Application for a Permit to Use

Groundwater

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OREGON WATER RESOURCES DEPARTMENT

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, Oregon 97301-1266
503-986-0900
www.oregon.gov/OWRD

SECTION 1: APPLICANT INFORMATION AND SIGNATURE

Applicant

NAME				PHONE (HM)
PHONE (WK)	CELL			FAX
ADDRESS				
CITY	STATE	ZIP	E-MAIL*	

Organization

NAME Port of Portland - Attn: Dorothy Sperry			PHONE 503-415-6642	FAX
ADDRESS PO Box 3529				CELL
CITY Portland	STATE OR	ZIP 97208	E-MAIL* Dorothy.Sperry@portofportland.com	

Agent – The agent is authorized to represent the applicant in all matters relating to this application.

AGENT / BUSINESS NAME GSI Water Solutions Inc. - Attn: Owen McMurtrey			PHONE 541 257-9005	FAX
ADDRESS 1600 SW Western Avenue				CELL
CITY Corvallis	STATE OR	ZIP 97333	E-MAIL* omcmurtrey@gsiws.com	

Note: Attach multiple copies as needed

* By providing an e-mail address, consent is given to receive all correspondence from the Department electronically. (Paper copies of the proposed and final order documents will also be mailed.)

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By my signature below I confirm that I understand:

- I am asking to use water specifically as described in this application.
- Evaluation of this application will be based on information provided in the application.
- I cannot use water legally until the Water Resources Department issues a permit.
- Oregon law requires that a permit be issued before beginning construction of any proposed well, unless the use is exempt. Acceptance of this application does not guarantee a permit will be issued.
- If I get a permit, I must not waste water.
- If development of the water use is not according to the terms of the permit, the permit can be cancelled.
- The water use must be compatible with local comprehensive land-use plans.
- Even if the Department issues a permit, I may have to stop using water to allow senior water-right holders to get water to which they are entitled.

I (we) affirm that the information contained in this application is true and accurate.

Applicant Signature	Print Name and Title if applicable	Date
	Vince Granato Chief Operating Officer	2/28/19
Applicant Signature	Print Name and Title if applicable	Date

For Department Use: App. Number: G-18798

Oregon Water Resources Department
Ground Water Application

Today's Date: Thursday, March 7, 2019

Base Application Fee.		$1,340.00
Number of proposed cubic feet per second (cfs) to be appropriated. (1 cfs = 448.83 gallons per minute)	10.03	$3,850.00
Number of proposed Use's for the appropriated water. (i.e. Irrigation, Supplemental Irrigation, Pond Maintenance, Industrial, Commercial, etc) *	1	
Number of proposed Ground Water points of appropriation. (i.e. number of wells) (include all injection wells, if applicable) **	11	$3,500.00
Permit Recording Fee. ***		$520.00
* the 1st Water Use is included in the base cost. ** the 1st Ground Water point of appropriation is included in the base cost. *** the Permit Recording Fee is not required when the application is submitted but, must be paid before a permit will be issued. It is fully refundable if a permit is not issued. If the recording fee is not paid prior to issuance of the Final Order, permit issuance will be delayed.	Recalculate	
Estimated cost of Permit Application		$9,210.00

OWRD Fee Schedule

Fee Calculator Version B20170117

BJORK Mary F * WRD

From: BJORK Mary F * WRD
Sent: Friday, March 08, 2019 9:34 AM
To: Owen McMurtrey
Cc: MUCKEN Alyssa M * WRD; Bruce Brody-Heine; GRAHAM Elisabeth A * WRD; BJORK Mary F * WRD
Subject: RE: Port of Portland Geothermal Groundwater Application

Hi Owen,

Thank you for clarifying the intent of the Port's groundwater application. The application has been accepted as complete and assigned application number G-18798. The caseworker assigned is Lisa Graham.

It is understood that the Port, at this time, requests that the application be reviewed with the Primary "Scenario 7B – 7P" well locations only, and that the Port will contact the Department should that request change.

Best Regards,

Mary

Mary F Bjork | Water Rights Program Analyst

Oregon Water Resources Department | 725 Summer St. NE, Suite A | Salem, Oregon 97301
Ph: 503.986.0804/503.986.0817 | Fax: 503.986.0901
Email: mary.f.bjork@oregon.gov | Web: http://www.oregon.gov/owrd

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From: Owen McMurtrey [mailto:OMcMurtrey@gsiws.com]
Sent: Thursday, March 07, 2019 5:44 PM
To: BJORK Mary F * WRD
Cc: MUCKEN Alyssa M * WRD; Bruce Brody-Heine
Subject: Port of Portland Geothermal Groundwater Application

Hi Mary,

I just left you a phone message regarding the Port of Portland's geothermal groundwater permit application. I understand that there was some confusion about the number of wells proposed and the fee paid. The Port's application was for 11 well locations, but the Port presented two scenarios for water well development, each with 11 wells. At this time, the Port would like the application to be processed with the Primary "Scenario 7B – 7P" well locations only. The Port will notify the Department, including the application caseworker, and pertinent groundwater staff, to request that the Department review a different well scenario. The Port expects to provide this notification within the next couple of months, and I understand that it's unlikely that the application would be picked up by groundwater staff prior to that time.

Please give me a call on my cell phone at 541 740 5619 if you have any questions.

Sincerely,

Owen McMurtrey
Water Resources Consultant
direct: 541.257.9005 | mobile: 541.740.5619
1600 SW Western Boulevard, Suite 240, Corvallis, OR 97333
GSI Water Solutions, Inc. | www.gsiws.com

BJORK Mary F * WRD

From: Owen McMurtrey <OMcMurtrey@gsiws.com>
Sent: Thursday, March 07, 2019 5:44 PM
To: BJORK Mary F * WRD
Cc: MUCKEN Alyssa M * WRD; Bruce Brody-Heine
Subject: Port of Portland Geothermal Groundwater Application

Hi Mary,

I just left you a phone message regarding the Port of Portland's geothermal groundwater permit application. I understand that there was some confusion about the number of wells proposed and the fee paid. The Port's application was for 11 well locations, but the Port presented two scenarios for water well development, each with 11 wells. At this time, the Port would like the application to be processed with the Primary "Scenario 7B – 7P" well locations only. The Port will notify the Department, including the application caseworker, and pertinent groundwater staff, to request that the Department review a different well scenario. The Port expects to provide this notification within the next couple of months, and I understand that it's unlikely that the application would be picked up by groundwater staff prior to that time.

Please give me a call on my cell phone at 541 740 5619 if you have any questions.

Sincerely,

Owen McMurtrey
Water Resources Consultant
direct: 541.257.9005 | mobile: 541.740.5619
1600 SW Western Boulevard, Suite 240, Corvallis, OR 97333
GSI Water Solutions, Inc. | www.gsiws.com

GSI
Water Solutions, Inc.

March 4, 2019

Alyssa Mucken
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

Re: Application for a Permit to Appropriate Groundwater in the name of Port of Portland

Dear Ms. Mucken:

Please find enclosed a groundwater permit application filed on behalf of the Port of Portland. The application requests authorization to appropriate groundwater from three proposed extraction wells at the Portland International Airport for low-temperature geothermal use. The applicant is requesting to appropriate groundwater at a rate of up to 10.03 cfs from the extraction wells. The water extracted will be used for a non-consumptive, geothermal heating system in the Portland International Airport Terminal and reinjected into the Troutdale Sandstone Aquifer at the same depths from which it is extracted. Additionally, the applicant is requesting to appropriate water for back-flushing of the injection wells for up to 60 minutes per well at 800 gpm two times per month, which equates to an annual volume of 28.28 acre-feet or a continuous instantaneous rate of 17.52 gpm. Enclosed is the required fee of $9,210, which was calculated as follows:

$1,340 – Base Fee
$3,850 – Rate Fee for a rate of 10.03 cfs
$3,500 – Fee for 11 points of appropriation
$ 520 – Permit Recording Fee
Total $9,210

Additionally, please find enclosed a Request for Approval of a Low Temperature Geothermal Injection Well, which provides information required under OAR 690-230-0115.

G-18798

1600 SW Western Boulevard, Suite 240 Corvallis, OR 97333 P: 541.753.0745 info@gsiws.com www.gsiws.com

If you have any questions about the enclosed materials, please contact me at 971-200-8519.

Sincerely,

Owen McMurtrey

Owen McMurtrey
GSI Water Solutions, Inc.

Enclosures: Application for a Permit to Appropriate Groundwater
Request for Approval of a Low Temperature Geothermal Injection Well
Check for application fee in the amount of $9,210

1600 SW Western Boulevard, Suite 240 Corvallis, OR 97333 P: 541.753.0745 info@gsiws.com www.gsiws.com

SECTION 2: PROPERTY OWNERSHIP

Please indicate if you own all the lands associated with the project from which the water is to be diverted, conveyed, and used.

☐ YES, there are no encumbrances.
☒ YES, the land is encumbered by easements, rights of way, roads or other encumbrances.

☐ NO, I have a recorded easement or written authorization permitting access.
☐ NO, I do not currently have written authorization or easement permitting access.
☐ NO, written authorization or an easement is not necessary, because the only affected lands I do not own are state-owned submersible lands, and this application is for irrigation and/or domestic use only (ORS 274.040).
☐ NO, because water is to be diverted, conveyed, and/or used only on federal lands.

Affected Landowners: List the names and mailing addresses of all owners of any lands that are not owned by the applicant and that are crossed by the proposed ditch, canal or other work, even if the applicant has obtained written authorization or an easement from the owner. (*Attach additional sheets if necessary).*

N/A

Legal Description: You must provide the legal description of: 1. The property from which the water is to be diverted, 2. Any property crossed by the proposed ditch, canal or other work, and 3. Any property on which the water is to be used as depicted on the map. **(See Attachment D)**

SECTION 3: WELL DEVELOPMENT

Note: In Section 3, and in the attached map (Attachment A), the applicant has proposed two different well location scenarios. A maximum of 3 extraction wells and 7 injection wells will be developed. The proposed rate and volume limits in section 5 apply to either scenario.

Primary Well Development Scenario ("Scenario 7B – 7P")

		IF LESS THAN 1 MILE:	
WELL NO.	NAME OF NEAREST SURFACE WATER	DISTANCE TO NEAREST SURFACE WATER	ELEVATION CHANGE BETWEEN NEAREST SURFACE WATER AND WELL HEAD
EW-1	Columbia River	3,120 FEET	12 - 16 FEET
EW-2	Columbia River	2,950 FEET	12 - 16 FEET
EW-3	Columbia River	2,980 FEET	12 - 16 FEET
IW-1	Columbia River	1,950 FEET	12 - 16 FEET
IW-2	Columbia River	1,960 FEET	12 - 16 FEET
IW-3	Columbia River	1,960 FEET	12 - 16 FEET
IW-4	Columbia River	1,960 FEET	12 - 16 FEET
IW-5	Columbia River	1,960 FEET	12 - 16 FEET
IW-6	Columbia River	1,950 FEET	12 - 16 FEET
IW-7	Columbia River	1,950 FEET	12 - 16 FEET
IW-8	Columbia River	1,950 FEET	12 - 16 FEET

Alternative Well Development Scenario ("Option 6")

WELL NO.	NAME OF NEAREST SURFACE WATER	IF LESS THAN 1 MILE: DISTANCE TO NEAREST SURFACE WATER	IF LESS THAN 1 MILE: ELEVATION CHANGE BETWEEN NEAREST SURFACE WATER AND WELL HEAD
EW-1	Columbia River	265 FEET	15 - 17 FEET
EW-2	Columbia River	265 FEET	15 - 17 FEET
EW-3	Columbia River	280 FEET	15 - 17 FEET
IW-1	Columbia River	300 FEET	19 - 25 FEET
IW-2	Columbia River	300 FEET	19 - 25 FEET
IW-3	Columbia River	300 FEET	19 - 25 FEET
IW-4	Columbia River	300 FEET	19 - 25 FEET
IW-5	Columbia River	300 FEET	19 - 25 FEET
IW-6	Columbia River	290 FEET	19 - 25 FEET
IW-7	Columbia River	275 FEET	19 - 25 FEET
IW-8	Columbia River	275 FEET	19 - 25 FEET

Please provide any information for your existing or proposed well(s) that you believe may be helpful in evaluating your application. For existing wells, describe any previous alteration(s) or repair(s) not documented in the attached well log or other materials *(attach additional sheets if necessary)*.

Extraction wells are proposed and not yet constructed. Attachment B includes the well log and lithography of a nearby well showing the approximate depth of the Troutdale Sandstone Aquifer.

For Department Use: App. Number: G-18798

SECTION 3: WELL DEVELOPMENT, continued

Total maximum rate requested: 10.03 CFS (each well will be evaluated at the maximum rate unless you indicate well-specific rates and annual volumes in the table below).

The table below must be completed for each source to be evaluated or the application will be returned. If this is an existing well, the information may be found on the applicable well log. *(If a well log is available, please submit it in addition to completing the table.)* If this is a proposed well, or well-modification, consider consulting with a licensed well driller, geologist, or certified water right examiner to obtain the necessary information.

* Licensed drillers are required to attach a Department-supplied Well Tag, with a unique Well ID or Well Tag Number to all new or newly altered wells. Landowners can request a Well ID for existing wells that do not have one. The Well ID is intended to serve as a unique identification number for each well.

** A well log ID (e.g. MARI 1234) is assigned by the Department to each log in the agency's well log database. A separate well log is required for each subsequent alteration of the well.

*** Source aquifer examples: Troutdale Formation, gravel and sand, alluvium, basalt, bedrock, etc.

Primary Well Development Scenario ("Scenario 7B – 7P")

										PROPOSED USE			
OWNER'S WELL NAME OR NO.	PROPOSED	EXISTING	WELL ID (WELL TAG) NO.* OR WELL LOG ID**	FLOWING ARTESIAN	CASING DIAMETER	CASING INTERVALS (IN FEET)	PERFORATED OR SCREENED INTERVALS (IN FEET)	SEAL INTERVALS (IN FEET)	MOST RECENT STATIC WATER LEVEL & DATE (IN FEET)	SOURCE AQUIFER***	TOTAL WELL DEPTH	WELL-SPECIFIC RATE (GPM)	ANNUAL VOLUME (ACRE-FEET)
EW-1	☒	☐	N/A	☐	16 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT		
EW-2	☒	☐	N/A	☐	16 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT		
EW-3	☒	☐	N/A	☐	16 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT		
IW-1	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-2	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-3	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-4	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-5	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-6	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-7	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-8	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54

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SECTION 3: WELL DEVELOPMENT, continued

Total maximum rate requested: 10.03 CFS (each well will be evaluated at the maximum rate unless you indicate well-specific rates and annual volumes in the table below).

The table below must be completed for each source to be evaluated or the application will be returned. If this is an existing well, the information may be found on the applicable well log. *(If a well log is available, please submit it in addition to completing the table.)* If this is a proposed well, or well-modification, consider consulting with a licensed well driller, geologist, or certified water right examiner to obtain the necessary information.

* Licensed drillers are required to attach a Department-supplied Well Tag, with a unique Well ID or Well Tag Number to all new or newly altered wells. Landowners can request a Well ID for existing wells that do not have one. The Well ID is intended to serve as a unique identification number for each well.

** A well log ID (e.g. MARI 1234) is assigned by the Department to each log in the agency's well log database. A separate well log is required for each subsequent alteration of the well.

