

June 16, 2009

Mr. James E. Burnett
Iron Mountain Quarry
22121 – 17th Avenue Southeast, Suite 117
Bothell, Washington 98021-0999

**Re: Discussion of Existing Ground Water Conditions Beneath & In The Vicinity
Of The New Shine Quarry (NSQ) Site**

Dear Mr. Burnett:

ENVIRON International Corporation (ENVIRON) has prepared this letter report on behalf of Iron Mountain Quarry (IMQ), which summarizes and interprets the information compiled to date from public and private ground water sources. Every effort has been made to verify the reliability of the logs and other information collected. Professional judgment was used in interpreting all information, particularly information from logs where the individuals' qualifications who completed the logs were unknown.

SCOPE OF WORK

Per ENVIRON's scope of work as presented in the November 19, 2008 proposal, the following activities were completed:

- Assessed the two ground water regimes onsite through field reconnaissance (i.e., perched water in surficial unconsolidated deposits, and limited ground water in basalt bedrock);
- Established the preliminary locations of 6 piezometers in the wetlands onsite;
- Conducted a telephone interview with Mr. Burnett to establish where bedrock boreholes have already been completed;
- Compiled and interpreted published hydrogeologic information and ground water well logs from wells in the immediate vicinity of the site.

CONCLUSIONS

Permanent water wells do not exist within the footprint of the proposed New Shine Quarry (NSQ) site and there is no hydrogeologic connection between the NSQ site and drinking water sources in the vicinity of the site.

Within at least a mile of the NSQ site, there is no confirmed water production from the basalt bedrock that underlies the NSQ site (i.e., the basalt either outcrops at the surface or exists beneath a soil horizon typically less than five to ten feet thick). The lack of significant water production from the basalt bedrock is consistent with well logs from the

site vicinity available on the Washington Department of Ecology website, and published information.^{1,2}

Area Aquifers

Robinson & Noble³ identified three aquifer systems in the Port Ludlow/Shine area: the South Aquifer; a system of isolated, perched aquifers referred to as the South Valley Aquifer, and a small, unnamed, low-yielding deep aquifer system. The approximate extent of the South Aquifer and South Valley Aquifer are shown in Figure 1.

By far the most significant water production in the vicinity of the NSQ site is from sand-rich horizons above basalt bedrock in Well 13, Well 14, and Well 16, within the South Aquifer (Figure 1). Wells 13, 14, and 16, operated by the Olympic Water and Sewer District, provide water to Port Ludlow residents. The boundaries of the producing South Aquifer are over one mile to the east-northeast of the NSQ site (Figure 1). There is no hydrogeologic connection between the South Aquifer and the NSQ site.

The South Valley Aquifer, primarily consisting of unconsolidated sands and silts, is shown in Figure 1. A portion of the South Valley Aquifer occupies the eastern portion of the NSQ site. As of 1992 (per Robinson & Noble 1992), it supplied a few low-yielding domestic wells in Shine and in the Tala Shores area to the east of Port Ludlow. Information reviewed for this report including the 2004 Reid Middleton Draft Supplemental Environmental Impact Statement⁴ indicates that no ground water is currently withdrawn from the South Valley Aquifer. Accordingly, it is not a drinking water source.

The third aquifer system occurs at the deepest bedrock lows and consists of sand and clay. It displays lower permeability than the South Aquifer. This aquifer is not a significant drinking water source.³

Ground Water Flow Direction

The ground water flow direction in aquifers in unconsolidated materials in East Jefferson County typically follows topography: flow moves from high elevation areas toward the valleys and coastal areas.⁵ Ground water movement in basalt is fracture-controlled and difficult to predict, and formal studies of ground water movement in bedrock have not been completed in Eastern Jefferson County.⁶

¹ USGS 2004. Ground-Water System in the Chimacum Creek Basin and Surface Water/Ground Water Interaction in Chimacum and Tarboo Creeks and the Big and Little Quilcene Rivers, Eastern Jefferson County, Washington. United States Geological Survey Scientific Investigations Report 2004-5058.

² Grimstad & Carson 1981. Geology and Groundwater Resources Eastern Jefferson County, Washington: Washington State Department of Ecology Water Supply Bulletin No. 54, 125 p. Grimstad, P., and Carson, R.J.

