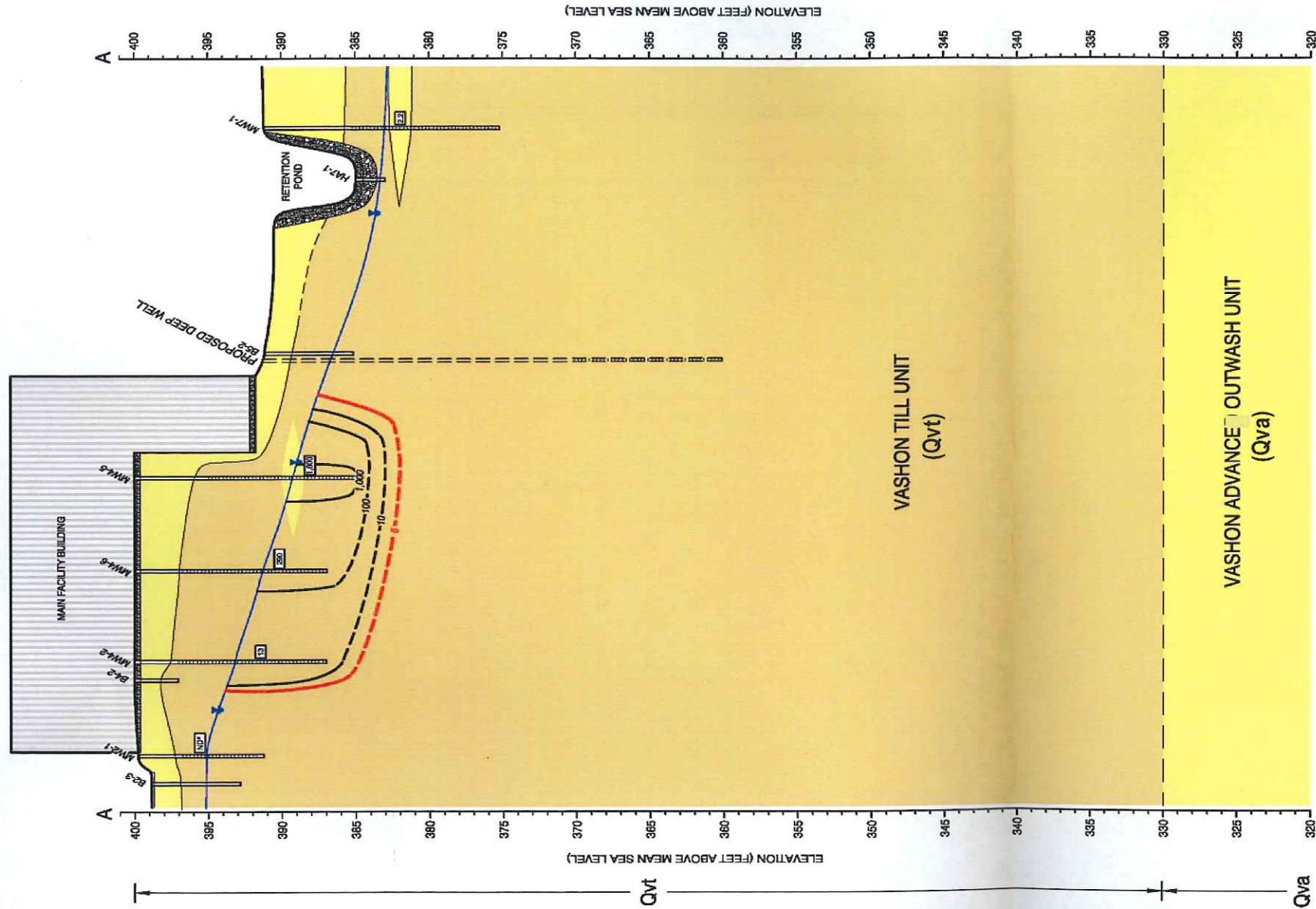


**LEGEND**

- Proposed Deep Well
- Monitoring Well
- Soil Boring (Grab Groundwater Sample)
- Trichloroethene Concentration in micrograms per liter ( $\mu\text{g/L}$ ); Sample collected in March 2015
- Trichloroethene Concentration in micrograms per liter ( $\mu\text{g/L}$ ); Sample collected in June 2015
- Not Detected
- Trichloroethene Preliminary Screening Goal Isoconcentration Contour based on June 2015 Sample Data;  $\mu\text{g/L}$
- Trichloroethene Isoconcentration Contour based on June 2015 Sample Data;  $\mu\text{g/L}$
- Inferred Groundwater Flow Direction - 3 June 2015
- General Schematic Cross Section (Figure 3)
- Area of Concern
- Property Boundary

Aerial Photo Source: Bing Maps © 2015 Microsoft Corporation

**Figure 2**  
*Proposed Well Location*  
*K2 Facility*  
*Vashon, Washington*



Note: Qvt - Vertical hydraulic conductivity is 0.005 feet/day based on Vashon Model.