*** Source aquifer examples: Troutdale Formation, gravel and sand, alluvium, basalt, bedrock, etc.

Alternative Well Development Scenario ("Option 6")

										PROPOSED USE			
OWNER'S WELL NAME OR NO.	PROPOSED	EXISTING	WELL ID (WELL TAG) NO.* OR WELL LOG ID**	FLOWING ARTESIAN	CASING DIAMETER	CASING INTERVALS (IN FEET)	PERFORATED OR SCREENED INTERVALS (IN FEET)	SEAL INTERVALS (IN FEET)	MOST RECENT STATIC WATER LEVEL & DATE (IN FEET)	SOURCE AQUIFER***	TOTAL WELL DEPTH	WELL-SPECIFIC RATE (GPM)	ANNUAL VOLUME (ACRE-FEET)
EW-1	☒	☐	N/A	☐	16 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT		
EW-2	☒	☐	N/A	☐	16 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT		
EW-3	☒	☐	N/A	☐	16 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT		
IW-1	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-2	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-3	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-4	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-5	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-6	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-7	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54
IW-8	☒	☐	N/A	☐	12 IN.	0-405	400-500	0-405	N/A	TROUTDALE SANDSTONE AQUIFER	500 FT	800	3.54

For Department Use: App. Number: G-18798

SECTION 4: SENSITIVE, THREATENED OR ENDANGERED FISH SPECIES PUBLIC INTEREST INFORMATION

This information must be provided for your application to be accepted as complete. The Water Resources Department will determine whether the proposed use will impair or be detrimental to the public interest with regard to sensitive, threatened or endangered fish species if your proposed groundwater use is determined to have the potential for substantial interference with nearby surface waters.

To answer the following questions, use the map provided in Attachment 3 or the link below to determine whether the proposed point of appropriation (POA) is located in an area where the Upper Columbia, the Lower Columbia, and/or the Statewide public interest rules apply.

For more detailed information, click on the following link and enter the TRSQQ or the Lat/Long of a POA and click on "Submit" to retrieve a report that will show which section, if any, of the rules apply:
https://apps.wrd.state.or.us/apps/misc/lkp_trsqq_features/

If you need help to determine in which area the proposed POA is located, please call the customer service desk at (503) 986-0801.

Upper Columbia - OAR 690-033-0115 thru -0130

Is the well or proposed well located in an area where the Upper Columbia Rules apply?

☐ Yes ☒ No

If yes, you are notified that the Water Resources Department will consult with numerous federal, state, local and tribal governmental entities so it may determine whether the proposed use is consistent with the "Columbia River Basin Fish and Wildlife Program" adopted by the Northwest Power Planning Council in 1994 for the protection and recovery of listed fish species. The application may be denied, heavily conditioned, or if appropriate, mitigation for impacts may be needed to obtain approval for the proposed use.

If yes, and if the Department determines that proposed groundwater use has the potential for substantial interference with nearby surface waters:

- I understand that the permit, if issued, will not allow use during the time period April 15 to September 30, except as provided in OAR 690-033-0140.
- I understand that the Department of Environmental Quality will review my application to determine if the proposed use complies with existing state and federal water quality standards.
- I understand that I will install and maintain water use measurement and recording devices as required by the Water Resources Department, and comply with recording and reporting permit condition requirements.

Lower Columbia - OAR 690-033-0220 thru -0230

Is the well or proposed well located in an area where the Lower Columbia rules apply?

☒ Yes ☐ No

If yes, and the proposed groundwater use is determined to have the potential for substantial interference with nearby surface waters you are notified that the Water Resources Department will determine, by reviewing recovery plans, the Columbia River Basin Fish and Wildlife Program, and regional restoration programs applicable to threatened or endangered fish species, in coordination with state and federal agencies, as

appropriate, whether the proposed use is detrimental to the protection or recovery of a threatened or endangered fish species and whether the use can be conditioned or mitigated to avoid the detriment.

If a permit is issued, it will likely contain conditions to ensure the water use complies with existing state and federal water quality standards; and water use measurement, recording and reporting required by the Water Resources Department. The application may be denied, or if appropriate, mitigation for impacts may be needed to obtain approval of the proposed use.

If yes, you will be required to provide the following information, if applicable.

☒ Yes ☐ No The proposed use is for more than **one** cubic foot per second (448.8 gpm) and is not subject to the requirements of OAR 690, Division 86 (Water Management and Conservation Plans).

If yes, provide a description of the measures to be taken to assure reasonably efficient water use:
Per OAR 690-086, a municipality or agricultural water user must submit a Water Management Conservation Plan (WMCP) if required by a provision included with the water right permit. The proposed use is not municipal, so the permit would not be subject to the requirements of OAR 690, Division 86. However, the Port of Portland as an entity is subject to the requirements of OAR 690, Division 86, and is in the process of developing a WMCP that includes conservation measures that will apply to all of the Port's water use, not just to water used under its municipal use water rights. Furthermore, the proposed use is non-consumptive, with the exception of a small amount of water used consumptively for back-flushing of injection wells.

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Statewide - OAR 690-033-0330 thru -0340

Is the well or proposed well located in an area where the Statewide rules apply?

☒ Yes ☐ No

If yes, and the proposed groundwater use is determined to have the potential for substantial interference with nearby surface waters you are notified that the Water Resources Department will determine whether the proposed use will occur in an area where endangered, threatened or sensitive fish species are located. If so, the Water Resources Department, Department of Fish and Wildlife, Department of Environmental Quality, and the Department of Agriculture will recommend conditions required to achieve "no loss of essential habitat of threatened and endangered (T&E) fish species," or "no net loss of essential habitat of sensitive (S) fish species." If conditions cannot be identified that meet the standards of no loss of essential T E fish habitat or no net loss of essential S fish habitat, the agencies will recommend denial of the application unless they conclude that the proposed use would not harm the species.

SECTION 5: WATER USE

USE	PERIOD OF USE	ANNUAL VOLUME (ACRE-FEET)
Industrial (Geothermal non-consumptive)	January 1 – December 31	7,264
Industrial (Consumptive – injection well back-flushing)	January 1 – December 31	28.28

For irrigation use only: N/A
Please indicate the number of primary and supplemental acres to be irrigated (*must match map*).

Primary: _____Acres Supplemental: _____Acres

If you listed supplemental acres, list the Permit or Certificate number of the underlying primary water right(s):

_____

Indicate the maximum total number of acre-feet you expect to use in an irrigation season: _____

- If the use is **municipal or quasi-municipal**, attach **Form M – N/A**
- If the use is **domestic**, indicate the number of households: N/A **(Exempt Uses**: Please note that 15,000 gallons per day for single or group **domestic** purposes and 5,000 gallons per day for a single **industrial or commercial** purpose are exempt from permitting requirements.)
- If the use is **mining**, describe what is being mined and the method(s) of extraction (*attach additional sheets if necessary*): **N/A**

SECTION 6: WATER MANAGEMENT

A. Diversion and Conveyance

What equipment will you use to pump water from your well(s)?

☒ Pump (give horsepower and type): The three 500-foot extraction wells will be equipped with a 10-inch, 250 HP pump motor. Eight 500-foot injection wells will be equipped with an 8-inch, 150 HP pump motor for back-flushing.

☐ Other means (describe): _____

Provide a description of the proposed means of diversion, construction, and operation of the diversion works and conveyance of water.

Water will be pumped from three extraction wells and conveyed via high-density polyethylene piping below ground. Above ground, water will be conveyed through the Portland International Airport terminal via an enclosed schedule 40 STD welded cast iron piping system. Pipe diameters range from 6 to 14 inches as the temperature of the water is extracted to heat and cool the airport terminal.

B. Application Method

What equipment and method of application will be used? (e.g., drip, wheel line, high-pressure sprinkler) (*attach additional sheets if necessary*)

Groundwater extracted for the geothermal heating system will be conveyed through a piping system directly to eight injection wells. Injection wells will be back-flushed to remove debris for up to 60 minutes per well at 800 gpm two times per month.

C. Conservation

Please describe why the amount of water requested is needed and measures you propose to: prevent waste; measure the amount of water diverted; prevent damage to aquatic life and riparian habitat; prevent the discharge of contaminated water to a surface stream; prevent adverse impact to public uses of affected surface waters (*attach additional sheets if necessary*).

The Port of Portland is applying to extract water for geothermal heating purposes. Most water extracted will be returned to the aquifer via four injection wells following conveyance through the enclosed schedule 40 STD cast iron piping system. Up to 28.28 acre-feet of water will be used annually to back-flush the eight injections wells for up to 60 minutes per well at 800 gpm two times per month.

SECTION 7: PROJECT SCHEDULE

a) Date construction will begin: Within 5 years of permit issuance
b) Date construction will be completed: Within 5 years of permit issuance
c) Date beneficial water use will begin: Within 5 years of permit issuance

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SECTION 8: RESOURCE PROTECTION

In granting permission to use water the state encourages, and in some instances requires, careful control of activities that may affect adjacent waterway or streamside area. See instruction guide for a list of possible permit requirements from other agencies. Please indicate any of the practices you plan to undertake to protect water resources.

☒ Water quality will be protected by preventing erosion and run-off of waste or chemical products.
Describe: **Water will remain enclosed in schedule 40 STD cast iron piping from the points of withdrawal to the points of injection into the aquifer.**

☒ - **N/A** Excavation or clearing of banks will be kept to a minimum to protect riparian or streamside areas.
Note: If disturbed area is greater than one acre, applicant should contact the Oregon Department of Environmental Quality to determine if a 1200C permit is required.
Describe planned actions and additional permits required for project implementation: **N/A - No excavation planned**

☒ Other state and federal permits or contracts required and to be obtained, if a water right permit is granted:
List: **Request for Approval of a Low Temperature Geothermal Injection Well (OWRD)**
Class V Underground Injection Control Authorization (Oregon Department of Environmental Quality)

SECTION 9: WITHIN A DISTRICT

☐ Check here if the point of appropriation (POA) or place of use (POU) are located within or served by an irrigation or other water district.

Irrigation District Name	Address	
City	State	Zip

SECTION 10: REMARKS

Use this space to clarify any information you have provided in the application *(attach additional sheets if necessary)*.

The Port of Portland is proposing to divert water from the Troutdale Sandstone Aquifer between depths of 400 and 500 feet beneath ground surface to harness geothermal energy for the heating and cooling of the Portland International Airport terminal. Water will be conveyed and used in an entirely enclosed system before being reinjected into the aquifer at depths between 400 and 500 feet beneath ground surface. Up to 28.28 acre-Feet of water per year will be consumptively used to maintain/back-flush the eight injection wells two times a month at up to 800 gpm for 60 minutes per well. In accordance with OAR 690-230-0115, the Port will submit a Low Temperature Geothermal Injection Plan to OWRD. The Port will also submit a Class V Underground Injection Control Authorization Form to ODEQ.

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Minimum Requirements Checklist

Minimum Requirements (OAR 690-310-0040, OAR 690-310-0050 & ORS 537.140)

Include this checklist with the application

Check that each of the following items is included. The application will be returned if all required items are not included. If you have questions, please call the Water Rights Customer Service Group at (503) 986-0900.

Please submit the original application and signatures to the Water Resources Department. Applicants are encouraged to keep a copy of the completed application.

- ☒ SECTION 1: Applicant Information and Signature
- ☒ SECTION 2: Property Ownership
- ☒ SECTION 3: Well Development
- ☒ SECTION 4: Sensitive, Threatened or Endangered Fish Species Public Interest Information
- ☒ SECTION 5: Water Use
- ☒ SECTION 6: Water Management
- ☒ SECTION 7: Project Schedule
- ☒ SECTION 8: Resource Protection
- ☒ SECTION 9: Within a District
- ☒ SECTION 10: Remarks

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OWRD

Include the following additional items:

☒ Land Use Information Form with approval and signature of local planning department (*must be an original*) or signed receipt. **(See Attachment C)**

☒ Provide the legal description of: (1) the property from which the water is to be diverted, (2) any property crossed by the proposed ditch, canal or other work, and (3) any property on which the water is to be used as depicted on the map.

The parcels covered by the application are: **1N2E05 200**
1N2E07 100
1N2E08 300
1N2E08 400

There are numerous legal instruments associated with each parcel. Legal descriptions can be provided upon request.

☒ Fees - Amount enclosed: $ 9,210
See the Department's Fee Schedule at www.oregon.gov/owrd or call (503) 986-0900.

1N2E08 400
5/B
1N2E09 400

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☒ Map that includes the following items: **(See Attachment A)**

- ☒ Permanent quality and drawn in ink
- ☒ Even map scale not less than 4" = 1 mile (example: 1" = 400 ft, 1" = 1320 ft, etc.)
- ☒ North Directional Symbol
- ☒ Township, Range, Section, Quarter/Quarter, Tax Lots
- ☒ Reference corner on map
- ☒ Location of each diversion, by reference to a recognized public land survey corner (distances north/south and east/west)
- ☐ Indicate the area of use by Quarter/Quarter and tax lot identified clearly. **N/A**
- ☐ Number of acres per Quarter/Quarter and hatching to indicate area of use if for primary irrigation, supplemental irrigation, or nursery **N/A**
- ☐ Location of main canals, ditches, pipelines or flumes (if well is outside of the area of use) **N/A**

Note: In addition to a groundwater application, a standard reservoir application is required to store groundwater in a reservoir. If an applicant proposes to divert water from a reservoir, a surface water application is also required.

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Attachment A
Application Map

Groundwater Permit Application – Port of Portland Geothermal

Attachment B
MULT 56462 Well Log and Lithography

Groundwater Permit Application – Port of Portland Geothermal

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STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

mult 56462

RECEIVED
OCT 05 1998
WATER RESOURCES DEPT.
SALEM, OREGON

Instructions for completing this report are on the last page of this form.

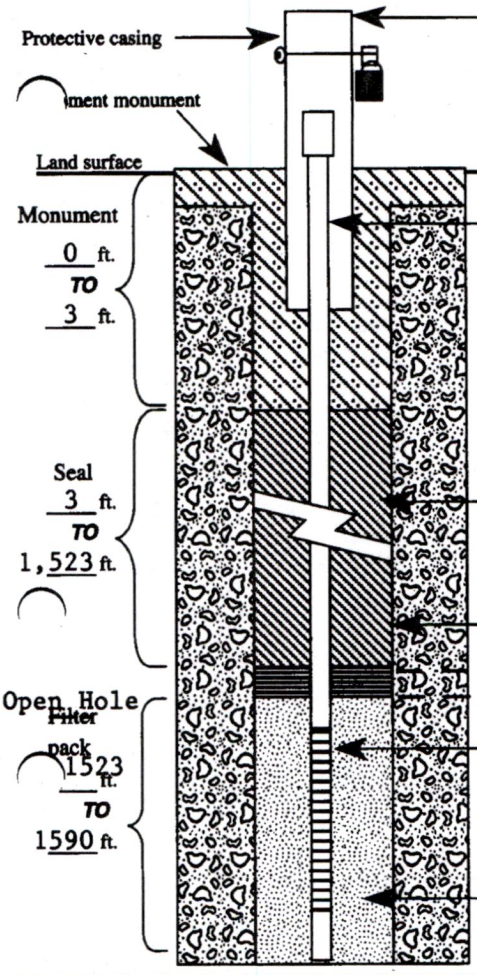
Start Card # 111810

(1) OWNER/PROJECT:
WELL NO. MTD-1
Name Port of Portland
Address 5506 NE Marine Drive
City Portland State OR Zip 97218

(2) TYPE OF WORK:
☐ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☒ Deepening ☐ Abandonment
By Coring

(3) DRILLING METHOD
☐ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other Wire Line Diamond Coring

(4) BORE HOLE CONSTRUCTION
Special Standards ☐ Yes ☒ No
Depth of completed well 1590 ft.