³ Robinson & Noble 1992. South Aquifer Study, Port Ludlow/Shine Area for Pope Resources, October 1992.

⁴ Reid Middleton 2004. Draft Supplemental Environmental Impact Statement, Port Ludlow Master Plan Report Resort Plan, April 2004.

⁵ EES & PGG 1994. Eastern Jefferson County Groundwater Characterization Study, Prepared for Public Utility District #1 of Jefferson County by Economic and Engineering Services, Inc. (EES) and Pacific Groundwater Group (PGG). 1994.

⁶ Bill Graham, Hydrogeologist and Resource Manager, Public Utility District #1 of Jefferson County, personal communication, April 21, 2009.

Given the hydrogeologic conditions within and surrounding the NSQ site as determined from well logs and water supply information in published reports, site vicinity topography, and observations of ground water in open boreholes onsite, it is unlikely that ground water flow within bedrock at the NSQ site would be in communication with the nearest water supply wells located to the southeast (i.e., the Graves well and the Reed well, Figure 1) and to the northeast (e.g., Well 13, Well 14 and Well 16). This is primarily due to the fact that the same basalt that outcrops at the surface of the NSQ site underlies the producing zones in Graves, Reed, Well 13, Well 14 and Well 16; these wells are not screened in the basalt horizon and are therefore not capable of effectively pulling water from the basalt.

Bedrock Well Production

Aside from the decidedly unlikely communication between the deeper basalt bedrock within the NSQ footprint and overlying producing sands (which do not exist at NSQ), it is documented that the county-wide wells in basalt render typically low yields.⁵ Fifteen bedrock wells were evaluated in the 1994 study.⁵ The average yield from these wells was 1.5 gallons per minute (gpm), and only one well produced significantly more (300 gpm); this well is considered anomalous. It is believed to be screened in a zone with greater than normal fracturing, and in general, the yield increases with fracturing.

Nearby Ground Water Wells

Well logs for all wells discussed are provided in Attachment A. Water resources within a two mile radius of the site can be characterized as follows:

a) There are shallow unconsolidated sand-rich deposits above bedrock, generally shallower than 120 feet below ground surface (bgs), such as from the 66-foot Reed well screened from 61-66 feet (ft) bgs; production @ 15 gpm. The Reed well is about three-quarters of a mile southeast of the east border of the NSQ footprint (Figure 1).

Another example of a shallow well in unconsolidated sand-rich deposits above bedrock is the Graves well, about ½ mile to the east of the east border of the NSQ footprint (Figure 1). It is 130 feet deep, and is screened in a sand-rich lens. Both the Reed and Graves wells are small producers suitable only for supply to 1-3 residences. There is no hydrogeologic connection between these wells, screened in sands above bedrock, and the bedrock-dominated NSQ site.

b) There are deep unconsolidated sand-rich lenses above bedrock (e.g., Well 14: 527 ft deep and screened from 502.5-507 ft and 507.6-524 ft bgs; combined production from Well 14 and the adjacent Well 13 in 2002 was reported at 109.2 gpm [Reid Middleton 2004]).

Other wells in the vicinity include:

Bedrock Well 0.8 Mile to WNW. This well, a Jefferson County Public Works Department well, is a crudely-constructed well that is screened in bedrock (by virtue of sawcuts in casing) from 220-662 ft bgs. A limited pump test on this well indicated production of 25 gpm over 1.5 hours. It is likely that there is no hydrogeologic connection between this well and the NSQ site, based on distance. Moreover, according to Jefferson County personnel, this well is not in use at this time.

Bedrock Well 1 Mile to SE. The Olympic Land & Investments well is located in Section 33 (NW1/4 of SW1/4). The well owner is Olympic Land & Investments (a subsidiary of Pope Resources). The well is 400 feet deep: 0-184 feet in sandy clay, and 184-400 feet in basalt bedrock. The depth to water (DTW) below the top of the well is 50 feet. Casing is set from 0-190 feet; there is no casing from 190-400 feet. Therefore, this well taps ground water in bedrock. A pump test yielded 1 gpm with 120 feet (ft) of drawdown after 4 hours. It is concluded that this bedrock well does not produce enough water for a single family residence. It is a good example of a low-yield bedrock well that is typical of this area. Furthermore, based on topographic evidence and distance, it is likely that there is no hydrogeologic connection between this well and the NSQ site.