Figure 3  
 Cross Section A-A'  
 K2 Site Investigation  
 Vashon, Washington

*Attachment A*  
*Water District 19 Well Log*

File Original with  
Department of Ecology  
Second Copy - Owner's Copy  
Third Copy - Driller's Copy

# WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W166285

UNIQUE WELL I.D. # AKM 948

112 JUL 15 2005

Water Right Permit No. 61-23519C

(1) OWNER Name: Water District No 19 DEPT OF ECOLOGY Address: 17630-100th Ave SW, Vashon Island, WA

(2) LOCATION OF WELL: County King SW 1/4 SE 1/4 Sec. 31 T 23 N.R. 3E WM

(2a) STREET ADDRESS OF WELL: (or nearest address) 1/2 mile south - Intersection 103 Ave SW & 188th St SW

TAX PARCEL NO.: 3123039154

23-3E-31Q

(3) PROPOSED USE:  Domestic  Industrial  Municipal  
 Irrigation  Test Well  Other  
 DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) 4  
 New Well Method:  Dug  Bored  
 Deepened  Cable  Driven  
 Reconditioned  Rotary  Jetted  
 Decommission

(5) DIMENSIONS: Diameter of well 12 inches  
Drilled 704 feet. Depth of completed well 704 ft.

(6) CONSTRUCTION DETAILS  
Casing installed:  
 Welded 16 " Diam. from 0 ft. to 395 ft.  
 Liner installed 12 " Diam. from 12 ft. to 616 ft.  
 Threaded Diam. from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION  
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Brown sandy gravelly silt	0	23
Gray sandy gravelly silt	23	94
Brown silty sand Gravel/Cobbles	94	109
Brown Sand & Gravel	109	171
Gray Sand & Gravel	171	176
Gray silty clay	176	470
gray silty clay w/ small gravel	470	490
Gray silt bound Sand & Gravel	490	530
Gray sticky clay	530	535
Gray sandy silt w/ minor gravel	535	576
Gray silty f-sand w/ minor gravel	576	582
Gray f-c sand	582	589
Gray f-m sand w/ silt interbeds and wood	589	601
Gray fine sand w/ silt interbeds and wood	601	611
Gray very silty gravelly sand	611	614
Gray slightly gravelly f-c sand	614	630
Gray sand & gravel	630	635
Gray very silty sand & gravel	635	640
Gray silt bound sand & gravel	640	651
Gray silt w/ minor gravel	651	657
Gray gravelly f-c sand w/ cobbles and wood	657	670
Gray f-c sand	670	680
Gray f-m sand	680	691
Gray silt	691	704

Qvt  
Qva  
Qpfi

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Perforations:  Yes  No  
Type of perforator used \_\_\_\_\_  
SIZE of perforations \_\_\_\_\_ in. by \_\_\_\_\_ in.  
perforations from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.  
APR 17 2006  
DEPT. OF ECOLOGY

Screens:  Yes  No  K-Pac Location \_\_\_\_\_  
Manufacturer's Name \_\_\_\_\_  
Type \_\_\_\_\_ Model No. \_\_\_\_\_  
Diam. \_\_\_\_\_ Slot Size \_\_\_\_\_ from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.  
Diam. \_\_\_\_\_ Slot Size \_\_\_\_\_ from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

Gravel/Filter packed:  Yes  No  Size of gravel/sand \_\_\_\_\_  
Material placed from \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

Surface seal:  Yes  No To what depth? 20 ft.  
Material used in seal Benboink  
Did any strata contain unusable water?  Yes  No  
Type of water? \_\_\_\_\_ Depth of strata \_\_\_\_\_  
Method of sealing strata off \_\_\_\_\_

(7) PUMP: Manufacturer's Name \_\_\_\_\_  
Type: \_\_\_\_\_ H.P. \_\_\_\_\_

(8) WATER LEVELS: Land-surface elevation above mean sea level 418 ft.  
Static level 412.5 ft. below top of well Date 5/24/05  
Artesian pressure \_\_\_\_\_ lbs. per square inch Date \_\_\_\_\_  
Artesian water is controlled by \_\_\_\_\_ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level  
Was a pump test made?  Yes  No If yes, by whom? PGG/Holt  
Yield: 260 gal./min. with 85.4 ft. drawdown after 24 hrs.  
Yield: \_\_\_\_\_ gal./min. with \_\_\_\_\_ ft. drawdown after \_\_\_\_\_ hrs.  
Yield: \_\_\_\_\_ gal./min. with \_\_\_\_\_ ft. drawdown after \_\_\_\_\_ hrs.  
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)  

Time	Water Level	Time	Water Level	Time	Water Level
1.0	466.85	15	449.14	55	443.96
5.0	452.58	20	448.16	110	440.56
10	450.45	30	446.5	187	437.49

  
Date of test \_\_\_\_\_  
Bailer test \_\_\_\_\_ gal./min. with \_\_\_\_\_ ft. drawdown after \_\_\_\_\_ hrs.  
Airtest \_\_\_\_\_ gal./min. with \_\_\_\_\_ ft. drawdown after \_\_\_\_\_ hrs.  
Artesian flow \_\_\_\_\_ g.p.m. Date \_\_\_\_\_  
Temperature of water \_\_\_\_\_ Was a chemical analysis made?  Yes  No

Work Started 3/3/05 Completed 5/20/05

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.  
Type or Print Name Randy Holt License No. 1099  
(Licensed Driller/Engineer)  
Trainee Name \_\_\_\_\_ License No. \_\_\_\_\_  
Drilling Company Holt Drilling / Brent Longyear  
(Signed) Randy Holt License No. 1099  
(Licensed Driller/Engineer)  
Address Po Box 1890 Melton WA 98354  
Contractor's Registration No. 30ARTLCO55PZ Date 6/20/05

(USE ADDITIONAL SHEETS IF NECESSARY)

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