Casing diameter 3" ID in.
material Sch.80 PVC
Welded ☐ Threaded ☒ Glued ☐
Liner NA
diameter ____ in.
material ____
Welded ☐ Threaded ☐ Glued ☐
Well seal:
Material Concrete/Bentonite
Amount Unknown
Grout weight Unknown
Borehole diameter 8 in.
Bentonite plug at least 3 ft. thick
Screen Open Hole
material NA
interval(s):
From ____ To ____
From ____ To ____
Slot size ____ in.
Filter pack:
Material NA
Size ____ in.

(5) WELL TEST:
☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ____ Yield ____ GPM
Conductivity 22,700uS/cm PH 8.24
Temperature of water 65.1 °F °C Depth artesian flow found ____ ft.
Was water analysis done? ☒ Yes ☐ No
By whom? North Creek Analytical
Depth of strata to be analyzed. From 1552 ft. to 1565 ft.
Remarks: Water Sample Obtained On 7/14/98 After Pumping Well At 5 GPM For 2 Hours
Name of supervising Geologist/Engineer Stephen Hay

(6) LOCATION OF WELL By legal description
Tax Lot Location: County MULTNOMAH
Township 1 (N) or S) Range 2 (E) or W) Section 6
1. NE 1/4 of SW 1/4 of above section.
2. Either Street address of well location 1000 feet east of Marine Drive/NE 147 Intersection
or Tax lot number of well location ____
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
2.32 Ft. below land surface. Date 7/14/98
Artesian Pressure ____ lb/sq. in. Date ____

(8) WATER BEARING ZONES:
Depth at which water was first found ____

From	To	Est. Flow Rate	SWL
1552	1565	Well flowed 1GPM	2.32
		During Drilling;	
		Stopped After	
		24 Hours	

(9) WELL LOG:
Ground elevation ____

Material	From	To	SWL
SEE ATTACHED BORING LOG			

Date started 6/8/98 Completed 6/12/98

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ____
Signed ____ Date ____

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 1063
Signed Walter R ____ Date 9/30/98

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

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BORING MTD-1

Depth in Feet	Rock Class.	Recovery (%)	RQD (%)	Core Run	Samples	Group Symbol	DESCRIPTION
1515						GP	**1512.0' - 1,523':** Rounded and subrounded fine-to coarse GRAVEL (cave-in) 1,523 feet. Grout shoe at 1,523 feet
1520							
							GROUT SHOE
		2	0	CR-1		GP	**1,523.0' - 1,525':** Rounded/subrounded fine to coarse GRAVEL (cave-in)
1525						BASALT	**1,525.0' - 1,534.0':** Dark gray, fresh, moderately fractured, medium hard BASALT. Highly fractured at 1,527 feet. Highly vesicular between 1,528.8 and 1,529.0 feet
1530		100	46	CR-2			
		100	88	CR-3		BASALT	**1,534.0' - 1,544.5':** Dark gray, fresh, slightly fractured, medium hard, non-vesicular, massive BASALT
1535							
1540							
1545		94	74	CR-4		BASALT	**1,544.5' - 1,554.5':** Dark gray, slightly fractured, medium hard massive, non-vesicular BASALT to approximately 1,550.5 feet. Slightly fractured, moderately fractured between 1,550.5 and 1,552.1 feet. Highly vesicular, highly fractured between 1,552.1 and 1,554.5 feet
1550							
1555		100	38	CR-5		BASALT	**1,554.5' - 1,564.5':** Dark gray, slightly weathered, medium hard, highly fractured, high vesicular BASALT (lost water return at start of run)
1560							

JSK:SPH:mln 9/30/98

6054-001-00-2150

GeoEngineers

LOG OF BORING

A-18798

BORING MTD-1
(Continued)

Depth in Feet	Rock Class.	Recovery (%)	RQD (%)	Core Run	Samples	Group Symbol	DESCRIPTION
1560							
1565		100	26	CR-6		BASALT	1,564.5' - 1,571.0': Dark gray, slightly weathered, moderately fractured, medium hard BASALT. Highly fractured at 1,567.0 feet. Light gray clay in some vesicles
1570		99	30	CR-7		BASALT	1,571' - 1,580.8': Dark gray, slightly weathered, highly fractured, medium hard BASALT. Becomes slightly vesicular, moderately fractured at 1,572.0 feet. Moderately vesicular, highly fractured at 1,578.0 feet. (Light blue staining in all vesicles)
1575							
1580		100	45	CR-8		BASALT	1,580.8' - 1,590.0': Dark gray, slightly weathered, highly fractured, medium hard BASALT. Slightly fractured at 1,586.0 feet, moderately vesicular entire run
1585							
1590							BORING TERMINATED AT A FINAL DEPTH OF 1,590.0 FEET ON 06/12/98

JSK:SPH:mln 9/30/98

6054-001-00-2150

Geo Engineers

LOG OF BORING

G-18798

B33

MTD-1 Portland Airport Deep Hole
1N 2E 6caaa Elevation Approx. 23' TD 1523'

This drill hole was cored with HQ wireline from 391' - 455', 473' - 474', and 724' - 841'. The rest of the hole was drilled with a mud rotary, tri-cone bit. Sample descriptions outside of the above intervals are from drill cuttings. Described by the author.

0' - 5': Dark brown, soft, clayey SILT. @5" - Greenish gray to brown, v. sticky, v. fine sandy, clayey SILT with organic material.

5' - 15': Gray brown, subangular to subrounded, poorly sorted, coarse - v. coarse SAND and GRAVEL with abundant wood chips.

15' - 25': Dark green gray with red and black, subangular to subrounded, loose, poorly sorted, fine to v. coarse, lithic rich, quartz bearing SAND with few wood chips. Lithics include basalt and granitic material.

25' - 35': As Above (AA) - dominantly medium grained.

35' - 37': Gray to brown, v. fine sandy, clayey SILT.

37' - 40': Dark green gray with red and black, subangular to subrounded, loose, poorly sorted, fine - v. coarse, lithic rich, quartz bearing SAND with few wood chips. Lithics include basalt and granitic material.

40' - 45: AA - with wood chips.

45' - 55': Gray, black, red, and green, subangular to subrounded, loose, micaceous, moderately sorted, medium - coarse lithic rich SAND with wood. Lithics include andesite, granite, granodiorite, and basalt.

55' - 60': AA - with lots of wood.

60' - 70': AA - with much less wood and some silt sized material.

70' - 90': Gray, angular to subrounded, loose, well sorted, micaceous, fine - medium, arkosic, lithic, quartz bearing SAND with scattered coarse grains.

90' - 95': Medium gray, angular to round, loose, poorly sorted, fine - v. coarse, arkosic, lithic, quartz bearing SAND.

95' - 100': Gray, angular to subrounded, loose, well sorted, micaceous, fine - medium, arkosic, lithic, quartz bearing SAND with scattered coarse grains.

100' - 135': Pale yellow brown, angular to subrounded, loose to slightly compacted (v. friable), slightly micaceous, moderately sorted, v. fine - v. coarse (mostly medium), arkosic, lithic, quartz bearing SAND.

135' - 145': White, dark gray, subangular to rounded, loose, moderately well sorted, coarse SAND to small GRAVEL consisting predominantly of pumice with some black basalt and lots of wood chips.

145' - 155': White, dark gray, subangular to subrounded, micaceous, poorly sorted, silty, fine - coarse, lithic SAND including pumice, tuff, scoria, black basalt, & gabbro(?) with wood.

155' - 165': Pale yellow brown, angular to subrounded, loose to slightly compacted (v. friable), slightly micaceous, moderately sorted, v. fine - v. coarse (mostly medium), arkosic, lithic, quartz bearing SAND.

165' - 185': White, dark gray, subangular to subrounded, loose, micaceous, moderately sorted, fine - medium, lithic SAND with occasional coarse pumice grains. @ 180' - 182' - wood chips.

185' - 195': Dark gray, micaceous, subangular to rounded, moderately sorted, v. coarse SAND to GRAVEL (up to 6 cm.) consisting dominantly of basalt with minor plutonic lithics and lots of wood.

195' - 205': Pale yellow brown, angular to subrounded, loose to slightly compacted (v. friable), slightly micaceous, moderately sorted, v. fine - v. coarse (mostly medium), arkosic, lithic, quartz bearing SAND to rounded basaltic GRAVEL.

205' - 225': Dark gray, micaceous, subangular to rounded, moderately sorted, v. coarse SAND to GRAVEL (up to 6 cm.) consisting dominantly of basalt with minor plutonic lithics and lots of wood.

225' - 245': Pale yellow brown, angular to subrounded, loose to slightly compacted (v. friable), slightly micaceous, moderately sorted, v. fine - v. coarse (mostly medium), arkosic, lithic, quartz bearing SAND.

245' - 250': White, dark gray, angular to subrounded, micaceous, loose, moderately sorted, fine - coarse, arkosic, lithic SAND.

250' - 279': Dark gray, black, red, white, angular chips of dominantly basaltic with subordinate granitic GRAVEL, COBBLES, and BOULDERS.

279' - 290': Brown, gray, micaceous, clayey SILT with basalt chips probably from above.

290' - 295': Gray, subangular to subrounded, micaceous, moderately sorted, silty, clayey, fine, basaltic SAND.

295' - 310': Gray, angular to rounded, moderately sorted, fine SAND to GRAVEL consisting dominantly of basalt and clayey SILT. @ 305' - micaceous, silty CLAY material noted mixed with sand.

310' - 320': Gray, micaceous, v. fine sandy, clayey SILT.

320' - 325': Gray, subangular to subrounded, moderately sorted, loose, medium - coarse SAND with occasional basaltic GRAVEL.

325' - 358': Green, gray, white, red, angular to rounded (quartz & basalt more angular), micaceous, moderately sorted, v. coarse SAND to GRAVEL consisting of various granitic and basaltic material, quartz, and sandstone. Gravel up to 5 cm. @ 353' - COBBLES and BOULDERS noted from hard drilling and angular basalt chips.

358' - 391': Gray to gray green, micaceous, v. fine sandy, clayey SILT. @ 375' - scattered occasional medium SAND. @ 385' - trace of wood.

CORE SAMPLES From 391' to 474'

391' - 394': Medium blue gray, oxidizing to green gray, micaceous (15%), massive, silty CLAY.

394' - 397': Medium gray to green gray, blocky, micaceous (5%), massive, somewhat plastic, sticky, slightly silty CLAY.

397' - 402': Medium gray with mottled white and light brown, blocky, slightly micaceous, massive, stiff, nonplastic, slightly silty CLAY. Slickensides noted @ 398' 8". Clay becomes more micaceous, mottled with more light brown @ 400'.

402' - 403': As Above (AA) - Clay laminated with irregular or wavy lenses of white and light brown-orange (Fe+3 staining) clay with traces of organic matter and ashy? white spots (< 1mm dia.). silt (10%) - also medium green gray, purer clay drape microlaminae.

403' - 405': Light to medium brown, blocky, micaceous, silty CLAY with purer clay clasts and rounded clasts of v. fine to fine sandy SILT up to 1 cm. dia. The silt clasts also have clay streaks. Also round (botryoidal?) spots of white powdery material surrounding hard, translucent cores.

405' - 405' 2": Mixed lenses of moderate brown, subrounded - rounded, moderately sorted, silty, v. fine-fine, lithic (dominant), quartz bearing SAND with occasional medium sized grains, interlayered with dusky brown, CLAY.

405' 2" - 405' 6": Dark gray, micaceous, silty CLAY with traces of scattered fine sand.

405' 6" - 406': Dark gray, micaceous, v. fine sandy, clayey SILT.

406' - 417' 3": Dark gray, angular - subrounded, well-sorted, micaceous, somewhat endurated (especially bt. 411' - 415'), friable, v. fine-fine, quartz bearing, basalt rich SAND with interlayered clay drapes only a few mm. thick. - Sand become medium grained @ 409'.

417' 3" - 418': AA- sand becomes v. fine grained with some clay and silt.

418' - 418' 5": Brownish black, micaceous, clayey SILT.

418' 5" - 427': Light gray, micaceous, endurated, friable, faintly parallel laminated, v.fine sandy, SILTSTONE. @ 421' - soft, clayey SILT. @ 425' + - back to sandy SILT with 2 to 4 cm lenses of light green gray, angular to subrounded, micaceous, clean, silty, v. fine SAND with a hint of cross-bedding.

427' - 428' 5": SAND - AA

428' 5" - 435': Light green gray, angular to subrounded, micaceous, well sorted, v.fine to fine, arkosic, quartz bearing, lithic (black basalt) SAND with interbedded layers of v. fine sandy SILT up to 8cm thick.

435' - 440': No core recovered,

440' - 443' 2": Pale olive, angular to subrounded, micaceous, moderately well sorted, cross-bedded, fine to medium, arkosic, quartz bearing, SAND with occasional coarse grains and interbedded clay drapes 5-7m thick.

443' 2" - 444': Pale olive to green gray, micaceous, slightly clayey, v. fine sandy SILT with scattered fine to medium lithic grains and wood material. @ 443' 8" - color changes to gray brown.

444' - 445': Dark green gray, micaceous, silty CLAY.

445' - 454': Light olive gray, micaceous, angular to subangular, v. friable, well sorted, silty, v. fine, arkosic, quartz bearing SAND with few black lithic basalt grains. Sand coarsens downward to v. fine-fine. @ 448' - Clay stringers noted. @ 452'+ - scattered organic matter noted.

454' - 456' 4": Light brown gray, angular to subrounded, micaceous, well sorted, organic bearing, silty, v. fine SAND. Becomes fine grained @ 456'+.

<u>456' 4" - 473': No core recovered. Drill cuttings only in this interval.</u>

456' - 459' 6": Grayish orange, angular to subrounded, micaceous, moderately sorted, v. friable, fine to coarse, arkosic, basaltic SAND with minor quartz. Basalt grains more subrounded and larger than plagioclase.

461' - 463': Dark gray to black, angular (quartz) to subrounded, moderately well sorted, v. friable, upper medium to coarse, basaltic SAND with minor quartz and plagioclase.

463' - 466': AA - except cobble sized black basalt with vesicles (up to 5 cm.).

466' - 473': Dark gray to black, angular to subangular, v. loose, poorly sorted, fine to gravel, basaltic SAND with minor quartz and muscovite, and trace organic matter (wood?).

473' - 474': <u>Core 2" - 3" long.</u> Dusky yellow brown, subangular to well rounded, poorly sorted, fine to coarse , arkosic, quartz bearing SAND to COBBLE (> 5cm.) sized, black, basalt fragments.

<u>Back to drill cuttings.</u>

474' - 478': AA - mostly gravel sized material.

478' - 481': AA - occasional cobble sized material.

481' - 488': Black and white, angular to subrounded, poorly sorted, micaceous, v. friable, fine to gravel, arkosic, basaltic SAND with 30%-40% basalt and occasional light green and red brown lithic material.

488' - 493': Black with white, angular to subrounded, v. poorly sorted, fine to large gravel, basaltic, quartz bearing, lithic SAND - GRAVEL.

493' - 507': AA - occasional cobble sized basalt.

NOTE: Drill cuttings samples from this depth and below are widely scattered and sample bags are marked with only one depth. Field log descriptions will be substituted where necessary.