Abandoned Sampson Well 0.4 Mile to NE. A well ("Well 12") is reportedly located about 0.4 mile northeast of the northeast border of NSQ (Figure 9 - Reid Middleton 2004). No details were available regarding this well. It appears likely that this well is actually the abandoned 84-foot Sampson Well.

If necessary for the Jefferson County permitting process, much of the information provided in this Technical Memorandum can be incorporated into a Hydro-Geological Report: Groundwater Supply and Water Quality of Recharge.

Please contact Malcolm Gander at 206-336-1653 should you have questions or comments regarding this letter.

Very truly yours,



Malcolm Gander, P.G., P. Hg.
Senior Manager

Attachments:

Figure 1 – Local Well Locations & Ground Water Protection Map
Attachment A – Well Logs

Attachment A

Wells Logs

File Original and First Copy with the Division of Water Resources
 Second Copy - Owner's Copy
 Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Intent Application No. 006758
62-27492
 Permit No.

(1) OWNER: Ludlow Address: 781 Walker Way, Port Ludlow, WA
 (2) LOCATION OF WELL: County Jefferson Sec. 21R T. 28N. R. 1E W.M.

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

(4) TYPE OF WORK: Owner's number of well 14
 (if more than one).....
 New well Method: Dug Bored
 Deepened Cable Driven
 Reconditioned Rotary Jetted

(5) DIMENSIONS: Diameter of well 8 inches.
 Drilled 527 ft. Depth of completed well 526 ft.

(6) CONSTRUCTION DETAILS:
 Casing installed: 12" Diam. from +1 ft. to 301 ft.
 Threaded 8" Diam. from +1.5 ft. to 505.4 ft.
 Welded " Diam. from " ft. to " ft.

Perforations: Yes No
 Type of perforator used _____
 SIZE of perforations _____ in. by _____ in.
 _____ perforations from _____ ft. to _____ ft.
 _____ perforations from _____ ft. to _____ ft.
 _____ perforations from _____ ft. to _____ ft.

Screens: Yes No
 Manufacturer's Name Johnson
 Type Stainless Model No. _____
 Diam. 8"TS Slot size 3 from 502.5 ft. to 507.6 ft.
 Diam. 8"TS Slot size 20 from 507.6 ft. to 524 ft.

Gravel packed: Yes No Size of gravel: _____
 Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes No To what depth? 18 ft.
 Material used in seal bentonite
 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... ~440 ft.
 Static level 365.5 ft. below top of well Date 11/23/88
 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 R+N
 Was a pump test made? Yes No If yes, by whom? _____
 Yield: 303 gal/min. with 74.3 ft. drawdown after 15 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
See additional test data from 15-day test using well 14 as obs. well; data available from 11/15 - 12/23/88					
Date of test	<u>10/26/88</u>				
Boiler test	gal./min. with	ft. drawdown after	hrs.		
Artesian flow	g.p.m.	Date			
Temperature of water		Was a chemical analysis made?	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Brown sand, gvl, clay	0	3
Gray till	3	30
Sand & gvl, minor water at top	30	112
Sand with gvl, slightly silty	112	135
Sand with gvl	135	150
Sand	150	154
Brown sand, minor water	154	164
Dk. gray silt	164	176
Fine gray sand w/ brittle clay laminae	176	178
Blue-gray silty clay, sandy at top	178	238
Sandy blue-gray silty clay, minor gvl	238	260
Very sandy gray clay	260	267
Dk. gray sand	267	280
Greenish gray sandy clay	280	284
Gray till	284	290
Gray clayey sand with gvl	290	353
Dk. brown peaty sand	353	363
Lt. brown sand	363	373
Fine gray sand w/ some clay, charcoal	373	398
Gray f-m sand, minor wood, water	398	406
English brown v silty f sand with wood and peat, water	406	420
Gray f-m sand, slightly silty, occ. wood, water	420	464
Gray silty sh-f sand, minor charcoal, water	464	500
Fine gray sand, water	500	508
Fine-medium gray sand w/ gvl, water	508	515
Fine-coarse gray sand w/ gvl, water	515	527
Possible basalt bedrock	527	

Log prepared by Joseph E. Pecker
Robinson & Noble, Inc.