507' - 514': No sample. Field log indicates more SAND and GRAVEL as above.

514' - 519': Black and white, angular to rounded, loose, moderately sorted, coarse - v. coarse SAND to GRAVEL or larger consisting dominantly of basalt chips (up to 1.5 cm.) and subordinate andesite and granitic material.

519' - 533': Black, green, white, red brown, angular to rounded, loose, moderately sorted, v. coarse SAND to GRAVEL consisting of massive black basalt, vesicular basalt, pumice, quartz, and other lithic material. @ 531' - lots of wood.

533' - 566': No sample. Field log indicates black, medium to coarse, micaceous, SAND with minor blue gray CLAY and rare GRAVEL.

566' - 575': Yellowish gray, micaceous, v. fine sandy, clayey SILT.

575' - 581': No sample. Field log indicates coarse to v. coarse SAND and minor blue gray CLAY.

581' - 585': Yellow gray, micaceous, silty CLAY with scattered v. coarse sand to gravel (from above?).

585' - 601': No sample. Field log indicates CLAY as above with scattered sand.

601' - 606': Sample mixed with yellow gray, micaceous, clayey SILT and dark gray, white, angular to subrounded, loose, moderately sorted, medium - v. coarse, lithic (mostly basalt), quartz bearing SAND.

606' - 629': No sample. Field log indicates black, coarse SAND.

629' - 630': Yellow gray, micaceous, silty CLAY.

630' - 692': No sample. Field log indicates black, coarse SAND and blue gray CLAY to approximately 670' with a conglomeratic layer @ 645'. Below 670', black, fine - coarse SAND with wood @ 678'.

692' - 714': Black, angular to rounded, micaceous, moderately sorted, loose, v. coarse SAND to GRAVEL consisting of dominantly basalt with minor quartz, mica, and glass. @ 713' - basalt chips up to 1 cm. - may be from cobbles - also lots of glass and some scoria.

CORE SAMPLES FROM 714' - 841'

714' - 724': Core sample not recovered. Field log indicates SAND.

724' - 726': Black, subangular to subrounded, endurated, but friable, faintly cross laminated, well sorted, medium, basaltic SANDSTONE with olive green glass shards and trace quartz. Basalt material is a rough cinder type. Rounded basalt gravel (up to 3 cm.) at the top of the interval.

726' - 736': No core recovered.

736' - 745': AA - quartz content increases with depth (10%-15%) @ 737'. @738' - core is not as endurated as above and cross laminations are better defined. @ 740' - Sand becomes v. loose and coarse grained. Glass still present.

745' - 776': No core recovered. Drill cuttings only.

746' - 766': Black, subangular to subrounded, well sorted, medium (a few coarse), basaltic, vitreous SAND with minor quartz and trace mica.

766' - 776': Black, rounded, basalt COBBLES up to 7cm.

BACK TO CORE SAMPLES.

776' - 778': Pale yellow to medium blue gray, angular to subrounded, massive, micaceous, moderately well sorted, silty, v. fine-fine, arkosic, quartz bearing, lithic SAND with 5% clay and trace organic matter (wood). @ 777' - An 8 cm. thick v. loose, angular to subrounded, moderately well sorted, medium to coarse, arkosic, quart bearing SAND.

778' - 780': Pale yellow brown, angular to subrounded, loose, moderately well sorted, medium to coarse, arkosic, quart bearing SAND. @ 779' 8" - 4-6cm. thick lens of pale yellow brown, angular to subrounded, micaceous, v. fine silty clayey, arkosic SAND.

780' - 782': No core recovered.

782' - 782' 3": Black and white, subangular to subrounded, loose, moderately well sorted, medium to coarse, quartz bearing (20%), arkosic (40%), lithic (40%) SAND with black basalt.

782' 3" - 786': Medium gray, micaceous, cross laminated, lithic rich v. fine sandy SILT with organic matter.

786' - 811': No core recovered. Drill cuttings @ 800'.

800': Yellow gray, angular to subrounded, moderately sorted, micaceous, fine to v. coarse, arkosic, quartz bearing SAND with basalt, pumice, and other lithic material.

811' - 821': Olive gray, angular to subrounded, micaceous, loose, moderately well sorted, medium to coarse, arkosic, quartz bearing, lithic (black basalt rich) SAND. Grain size variations with depth from medium to small rounded gravel from 819' - 821'.

821' - 831': NO core recovered.

831' - 831' 2": Black, loose, rounded basalt GRAVEL (up to 8 cm. dia.).

831' 2" - 835': Grayish olive, incompetent, micaceous, silty CLAY.

835' - 841': Olive gray, micaceous, clayey, v. fine sandy SILT, grading to a clayey SILT @ 836'. @ 837" - back to v. fine sandy SILT.

841' - Very small sample - core broken into pieces. Pale olive, micaceous, angular to subangular, moderately sorted, v. fine, silty SAND with pockets of medium quartz bearing, arkosic, basaltic SAND.

NO CORE BELOW 841' Only scattered drill cutting descriptions to TD.

864' - 872': Black, white, red brown, angular to rounded (rare), moderately sorted, micaceous, loose, v. coarse SAND to GRAVEL with dominant basalt and subordinate quartz, granitic lithic material, and pumice. @ 872' - about 10% yellow gray, micaceous, silty CLAY fragments.

873' - 876': Yellow gray, black, angular to rounded, moderately sorted, medium - v. coarse, arkosic, lithic, quartz bearing SAND.

876' - 900': Blue, oxidized to pale yellow, micaceous, silty CLAY with minor organic matter (wood).

900' - 917': Medium blue gray, v. sticky. plastic, silty CLAY to clayey SILT - almost 50% of each with scattered patches of v. fine sandy SILT.

917' - 958': Medium gray, micaceous, blocky, non plastic, silty CLAY with mottled white, v. fine sandy, clayey SILT lenses.

958' - 1004': Medium gray to grayish green, micaceous, slightly silty CLAY with trace scattered lenses of clayey SILT. **Only sample in this interval is @ 958'.**

1004' - 1124': Blue gray to light gray, micaceous, silty CLAY with common white, gray green, lenses of v. fine sandy, micaceous SILT and white clayey SILT. @ 1093' - minor coarse sand noted. **Only sample in this interval @ 1004'.** Field log notes scattered coarse SAND(from above?) from 1105' to 1124'.

1124' - 1184': Mixed, yellow gray, micaceous, clayey SILT and white to medium gray, silty CLAY (most common). @ 1131' - minor coarse sand noted. @ 1174' to 1180' - scattered wood chips present. **Only sample in this interval is @ 1124'.**

1184' - 1204': No samples. Field log indicates coarse SAND and CLAY with wood @ 1200' - 1202'. Sand is up to 30% mica @ 1204'.

1204' - 1209': No samples. Field log indicates predominant clay with lenses of black, micaceous, coarse SAND.

1209' - 1230': No samples. Field log indicates Black, micaceous, coarse SAND and blue CLAY with minor wood @ 1217'.

1230' - 1241': Black, angular to subrounded, loose, moderately sorted, v. coarse SAND to GRAVEL consisting dominantly of basalt and glass, trace wood, and lots of white clayey SILT and gray silty CLAY (from above?).

1241' - 1244': Medium brown to gray and white, silty CLAY.

1244' - 1256': Gray, silty CLAY with lenses of basalt SAND and white silty CLAY with organic stringers.

1256' - 1311': Blue gray, oxidized to gray green, micaceous, silty CLAY with white silty CLAY with scattered, thin lenses of coarse SAND below 1281'. No sample below 1256' in this interval. Only sample in this interval is @ 1256'.

1311' - 1314': Light brown, white, gray, micaceous, clayey, v. fine sandy SILT.

1314' - 1331': Yellow gray, micaceous, silty CLAY with white, micaceous clayey SILT @ 1321' and light brown, v. fine sandy, clayey SILT @ 1323'.

1331' - 1338': Brown gray, micaceous, silty CLAY with light brown Fe+3 staining.

1338' - 1361': Yellow brown mottled with light gray and medium gray, v. sticky, plastic, slightly silty CLAY with widely scattered, highly weathered, sand sized basalt beginning @ 1352'.

1361' - 1376': Bright ochre CLAY with light gray to black clay clasts (from above?) and round, gravel sized, basaltic nodules.

1376' - 1389': Red brown,, v. sticky, plastic CLAY with some ochre and silty to v. fine sand particles.

1389' - 1399': Mixed red brown, orange, yellow, gray, and white, silty CLAY and highly weathered basalt fragments.

1399' - 1420': Light brown, silty CLAY with highly weathered plagioclase crystals and basalt fragments.

1420' - 1436': Light brown, highly weathered BASALT. - **Top Of Columbia River Basalt.**

1436' - 1442': Black, hard BASALT chips and mixed samples from above.

1442' - 1456': Black, hard BASALT - vesicular and crystalline texture is distinguishable.

1456' - 1459': Weathered and fresh BASALT with lots of brown gray to medium gray, silty CLAY and red brown CLAY.

1459' - 1480': Black, fresh, hard BASALT.

1480' - 1483': Light brown, black, angular to subrounded, moderately well sorted, loose, fine - medium, quartz bearing, basaltic, arkosic SAND with black basalt chips. Drilling rate much faster and lose of drilling mud to formation.

1483' - 1488': Black, white, light brown, angular to rounded, upper v. coarse SAND to mostly GRAVEL consisting of chips of massive and vesicular basalt, rounded basalt, granitic material, and quartz.

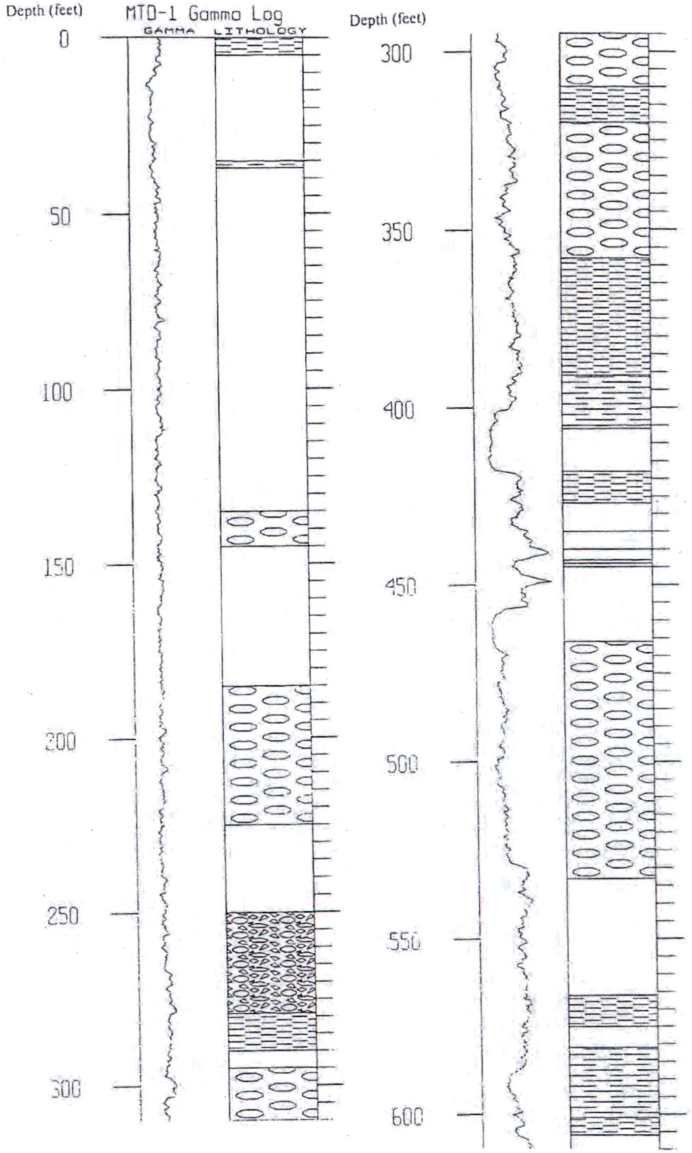
1493' - 1515': Black, angular BASALT chips and subrounded basalt grains present.

1515' - 1523': Black, hard, angular chips of BASALT.

Total Depth: 1523' (464.2 m)

Recorded 10-93
by Doyle Wilson

B44



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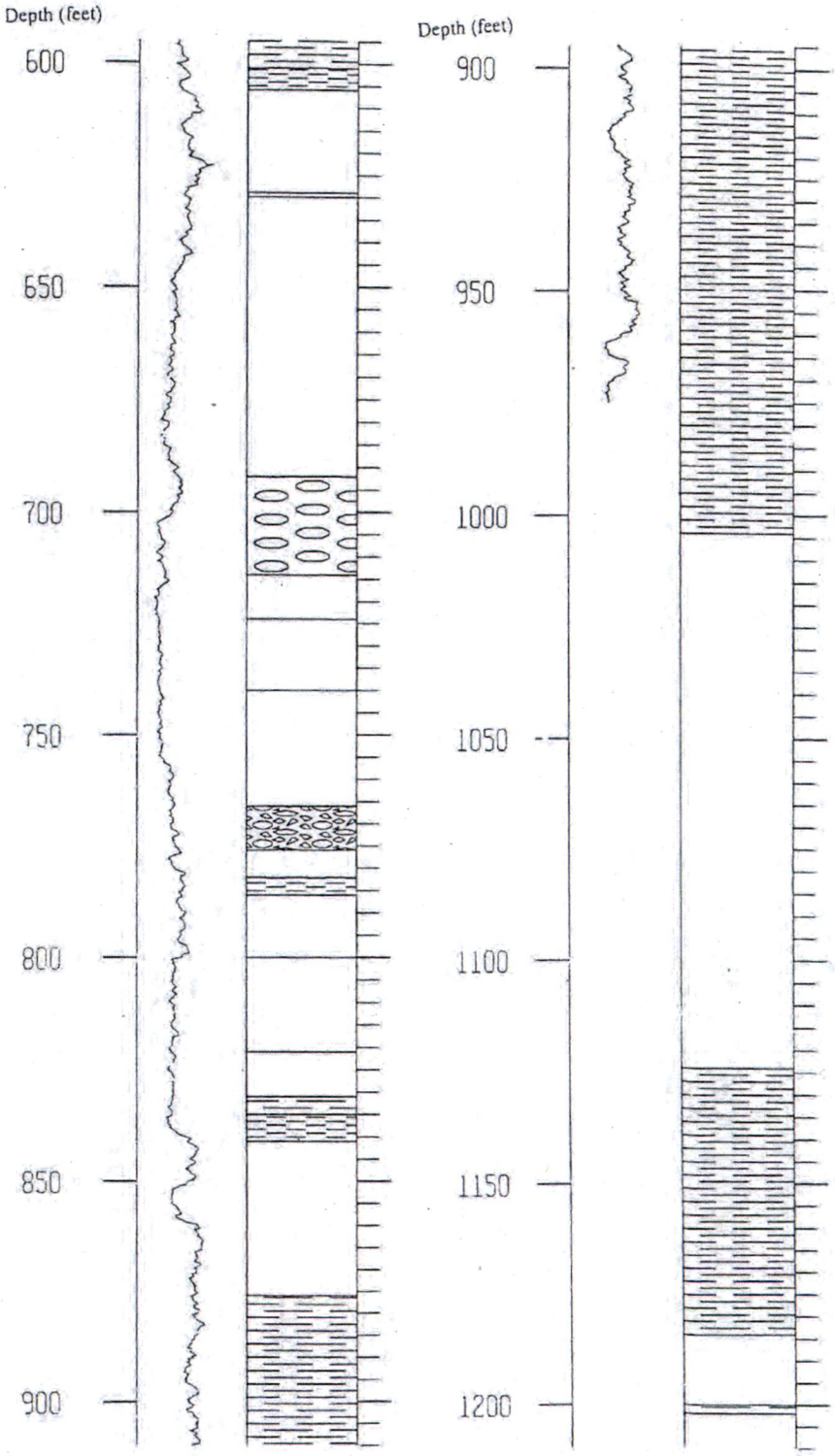

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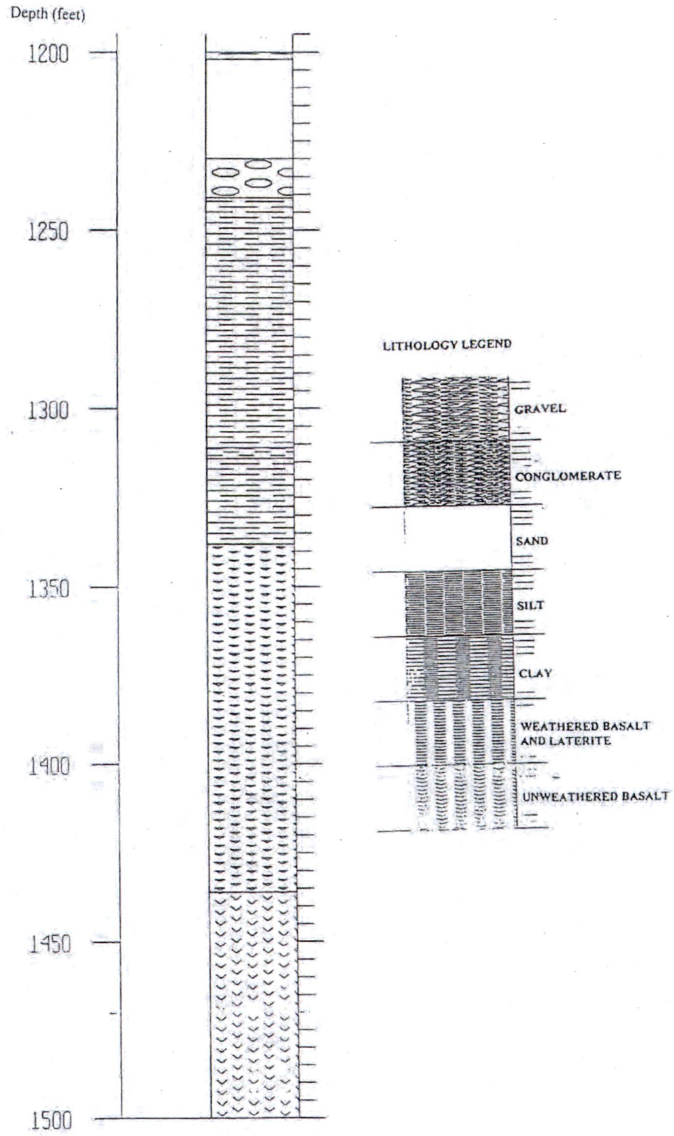

Attachment C
Land Use Form

Groundwater Permit Application – Port of Portland Geothermal

Land Use Information Form

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, Oregon 97301-1266
(503) 986-0900
www.wrd.state.or.us

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NOTE TO APPLICANTS

In order for your application to be processed by the Water Resources Department (WRD), this Land Use Information Form must be completed by a local government planning official in the jurisdiction(s) where your water right will be used and developed. The planning official may choose to complete the form while you wait, or return the receipt stub to you. Applications received by WRD without the Land Use Form or the receipt stub will be returned to you. Please be aware that your application will not be approved without land use approval.

This form is NOT required if:

1) Water is to be diverted, conveyed, and/or used only on federal lands; **OR**
2) The application is for a water right transfer, allocation of conserved water, exchange, permit amendment, or ground water registration modification, and **all** of the following apply:
   a) The existing and proposed water use is located entirely within lands zoned for exclusive farm-use or within an irrigation district;
   b) The application involves a change in place of use only;
   c) The change does not involve the placement or modification of structures, including but not limited to water diversion, impoundment, distribution facilities, water wells and well houses; and
   d) The application involves irrigation water uses only.

NOTE TO LOCAL GOVERNMENTS

The person presenting the attached Land Use Information Form is applying for or modifying a water right. The Water Resources Department (WRD) requires its applicants to obtain land-use information to be sure the water rights do not result in land uses that are incompatible with your comprehensive plan. Please complete the form or detach the receipt stub and return it to the applicant for inclusion in their water right application. You will receive notice once the applicant formally submits his or her request to the WRD. The notice will give more information about WRD's water rights process and provide additional comment opportunities. You will have 30 days from the date of the notice to complete the land-use form and return it to the WRD. If no land-use information is received from you within that 30-day period, the WRD may presume the land use associated with the proposed water right is compatible with your comprehensive plan. Your attention to this request for information is greatly appreciated by the Water Resources Department. If you have any questions concerning this form, please contact the WRD's Customer Service Group at 503-986-0801.

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Land Use Information Form

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, Oregon 97301-1266
(503) 986-0900
www.wrd.state.or.us

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MAR 05 2019
OWRD

Applicant(s): Port of Portland Attn: Dorothy Sperry

Mailing Address: PO Box 3529

City: Portland State: OR Zip Code: 97208 Daytime Phone: 503-415-6642

A. Land and Location

Please include the following information for all tax lots where water will be diverted (taken from its source), conveyed (transported), and/or used or developed. Applicants for municipal use, or irrigation uses within irrigation districts may substitute existing and proposed service-area boundaries for the tax-lot information requested below.

Township	Range	Section	¼ ¼	Tax Lot #	Plan Designation (e.g., Rural Residential/RR-5)	Water to be:			Proposed Land Use:
1 N	2 E	8	NWNW	See Attached Map	IG2	☒ Diverted	☒ Conveyed	☒ Used	Industrial
1 N	2 E	8	NENW		IG2	☒ Diverted	☒ Conveyed	☒ Used	Industrial
1 N	2 E	8	NWNE		IG2	☒ Diverted	☒ Conveyed	☐ Used	Industrial
1 N	2 E	8	SWNW		IG2	☐ Diverted	☒ Conveyed	☒ Used	Industrial
1 N	2 E	8	SENW		IG2	☒ Diverted	☒ Conveyed	☒ Used	Industrial
1 N	2 E	7	NENE		IG2	☐ Diverted	☒ Conveyed	☒ Used	Industrial

List all counties and cities where water is proposed to be diverted, conveyed, and/or used or developed:

City of Portland, OR

B. Description of Proposed Use

Type of application to be filed with the Water Resources Department:

☒ Permit to Use or Store Water ☐ Water Right Transfer ☐ Permit Amendment or Ground Water Registration Modification
☐ Limited Water Use License ☐ Allocation of Conserved Water ☐ Exchange of Water

Source of water: ☐ Reservoir/Pond ☒ Ground Water ☐ Surface Water (name) _____

Estimated quantity of water needed: 12.48 ☒ cubic feet per second ☐ gallons per minute ☐ acre-feet

Intended use of water: ☐ Irrigation ☐ Commercial ☐ Industrial ☐ Domestic for _____ household(s)
☐ Municipal ☐ Quasi-Municipal ☐ Instream ☒ Other Geothermal

Briefly describe:

The Applicant (Port of Portland) is proposing to pump groundwater from three proposed extraction wells for geothermal heating and cooling in the Portland International Airport terminal. Water will be conveyed entirely within enclosed piping (high-density polyethylene below-ground and cast iron above-ground) and reinjected back into the aquifer at the same depth of extraction through seven proposed injection wells. Back-flushing for well maintenance will be conducted twice a month at each well.

Note to applicant: If the Land Use Information Form cannot be completed while you wait, please have a local government representative sign the receipt at the bottom of the next page and include it with the application filed with the Water Resources Department.

See bottom of Page 3. →

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For Local Government Use Only

The following section must be completed by a planning official from each county and city listed unless the project will be located entirely within the city limits. In that case, only the city planning agency must complete this form. This deals only with the local land-use plan. Do not include approval for activities such as building or grading permits.

Please check the appropriate box below and provide the requested information

☒ Land uses to be served by the proposed water uses (including proposed construction) are allowed outright or are not regulated by your comprehensive plan. Cite applicable ordinance section(s): PCC SECTION 33.565.100. AVIATION AND SURFACE PASSENGER TERMINALS ARE ALLOWED.

☐ Land uses to be served by the proposed water uses (including proposed construction) involve discretionary land-use approvals as listed in the table below. (Please attach documentation of applicable land-use approvals which have already been obtained. Record of Action/land-use decision and accompanying findings are sufficient.) **If approvals have been obtained but all appeal periods have not ended, check "Being pursued."**

Type of Land-Use Approval Needed (e.g., plan amendments, rezones, conditional-use permits, etc.)	Cite Most Significant, Applicable Plan Policies & Ordinance Section References	Land-Use Approval:	
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued

Local governments are invited to express special land-use concerns or make recommendations to the Water Resources Department regarding this proposed use of water below, or on a separate sheet.

SITE IS IN IG2, GENERAL INDUSTRIAL 2, ZONE. USE IS ALLOWED IN BASE ZONE. PER 33.565.100. APPLICABLE OVERLAY ZONES AT THIS SITE (h, K AND X OVERLAYS) DO NOT RESTRICT THIS USE.

Name: GINA TYNAN Title: CITY PLANNER

Signature: [signature] Phone: 503-823-7271 Date: 12/18/18

Government Entity: CITY OF PORTLAND

Note to local government representative: Please complete this form or sign the receipt below and return it to the applicant. If you sign the receipt, you will have 30 days from the Water Resources Department's notice date to return the completed Land Use Information Form or WRD may presume the land use associated with the proposed use of water is compatible with local comprehensive plans.

Receipt for Request for Land Use Information

Applicant name: _____

City or County: _____ Staff contact: _____

Signature: _____ Phone: _____ Date: _____

G-18798

OREGON WATER RESOURCES DEPARTMENT
LOW TEMPERATURE GEOTHERMAL PROGRAM

RECEIVED
MAR 05 2019
OWRD

REQUEST FOR APPROVAL OF A LOW TEMPERATURE GEOTHERMAL INJECTION WELL

APPLICANT

Name: Port of Portland - Attn: Dorothy Sperry Phone: 503-415-6642

Address: PO Box 3529
Street

Portland OR 97208
City *State* *Zip*

ADDRESS AND LOCATION OF PRODUCTION WELL(S)

Please list any wells which produce waste water that will ultimately be disposed of at your proposed injection well.

Name and address of well owner: Port of Portland

PO Box 3529, Portland, OR 97208

Address at well site or nearest known address: 7000 NE Airport Way, Portland, OR 97218

Location of well: Township 1N, Range 2E, Section 5, 8, 9, 1/4 _____, 1/4 _____

Note: If you plan to dispose of effluent (waste water) that originates from more than one production well, please record the additional information required under this section on a separate page and include with this request. (See Maps in the Attached Geothermal Injection Plan)

ADDRESS AND LOCATION OF PROPOSED INJECTION WELL

Name and address of well owner: Port of Portland

PO Box 3529, Portland, OR 97208

Address at well site or nearest known address: 7000 NE Airport Way, Portland, OR 97218

Location of well: Township 1N, Range 2E, Section 5, 8, 9 1/4 _____, 1/4 _____

Note: Any production well(s) and the injection well must be shown on a 7 1/2-minute USGS topographic map or a tax lot map. Indicate elevation of land surface at each well head, horizontal distance between production well(s) and injection well, and identify the owner of each well on the map (maps should be available from the Department in Salem or the local Watermaster office). The Department or local Watermaster will send you a photocopy of the map at your request. (See Maps in the Attached Geothermal Injection Plan)

WATER WELL REPORTS (See Attachment A & B - key TSA well logs in vicinity of proposed wells in the Attached Geothermal Injection Plan)

Attach water well reports for each well involved in this proposal. Record current owner on each water well report if known. Water well reports are available from the Department in Salem or the local Watermaster office. If a water well report cannot be found, provide the following well information if readily available. Include the following:

Original well owner: _____

Date originally drilled: _____, Well driller: _____

Well depth: _____, Casing Size: _____

Is casing perforated?: _____yes, _____no. If yes, at what depths: _____

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WATER WELL REPORTS (Continued)

Bottom hole temperature (degrees Fahrenheit): _____, Date: _____

Static water level: _____, Date: _____

Note: If no well information is available, skip this section and proceed to the next section.

DESCRIBE YOUR CURRENT WELL SYSTEM

How is your well utilized? Up to 3 extraction wells in the TSA will pump water to the geothermal heating system and the water will be injected into any one of the 8 available injection wells also completed in the TSA.

If known, please provide the following information. (*Please attach copies of any known water quality data for your well).*

Pumping rate: 4,500 gpm (10.03 cfs) (gallons per minute).

Disposal temperature of waste water as it exits your system: 37 to 94 F (degrees Fahrenheit).

Have you added any substance (oil, paraffin, etc.) to your well to inhibit corrosion?

_____yes ___x___no _____don't know.

Additional comments: _____

DESCRIBE YOUR INJECTION PLANS (See Attachment Geothermal Injection Plan)

If known, please provide the following information:

Proposed well depth: _____ Proposed casing size: _____

Proposed injection temperature: _____(degrees Fahrenheit).

Proposed injection rate: _____(gallons per minute).

Note: If the proposed injection well has already been drilled, please attach the water well report.

Signature of Applicant

2-28-19

Date

If you need more information or help with your injection plans, contact the **OREGON WATER RESOURCES DEPARTMENT** in Salem at **503-986-0844.**

Please send your completed request to the following address:

OREGON WATER RESOURCES DEPARTMENT
Low-temperature Geothermal Program
725 Summer Street NE, Suite A
Salem, OR 97301-1266

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Low Temperature Geothermal Injection Plan
Portland International Airport Geothermal Project
Port of Portland

The Port of Portland (Port) owns and operates the Portland International Airport. The Port plans to install an open-loop Groundwater Source Heat Pump (GSHP) to heat and cool terminal buildings during the upcoming terminal upgrade projects. The system will consist of extraction wells that pump groundwater, heat exchangers that extract heat or cold from the water, and injection wells that re-inject the water into the aquifer. No additives will be added to the water stream. The Port is currently in the final planning stages for the GSHP system and will be submitting the following applications to permit this project:

- Class V Underground Injection Control Authorization (UIC) from the Oregon Department of Environmental Quality (DEQ)
- Permit to Use Groundwater from the Oregon Water Resources Department (OWRD).
- Low Temperature Geothermal Permit from the OWRD

The Port's low-temperature geothermal system will be installed to produce water from three extraction wells, and reinject the water into seven injection wells. All injection and extraction wells will be completed to interact with the same aquifer. The Port will continuously monitor water levels in all of the wells and flow rates in all the extraction and injection wells and will also measure the temperature of the water injected back into the aquifer. The Port will regularly review data to monitor the efficiency of the system.

OWRD low temperature geothermal production and injection rules require the Port to submit this Injection Plan [see Oregon Administrative Rules (OAR) 690-230-0115]. The following paragraphs address the requirements of the Injection Plan under OAR 690-230-0115.