Work started Aug 17, 1988 Completed Oct 29, 1988

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Burt Well Drilling, Inc.
 (Person, firm, or corporation) (Type or print)

Address 19782 N.E. Lincoln Paulsbo, Wa 98320

[Signed] George D. Burt
 (Well Driller)

License No. 0048 Date 2-3, 1989

(USE ADDITIONAL SHEETS IF NECESSARY)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

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WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

CURRENT Notice of Intent No. W1166287
 Unique Ecology Well ID Tag No. ALN 492
 Water Right Permit No. 62-25816C

RECEIVED

OCT 17 2006

Construction/Decommission ("x" in circle)
 Construction
 Decommission ORIGINAL CONSTRUCTION Notice of Intent Number _____

DEPARTMENT OF ECOLOGY
 PROPOSED USE: Domestic Industrial Municipal
 DeWater Irrigation Test Well Other

Property Owner Name OLYMPIC WATER & SEWER
 Well Street Address 70 BREAKER LANE

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

City PT LUDLOW County: JEFFERSON
 Location SE 1/4 - 1/4 - SE 1/4 Sec 21 Twn 28 R 1 EWM or one

DIMENSIONS: Diameter of well 16x12 inches, drilled 543 ft.
 Depth of completed well 541 ft.

Lat/Long: (s, l, r still REQUIRED) Lat-Deg _____ Lat Min/Sec _____
 Long Deg _____ Long Min/Sec _____
 Tax Parcel No. 821-211-003

CONSTRUCTION DETAILS
 Casing Welded 16" Diam. from +1 ft. to -311 ft.
 Installed: Liner installed 12" Diam. from +2 1/2 ft. to -542 ft.
 Threaded _____ Diam. from _____ ft. to _____ ft.

CONSTRUCTION OR DECOMMISSION PROCEDURE
 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.
 (USE ADDITIONAL SHEETS IF NECESSARY.)

Perforations: Yes No
 Type of perforator used _____
 SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

MATERIAL	FROM	TO
BROWN SILTY S&G	0	20
BROWN S&G w COBBLES	20	177
BROWN F. SAND w TH	177	
OCCL GRAVEL		175
GRAY & BROWN F. SAND	175	
WITH PEAT LAYERS,		
MINOR WATER		196
GRAY SILT WITH THIN	196	
SAND LAYERS		220
GRAY SILT	220	241
GRAY CLAY	241	310
BROWN CLAY w/OCCL	310	
GRAVEL & SAND		
LAYERS, HAND		325
GRAY CLAY w/OCCL GRAN	325	356
GRAY SANDY CLAY, HAND	356	368
GRAY SILT-BND S&G	368	398
GRAY VERY SILTY F SAND	398	425
GRAY F-M SAND w/	425	
OCCL WOOD & GRAVEL,		
WATER BEARING		542
BASALTIC BEDROCK	542	543

Screens: Yes No K-Pac Location _____
 Manufacturer's Name JOHNSON
 Type CONT V WIRE Model No. _____
 Diam. 8" Slot Size 40 from 499 ft. to 535 ft.
 Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: Yes No Size of gravel/sand 8x12
 Materials placed from _____ ft. to _____ ft.

Surface Seal: Yes No To what depth? 18 ft
 Materials used in seal BENTONITE
 Did any strata contain unusable water? Yes No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

PUMP: Manufacturer's Name _____
 Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level 430 ft.
 Static level 376 ft. below top of well Date 7/28/05
 Artesian pressure _____ lbs. per square inch Date _____
 Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level.
 Was a pump test made? Yes No If yes, by whom? REN
 Yield: 291 gal./min. with 67 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
0	443	30	378	4	376
1	381	60	377		
10	380	120	376 1/2		

Date of test 7/28/05
 Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
 Artesian flow _____ g.p.m. Date _____
 Temperature of water 53 Was a chemical analysis made? Yes No

RECEIVED
 MAY 22 2006
 Washington State
 Department of Ecology
 Start Date 5/9/05 Completed Date 7/28/05

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.

Driller Engineer Trainee Name (Print) Wade J. Jorgensen
 Driller/Engineer/Trainee Signature Wade J. Jorgensen
 Driller or Trainee License No. 597

Drilling Company HOLT DRILLING
 Address Po Box 1890
 City, State, Zip Milton WA 98354
 Contractor's Registration No. BARTICOSSP Date 4-06-06

If trainee, licensed driller's Signature and License no. _____