Well Construction – *OAR 690-230-0115(1): Details of well construction, including water well reports for the production well and the injection well.*

All injection and extraction wells will be drilled and installed by an Oregon-licensed driller and in accordance with OWRD regulations. Construction for the wells is planned to commence in November 2019. The extraction wells will be constructed with a 16-inch casing and the injection wells will be constructed with a 12-inch casing. All wells will be sealed, at a minimum, five feet into the confining unit located above the target aquifer. The wells will include a screened interval that coincides with the target aquifer thickness. The base of the target aquifer is anticipated to be approximately 500 feet below ground surface in the project area. Figure 1 and 1b is a schematic of the proposed extraction and injection wells with the expected geology, and is attached to this Injection Plan.

Water Bearing Zones – *OAR 690-230-0115(2): Description of the number and location of water bearing zones from both production and injection wells.*

Existing water well logs indicate the presence of multiple aquifers in the area that are separated by confining units. The target aquifer for the extraction and injection wells is the Troutdale Sandstone Aquifer (TSA). At the Portland International Airport, the top and bottom of the TSA are bounded by two clay confining units – the CU1 and CU2 – which hydraulically separate the TSA from other aquifers in the Portland Basin (i.e., the Columbia River Sand Aquifer, Troutdale Gravel Aquifer, and Sand and Gravel Aquifer). The Port is currently finalizing their evaluation

of well spacing options and locations and the potential for injury to other groundwater wells in the TSA using a numerical groundwater model.

The well log and lithographic description for MTD-1 is included in Attachment A. The information from this log is being used to estimate the geology and approximate depths to, and thickness of, the TSA (the target aquifer) in the project area.

Water Temperature Data – *OAR 690-230-0115(3): Water temperature data from both the production and injection wells.*

The estimated water temperature of the TSA, based on well log MULT 57, is approximately 58 degrees Fahrenheit (°F) (see Attachment B). The temperature of the water the Port will inject back into the ground is estimated to be 37 to 38 °F during the winter when heat is extracted, and up to 94 °F during peak summer cooling and 68 °F during partial cooling.

Water temperature will be measured at the well head of each extraction and injection well on a regular basis when the system is operating. The Port will submit water temperature data obtained from the extraction wells and injection wells as required for this Injection Plan.

Water Level Data – *OAR 690-230-0115(4): Water level data from both the production and injection wells.*

The Port plans to record the water levels in all the project wells with a down-hole pressure transducer (or equivalent). Water level data from the extraction wells and injection wells will be submitted to OWRD as required for this Injection Plan.

Water Quality Data – *OAR 690-230-0115(5): Water quality information including analysis by a laboratory certified by the Oregon Health Division for drinking water standards for the following parameters: arsenic, boron, calcium, carbonate or bicarbonate, chloride, fluoride, iron, magnesium, manganese, pH, potassium, silica, sodium, specific conductance, sulfate, suspended solids, total dissolved solids, and total coliform bacteria.*

Following the completion of each extraction and injection well, the Port will conduct a pumping test to assess the characteristics of the TSA aquifer in the project area. At the end of the aquifer tests, a water quality sample will be collected and tested for the required parameters in OAR 690-230-0115(5) in at least one of the extraction wells. All water quality testing results collected from the extraction wells will be submitted to OWRD following completion and testing of the project's wells.

Although no additives will be inserted into the water stream, additional water quality testing will be completed on the water after passing through the GSHP to understand the water quality of the injection water. Water quality data will be collected and submitted to OWRD as required for this Injection Plan.

Project Map - *OAR 690-230-0115 (6): A map indicating the location and elevation of both the production well and the injection well in accordance with OAR 690-230-0045. All maps shall be drawn to a standard, even scale of not less than 4 inches = 1 mile. Small area maps may be more easily and clearly drawn to a larger scale, such as 1 inch = 400 feet. The well owner shall submit injection plans to the Director indicating proposed separation distances between production and injection wells on the parcel of land on which the production well is located, on the parcel of land on which the injection well is located, and on all adjacent parcels of land, as well as land surface elevation at each well head.*

Figures presenting the locations of the two final options being evaluated by the project team for the projects extraction and injection wells and place of use (Portland International Airport

Terminal) are attached. The Port owns the tax lot where wells are proposed and all of the adjacent tax lots for some distance beyond.

Safeguards for Interference with Existing Rights - *OAR 690-230-0115(7): Any planned safeguards to prevent substantial thermal or hydrologic interference with existing rights to appropriate groundwater and surface water and alteration of existing or potential drinking water supplies.*

A review of nearby water rights indicated 11 Certificates, Permits or Claims using groundwater within 2.5 miles of the Port's project area, (Portland International Airport Terminal). Of the 11 rights, only three of these water rights produce water from the TSA (one Certificate (32131, irrigation of 4.47 acres) and two Permits (G-10967 and G-8755)) based on the well logs. The Port owns the land to which Certificate 32131 is appurtenant and it is suspected the well associated with this right has likely been abandoned. The Port also owns and operates the irrigation well associated with permit G-10967. The third potentially impacted water right permit, G-8755, is a City of Portland water right associated with City production wells near, or east, of Interstate 205 (approximately 2.3 miles east of the Port's project area).

Water withdrawn by the Port for geothermal heating will be reinjected into the TSA at the same depths to minimize drawdown within the TSA and potential interference with existing rights. Additional, groundwater modeling will be used to further understand the potential impacts of the project on other TSA wells. The results of this modeling can be shared with OWRD upon request.

Figures
Injection & Extraction Well Proposed Construction
Map of Proposed Well Locations - 2 Scenarios

Geothermal Injection Plan – Port of Portland: Portland International Terminal

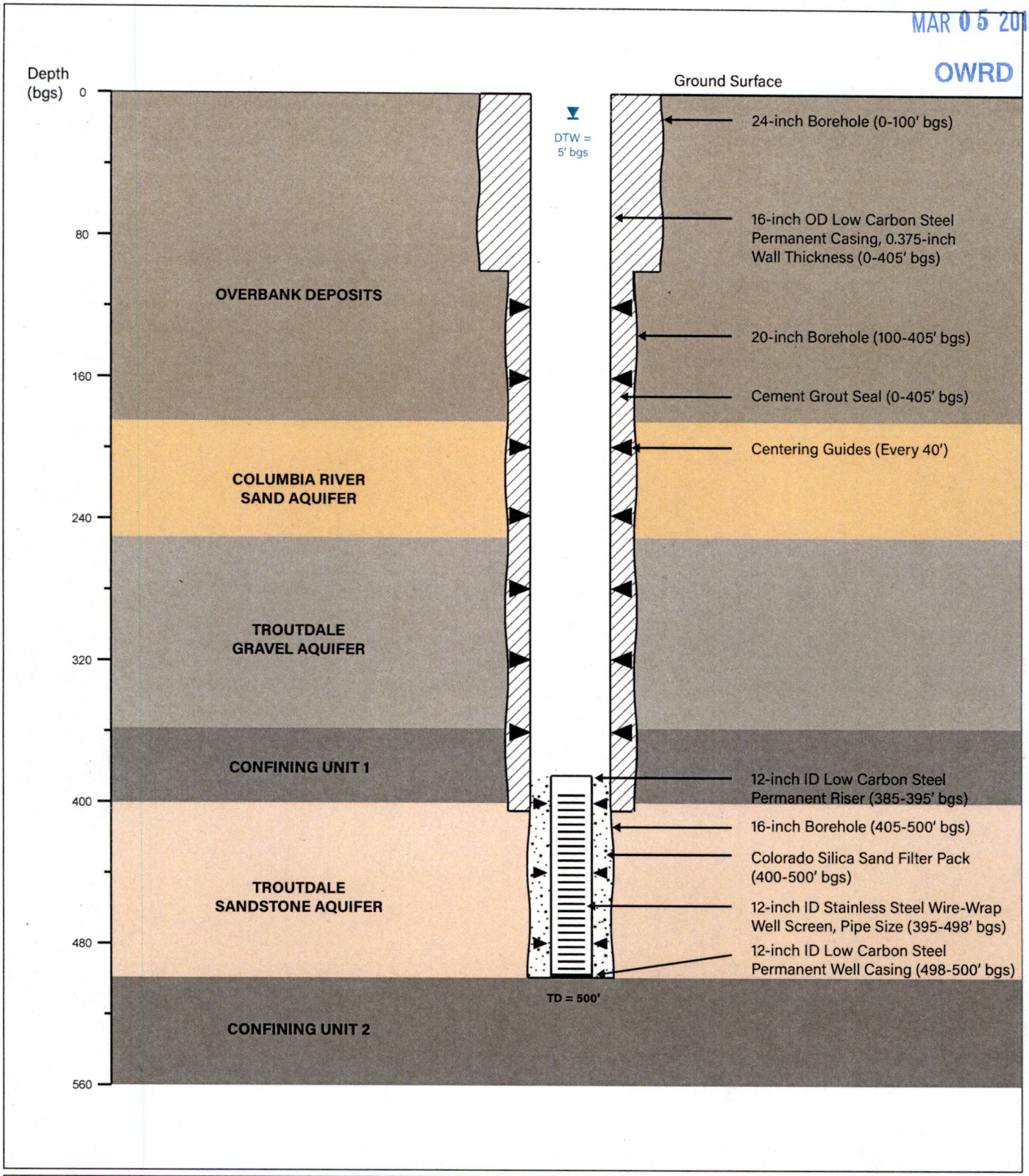

FIGURE 1

Extraction Well - 30% Design

Portland International Airport GSHP

NOTES:
ID = Inner diameter
OD = Outer diameter
bgs = Below ground surface
DTW = Depth to water
GSHP = Groundwater Source Heat Pump

Date: November 20, 2018

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GSI Water Solutions, Inc.

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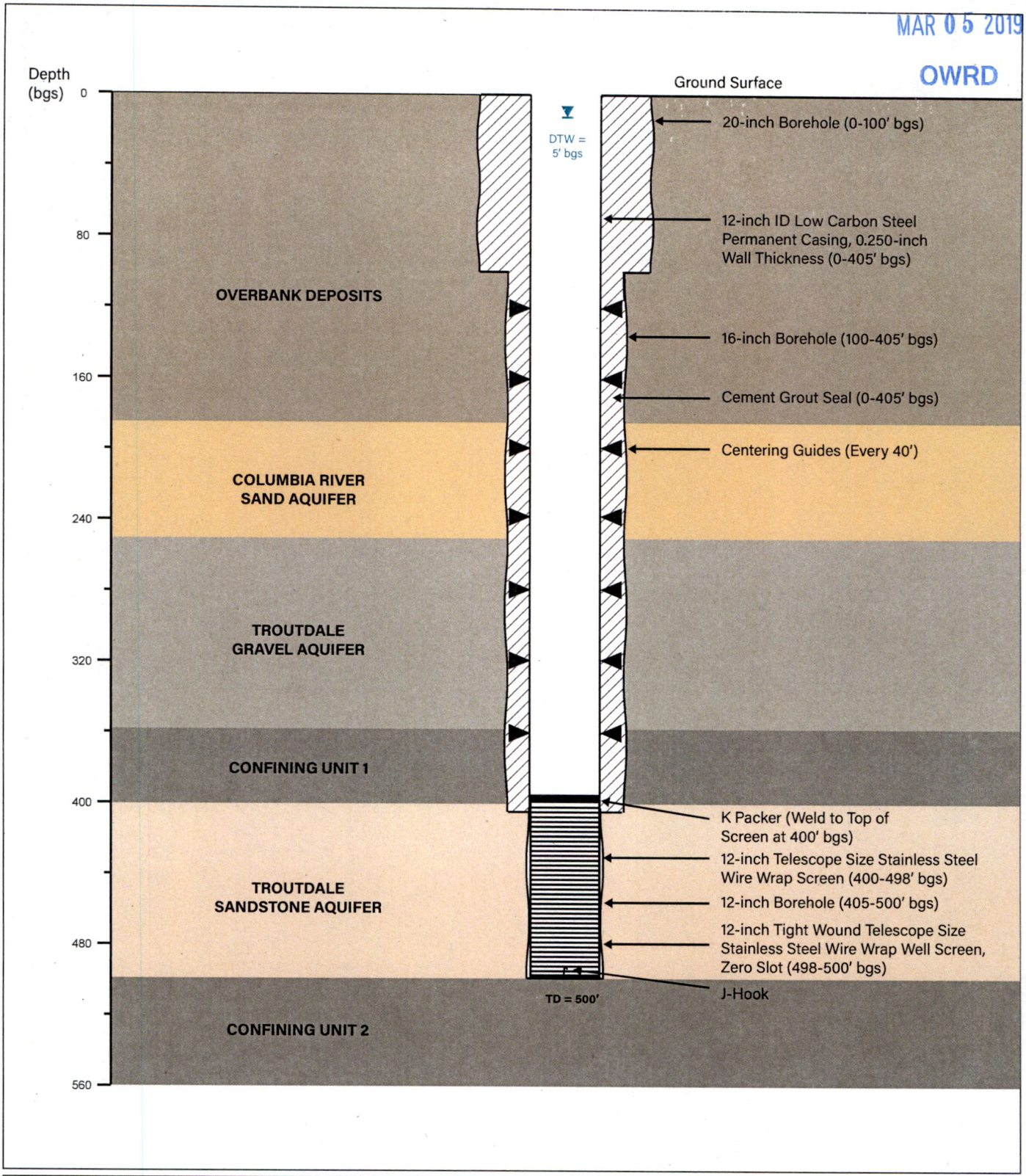

FIGURE1b

Injection Well - 30% Design

Portland International Airport GSHP

NOTES:

ID = Inner diameter
OD = Outer diameter
bgs = Below ground surface
DTW = Depth to water
GSHP = Groundwater Source Heat Pump

Date: November 20, 2018

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GSI Water Solutions, Inc.

G-18798

Attachment A
MTD-1 Well Log

Geothermal Injection Plan – Port of Portland: Portland International Terminal

B33

MTD-1 Portland Airport Deep Hole
1N 2E 6caaa Elevation Approx. 23' TD 1523'

This drill hole was cored with HQ wireline from 391' - 455', 473' - 474', and 724' - 841'. The rest of the hole was drilled with a mud rotary, tri-cone bit. Sample descriptions outside of the above intervals are from drill cuttings. Described by the author.

0' - 5': Dark brown, soft, clayey SILT. @5" - Greenish gray to brown, v. sticky, v. fine sandy, clayey SILT with organic material.

5' - 15': Gray brown, subangular to subrounded, poorly sorted, coarse - v. coarse SAND and GRAVEL with abundant wood chips.

15' - 25': Dark green gray with red and black, subangular to subrounded, loose, poorly sorted, fine to v. coarse, lithic rich, quartz bearing SAND with few wood chips. Lithics include basalt and granitic material.

25' - 35': As Above (AA) - dominantly medium grained.

35' - 37': Gray to brown, v. fine sandy, clayey SILT.

37' - 40': Dark green gray with red and black, subangular to subrounded, loose, poorly sorted, fine - v. coarse, lithic rich, quartz bearing SAND with few wood chips. Lithics include basalt and granitic material.

40' - 45: AA - with wood chips.

45' - 55': Gray, black, red, and green, subangular to subrounded, loose, micaceous, moderately sorted, medium - coarse lithic rich SAND with wood. Lithics include andesite, granite, granodiorite, and basalt.

55' - 60': AA - with lots of wood.

60' - 70': AA - with much less wood and some silt sized material.

70' - 90': Gray, angular to subrounded, loose, well sorted, micaceous, fine - medium, arkosic, lithic, quartz bearing SAND with scattered coarse grains.

90' - 95': Medium gray, angular to round, loose, poorly sorted, fine - v. coarse, arkosic, lithic, quartz bearing SAND.

95' - 100': Gray, angular to subrounded, loose, well sorted, micaceous, fine - medium, arkosic, lithic, quartz bearing SAND with scattered coarse grains.

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100' - 135': Pale yellow brown, angular to subrounded, loose to slightly compacted (v. friable), slightly micaceous, moderately sorted, v. fine - v. coarse (mostly medium), arkosic, lithic, quartz bearing SAND.

135' - 145': White, dark gray, subangular to rounded, loose, moderately well sorted, coarse SAND to small GRAVEL consisting predominantly of pumice with some black basalt and lots of wood chips.

145' - 155': White, dark gray, subangular to subrounded, micaceous, poorly sorted, silty, fine - coarse, lithic SAND including pumice, tuff, scoria, black basalt, & gabbro(?) with wood.

155' - 165': Pale yellow brown, angular to subrounded, loose to slightly compacted (v. friable), slightly micaceous, moderately sorted, v. fine - v. coarse (mostly medium), arkosic, lithic, quartz bearing SAND.

165' - 185': White, dark gray, subangular to subrounded, loose, micaceous, moderately sorted, fine - medium, lithic SAND with occasional coarse pumice grains. @ 180' - 182' - wood chips.

185' - 195': Dark gray, micaceous, subangular to rounded, moderately sorted, v. coarse SAND to GRAVEL (up to 6 cm.) consisting dominantly of basalt with minor plutonic lithics and lots of wood.

195' - 205': Pale yellow brown, angular to subrounded, loose to slightly compacted (v. friable), slightly micaceous, moderately sorted, v. fine - v. coarse (mostly medium), arkosic, lithic, quartz bearing SAND to rounded basaltic GRAVEL.

205' - 225': Dark gray, micaceous, subangular to rounded, moderately sorted, v. coarse SAND to GRAVEL (up to 6 cm.) consisting dominantly of basalt with minor plutonic lithics and lots of wood.

225' - 245': Pale yellow brown, angular to subrounded, loose to slightly compacted (v. friable), slightly micaceous, moderately sorted, v. fine - v. coarse (mostly medium), arkosic, lithic, quartz bearing SAND.

245' - 250': White, dark gray, angular to subrounded, micaceous, loose, moderately sorted, fine - coarse, arkosic, lithic SAND.

250' - 279': Dark gray, black, red, white, angular chips of dominantly basaltic with subordinate granitic GRAVEL, COBBLES, and BOULDERS.

279' - 290': Brown, gray, micaceous, clayey SILT with basalt chips probably from above.

290' - 295': Gray, subangular to subrounded, micaceous, moderately sorted, silty, clayey, fine, basaltic SAND.

295' - 310': Gray, angular to rounded, moderately sorted, fine SAND to GRAVEL consisting dominantly of basalt and clayey SILT. @ 305' - micaceous, silty CLAY material noted mixed with sand.

310' - 320': Gray, micaceous, v. fine sandy, clayey SILT.

320' - 325': Gray, subangular to subrounded, moderately sorted, loose, medium - coarse SAND with occasional basaltic GRAVEL.

325' - 358': Green, gray, white, red, angular to rounded (quartz & basalt more angular), micaceous, moderately sorted, v. coarse SAND to GRAVEL consisting of various granitic and basaltic material, quartz, and sandstone.
Gravel up to 5 cm. @ 353' - COBBLES and BOULDERS noted from hard drilling and angular basalt chips.

358' - 391': Gray to gray green, micaceous, v. fine sandy, clayey SILT. @ 375' - scattered occasional medium SAND. @ 385' - trace of wood.

CORE SAMPLES From 391' to 474'

391' - 394': Medium blue gray, oxidizing to green gray, micaceous (15%), massive, silty CLAY.

394' - 397': Medium gray to green gray, blocky, micaceous (5%), massive, somewhat plastic, sticky, slightly silty CLAY.

397' - 402': Medium gray with mottled white and light brown, blocky, slightly micaceous, massive, stiff, nonplastic, slightly silty CLAY. Slickensides noted @ 398' 8". Clay becomes more micaceous, mottled with more light brown @ 400'.

402' - 403': As Above (AA) - Clay laminated with irregular or wavy lenses of white and light brown-orange (Fe+3 staining) clay with traces of organic matter and ashy? white spots (< 1mm dia.). silt (10%) - also medium green gray, purer clay drape microlaminae.

403' - 405': Light to medium brown, blocky, micaceous, silty CLAY with purer clay clasts and rounded clasts of v. fine to fine sandy SILT up to 1 cm. dia. The silt clasts also have clay streaks. Also round (botryoidal?) spots of white powdery material surrounding hard, translucent cores.

405' - 405' 2": Mixed lenses of moderate brown, subrounded - rounded, moderately sorted, silty, v. fine-fine, lithic (dominant), quartz bearing SAND with occasional medium sized grains, interlayered with dusky brown, CLAY.

405' 2" - 405' 6": Dark gray, micaceous, silty CLAY with traces of scattered fine sand.

405' 6" - 406': Dark gray, micaceous, v. fine sandy, clayey SILT.

406' - 417' 3": Dark gray, angular - subrounded, well-sorted, micaceous, somewhat endurated (especially bt. 411' - 415'), friable, v. fine-fine, quartz bearing, basalt rich SAND with interlayered clay drapes only a few mm. thick. - Sand become medium grained @ 409'.

417' 3" - 418': AA- sand becomes v. fine grained with some clay and silt.

418' - 418' 5": Brownish black, micaceous, clayey SILT.

418' 5" - 427': Light gray, micaceous, endurated, friable, faintly parallel laminated, v.fine sandy, SILTSTONE. @ 421' - soft, clayey SILT. @ 425' + - back to sandy SILT with 2 to 4 cm lenses of light green gray, angular to subrounded, micaceous, clean, silty, v. fine SAND with a hint of cross-bedding.

427' - 428' 5": SAND - AA

428' 5" - 435': Light green gray, angular to subrounded, micaceous, well sorted, v.fine to fine, arkosic, quartz bearing, lithic (black basalt) SAND with interbedded layers of v. fine sandy SILT up to 8cm thick.

435' - 440': No core recovered,

440' - 443' 2": Pale olive, angular to subrounded, micaceous, moderately well sorted, cross-bedded, fine to medium, arkosic, quartz bearing, SAND with occasional coarse grains and interbedded clay drapes 5-7m thick.

443' 2" - 444': Pale olive to green gray, micaceous, slightly clayey, v. fine sandy SILT with scattered fine to medium lithic grains and wood material. @ 443' 8" - color changes to gray brown.

444' - 445': Dark green gray, micaceous, silty CLAY.

445' - 454': Light olive gray, micaceous, angular to subangular, v. friable, well sorted, silty, v. fine, arkosic, quartz bearing SAND with few black lithic basalt grains. Sand coarsens downward to v. fine-fine. @ 448' - Clay stringers noted. @ 452'+ - scattered organic matter noted.

454' - 456' 4": Light brown gray, angular to subrounded, micaceous, well sorted, organic bearing, silty, v. fine SAND. Becomes fine grained @ 456'+.

456' 4" - 473': No core recovered. Drill cuttings only in this interval.

456' - 459' 6": Grayish orange, angular to subrounded, micaceous, moderately sorted, v. friable, fine to coarse, arkosic, basaltic SAND with minor quartz. Basalt grains more subrounded and larger than plagioclase.

461' - 463': Dark gray to black, angular (quartz) to subrounded, moderately well sorted, v. friable, upper medium to coarse, basaltic SAND with minor quartz and plagioclase.

463' - 466': AA - except cobble sized black basalt with vesicles (up to 5 cm.).

466' - 473': Dark gray to black, angular to subangular, v. loose, poorly sorted, fine to gravel, basaltic SAND with minor quartz and muscovite, and trace organic matter (wood?).

473' - 474': **Core 2" - 3" long.** Dusky yellow brown, subangular to well rounded, poorly sorted, fine to coarse , arkosic, quartz bearing SAND to COBBLE (> 5cm.) sized, black, basalt fragments.

Back to drill cuttings.

474' - 478': AA - mostly gravel sized material.

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478' - 481': AA - occasional cobble sized material.

481' - 488': Black and white, angular to subrounded, poorly sorted, micaceous, v. friable, fine to gravel, arkosic, basaltic SAND with 30%-40% basalt and occasional light green and red brown lithic material.

488' - 493': Black with white, angular to subrounded, v. poorly sorted, fine to large gravel, basaltic, quartz bearing, lithic SAND - GRAVEL.

493' - 507': AA - occasional cobble sized basalt.

NOTE: Drill cuttings samples from this depth and below are widely scattered and sample bags are marked with only one depth. Field log descriptions will be substituted where necessary.

507' - 514': No sample. Field log indicates more SAND and GRAVEL as above.

514' - 519': Black and white, angular to rounded, loose, moderately sorted, coarse - v. coarse SAND to GRAVEL or larger consisting dominantly of basalt chips (up to 1.5 cm.) and subordinate andesite and granitic material.

519' - 533': Black, green, white, red brown, angular to rounded, loose, moderately sorted, v. coarse SAND to GRAVEL consisting of massive black basalt, vesicular basalt, pumice, quartz, and other lithic material. @ 531' - lots of wood.

533' - 566': No sample. Field log indicates black, medium to coarse, micaceous, SAND with minor blue gray CLAY and rare GRAVEL.

566' - 575': Yellowish gray, micaceous, v. fine sandy, clayey SILT.

575' - 581': No sample. Field log indicates coarse to v. coarse SAND and minor blue gray CLAY.

581' - 585': Yellow gray, micaceous, silty CLAY with scattered v. coarse sand to gravel (from above?).

585' - 601': No sample. Field log indicates CLAY as above with scattered sand.

601' - 606': Sample mixed with yellow gray, micaceous, clayey SILT and dark gray, white, angular to subrounded, loose, moderately sorted, medium - v. coarse, lithic (mostly basalt), quartz bearing SAND.

606' - 629': No sample. Field log indicates black, coarse SAND.

629' - 630': Yellow gray, micaceous, silty CLAY.

630' - 692': No sample. Field log indicates black, coarse SAND and blue gray CLAY to approximately 670' with a conglomeratic layer @ 645'. Below 670', black, fine - coarse SAND with wood @ 678'.

692' - 714': Black, angular to rounded, micaceous, moderately sorted, loose, v. coarse SAND to GRAVEL consisting of dominantly basalt with minor quartz, mica, and glass. @ 713' - basalt chips up to 1 cm. - may be from cobbles - also lots of glass and some scoria.

CORE SAMPLES FROM 714' - 841'

714' - 724': Core sample not recovered. Field log indicates SAND.

724' - 726': Black, subangular to subrounded, endurated, but friable, faintly cross laminated, well sorted, medium, basaltic SANDSTONE with olive green glass shards and trace quartz. Basalt material is a rough cinder type. Rounded basalt gravel (up to 3 cm.) at the top of the interval.

726' - 736': No core recovered.

736' - 745': AA - quartz content increases with depth (10%-15%) @ 737'. @738' - core is not as endurated as above and cross laminations are better defined. @ 740' - Sand becomes v. loose and coarse grained. Glass still present.

745' - 776': No core recovered. Drill cuttings only.

746' - 766': Black, subangular to subrounded, well sorted, medium (a few coarse), basaltic, vitreous SAND with minor quartz and trace mica.

766' - 776': Black, rounded, basalt COBBLES up to 7cm.

BACK TO CORE SAMPLES.

776' - 778': Pale yellow to medium blue gray, angular to subrounded, massive, micaceous, moderately well sorted, silty, v. fine-fine, arkosic, quartz bearing, lithic SAND with 5% clay and trace organic matter (wood). @ 777' - An 8 cm. thick v. loose, angular to subrounded, moderately well sorted, medium to coarse, arkosic, quart bearing SAND.

778' - 780': Pale yellow brown, angular to subrounded, loose, moderately well sorted, medium to coarse, arkosic, quart bearing SAND. @ 779' 8" - 4-6cm. thick lens of pale yellow brown, angular to subrounded, micaceous, v. fine silty clayey, arkosic SAND.

780' - 782': No core recovered.

782' - 782' 3": Black and white, subangular to subrounded, loose, moderately well sorted, medium to coarse, quartz bearing (20%), arkosic (40%), lithic (40%) SAND with black basalt.

782' 3" - 786': Medium gray, micaceous, cross laminated, lithic rich v. fine sandy SILT with organic matter.

786' - 811': No core recovered. Drill cuttings @ 800'.

800': Yellow gray, angular to subrounded, moderately sorted, micaceous, fine to v. coarse, arkosic, quartz bearing SAND with basalt, pumice, and other lithic material.

811' - 821': Olive gray, angular to subrounded, micaceous, loose, moderately well sorted, medium to coarse, arkosic, quartz bearing, lithic (black basalt rich) SAND. Grain size variations with depth from medium to small rounded gravel from 819' - 821'.

821' - 831': NO core recovered.

831' - 831' 2": Black, loose, rounded basalt GRAVEL (up to 8 cm. dia.).

831' 2" - 835': Grayish olive, incompetent, micaceous, silty CLAY.

835' - 841': Olive gray, micaceous, clayey, v. fine sandy SILT, grading to a clayey SILT @ 836'. @ 837" - back to v. fine sandy SILT.

841' - Very small sample - core broken into pieces. Pale olive, micaceous, angular to subangular, moderately sorted, v. fine, silty SAND with pockets of medium quartz bearing, arkosic, basaltic SAND.

NO CORE BELOW 841' Only scattered drill cutting descriptions to TD.

864' - 872': Black, white, red brown, angular to rounded (rare), moderately sorted, micaceous, loose, v. coarse SAND to GRAVEL with dominant basalt and subordinate quartz, granitic lithic material, and pumice. @ 872' - about 10% yellow gray, micaceous, silty CLAY fragments.

873' - 876': Yellow gray, black, angular to rounded, moderately sorted, medium - v. coarse, arkosic, lithic, quartz bearing SAND.

876' - 900': Blue, oxidized to pale yellow, micaceous, silty CLAY with minor organic matter (wood).

900' - 917': Medium blue gray, v. sticky. plastic, silty CLAY to clayey SILT - almost 50% of each with scattered patches of v. fine sandy SILT.

917' - 958': Medium gray, micaceous, blocky, non plastic, silty CLAY with mottled white, v. fine sandy, clayey SILT lenses.

958' - 1004': Medium gray to grayish green, micaceous, slightly silty CLAY with trace scattered lenses of clayey SILT. **Only sample in this interval is @ 958'.**

1004' - 1124': Blue gray to light gray, micaceous, silty CLAY with common white, gray green, lenses of v. fine sandy, micaceous SILT and white clayey SILT. @ 1093' - minor coarse sand noted. **Only sample in this interval @ 1004'.** Field log notes scattered coarse SAND(from above?) from 1105' to 1124'.

1124' - 1184': Mixed, yellow gray, micaceous, clayey SILT and white to medium gray, silty CLAY (most common). @ 1131' - minor coarse sand noted. @ 1174' to 1180' - scattered wood chips present. **Only sample in this interval is @ 1124'.**

1184' - 1204': No samples. Field log indicates coarse SAND and CLAY with wood @ 1200' - 1202'. Sand is up to 30% mica @ 1204'.

1204' - 1209': No samples. Field log indicates predominant clay with lenses of black, micaceous, coarse SAND.

1209' - 1230': No samples. Field log indicates Black, micaceous, coarse SAND and blue CLAY with minor wood @ 1217'.

1230' - 1241': Black, angular to subrounded, loose, moderately sorted, v. coarse SAND to GRAVEL consisting dominantly of basalt and glass, trace wood, and lots of white clayey SILT and gray silty CLAY (from above?).

1241' - 1244': Medium brown to gray and white, silty CLAY.

1244' - 1256': Gray, silty CLAY with lenses of basalt SAND and white silty CLAY with organic stringers.

1256' - 1311': Blue gray, oxidized to gray green, micaceous, silty CLAY with white silty CLAY with scattered, thin lenses of coarse SAND below 1281'. No sample below 1256' in this interval. Only sample in this interval is @ 1256'.

1311' - 1314': Light brown, white, gray, micaceous, clayey, v. fine sandy SILT.

1314' - 1331': Yellow gray, micaceous, silty CLAY with white, micaceous clayey SILT @ 1321' and light brown, v. fine sandy, clayey SILT @ 1323'.

1331' - 1338': Brown gray, micaceous, silty CLAY with light brown Fe+3 staining.

1338' - 1361': Yellow brown mottled with light gray and medium gray, v. sticky, plastic, slightly silty CLAY with widely scattered, highly weathered, sand sized basalt beginning @ 1352'.

1361' - 1376': Bright ochre CLAY with light gray to black clay clasts (from above?) and round, gravel sized, basaltic nodules.

1376' - 1389': Red brown,, v. sticky, plastic CLAY with some ochre and silty to v. fine sand particles.

1389' - 1399': Mixed red brown, orange, yellow, gray, and white, silty CLAY and highly weathered basalt fragments.

1399' - 1420': Light brown, silty CLAY with highly weathered plagioclase crystals and basalt fragments.

1420' - 1436': Light brown, highly weathered BASALT. - **Top Of Columbia River Basalt.**

1436' - 1442': Black, hard BASALT chips and mixed samples from above.

1442' - 1456': Black, hard BASALT - vesicular and crystalline texture is distinguishable.

1456' - 1459': Weathered and fresh BASALT with lots of brown gray to medium gray, silty CLAY and red brown CLAY.

1459' - 1480': Black, fresh, hard BASALT.

1480' - 1483': Light brown, black, angular to subrounded, moderately well sorted, loose, fine - medium, quartz bearing, basaltic, arkosic SAND with black basalt chips. Drilling rate much faster and lose of drilling mud to formation.

1483' - 1488': Black, white, light brown, angular to rounded, upper v. coarse SAND to mostly GRAVEL consisting of chips of massive and vesicular basalt, rounded basalt, granitic material, and quartz.

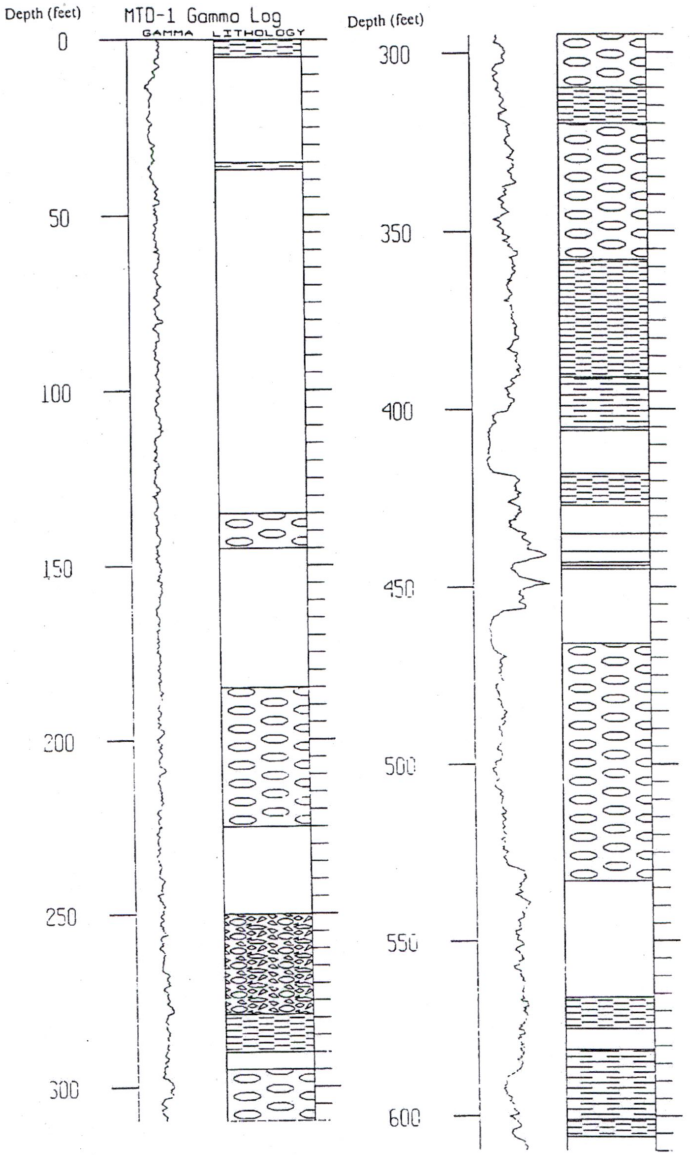
1493' - 1515': Black, angular BASALT chips and subrounded basalt grains present.

1515' - 1523': Black, hard, angular chips of BASALT.

Total Depth: 1523' (464.2 m)

B44

Recorded 10-93
by Doyle Wilson



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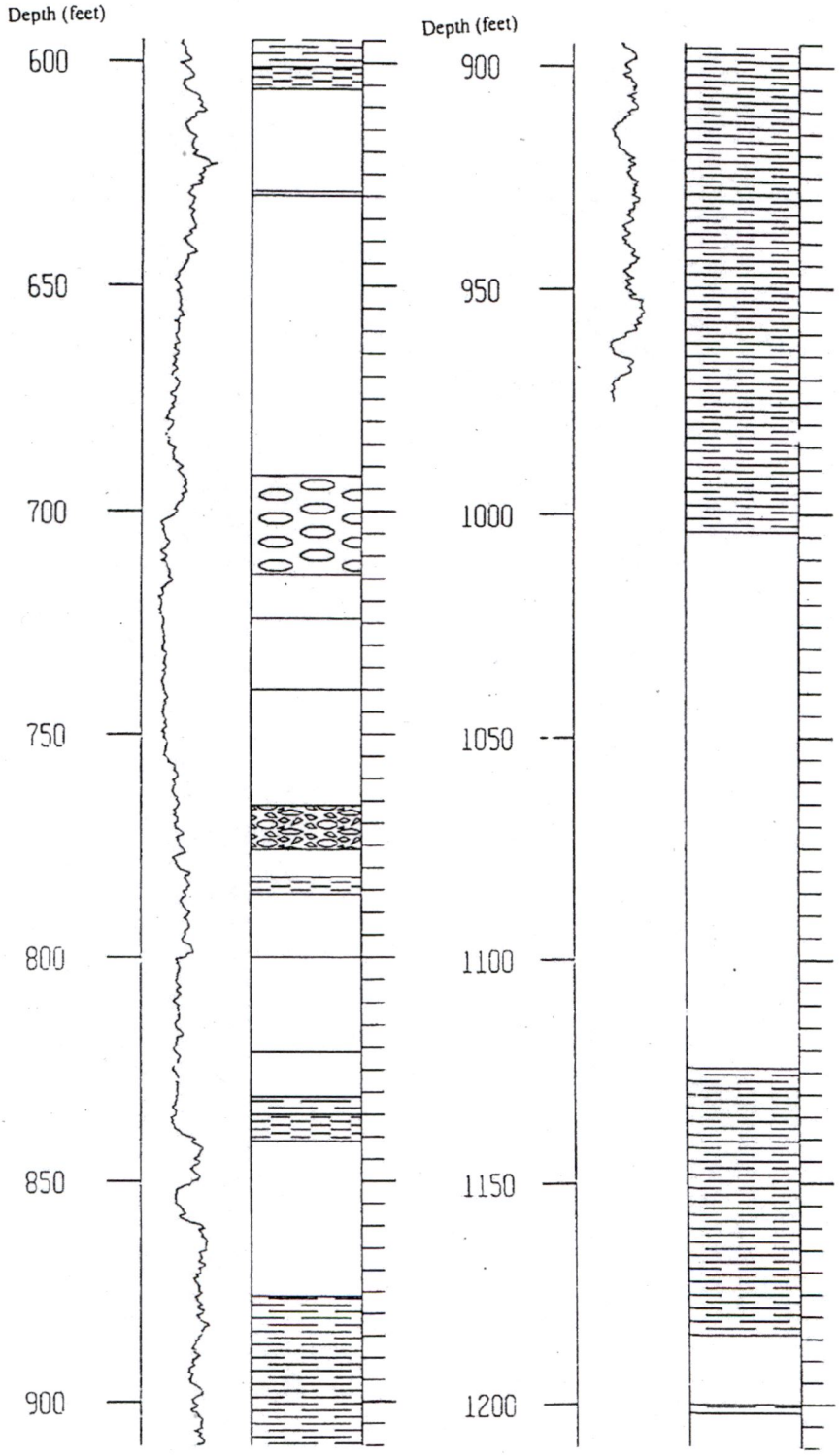
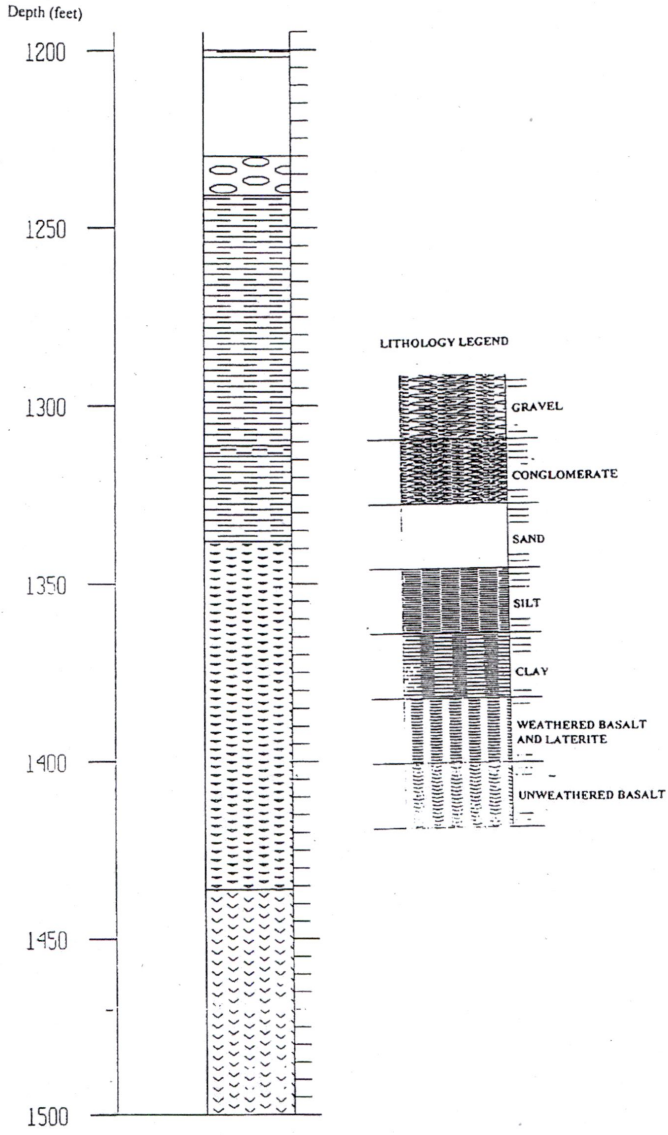
B45



A-18198



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Attachment B
Well Log MULT_57

Geothermal Injection Plan – Port of Portland: Portland International Terminal

#08

Mult 057

RECEIVED
MAR 05 2019
OWRD

1N/2E/16bd

(START CARD) # 14715

STATE OF OREGON
WATER WELL REPORT
(as required by ORS 537.765)

(1) OWNER: Well Number: 5A
Name Port of Portland
Address P.O. Box 3529
City Portland Ore State

RECEIVED
DEC 17 1990
WATER RESOURCES DEPARTMENT
SALEM, OREGON

(2) TYPE OF WORK:
☒ New Well ☐ Deepen ☐ Recondition ☐ Abandon

(3) DRILL METHOD
☒ Rotary Air ☒ Rotary Mud ☐ Cable
☐ Other

(4) PROPOSED USE:
☐ Domestic ☐ Community ☐ Industrial ☒ Irrigation
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval Yes ☐ No ☒ Depth of Completed Well 389 ft.
Explosives used Yes ☐ No ☒ Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Amount sacks or pounds
12"	0	342	Cemnt	0	50'	42
			Drill Gel	50'	320'	Drill Gel
			Cemnt	320	342	20
8"	342	389				

How was seal placed: Method ☐ A ☐ B ☒ C ☒ D ☐ E
☐ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	8 5/8	+18"	342	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s) 342' 6"

(7) PERFORATIONS/SCREENS:
☐ Perforations Method
☒ Screens Type Johnson Material Stainless

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
343	348	.50		6"		☐	☐
348	373	.60		6"		☐	☐
373	378	.40		6"		☐	☐
378	388	.25		6"		☐	☐
						☐	☐
330	343			6"	6" 5/8"	☒	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☒ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

	Yield gal/min	Drawdown	Drill stem at	Time
Pump	350	26'		1 hr.
	400	Full	100'	4 hrs
Pump	200	18'		8

Temperature of water 58 Depth Artesian Flow Found No
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☒ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other sandy with clay
Depth of strata: 152 - 184

(9) LOCATION OF WELL by legal description:
County Multnomah Latitude ' " Longitude ' "
Township 1N N or S, Range 2E E or W, WM.
Section 16 NW ¼ NW ¼
Tax Lot 50 2847 Lot Block Subdivision
Street Address of Well (or nearest address) NE Alderwood Dr.

(10) STATIC WATER LEVEL:
2 ft. below land surface. Date Mar 29, 90
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found 160

From	To	Estimated Flow Rate	SWL
152	184	30	22'

(12) WELL LOG: Ground elevation 27.90'

Material	From	To	SWL
Brown Sandy Clay	0	10	
Gray Sandy Clay	10	41	
Blue Clay w/ small pea gravel	41	53	
Gray Sandy Clay	53	84	
Small pea gravel with clay	84	89	
Gray Sandy clay	89	152	
Sandy Material with gray clay	152	184	22
Gray Sand w/ small pea gravel	184	220	
Gray Sandy Clay	220	246	
Cedar Log - Wood	246	253	
Blue gray Clay - Sticky	253	302	
Dark Blue Green Clay	302	314	
Dark Blue Sandstone	314	342	
Blue gray Sand & gravel - Small	342	359	
Black Sand & gravel - Small	359	365	
Cemented Gravels	365	367	
Black Sand & gravels - Small	367	380	
Black & gray Sand	380	385	
Small Black Sand & gravel	385	388	
Sticky Clay - gray ?	388	390	

Date started Mar 5 90 Completed Mar 29, 90

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to my best knowledge and belief.
WWC Number
Signed Date

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. all work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 1281
Signed Jack L. Abernathy Date Mar 29 90

ORIGINAL & FIRST COPY - WATER RESOURCES DEPARTMENT SECOND COPY - CONSTRUCTOR THIRD COPY - CUSTOMER 9809C 3/88

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