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City of Longview
Mint Farm Regional Water Treatment Plant
Preliminary Design Report

Part 2C
Preliminary Wellhead Protection Plan

March 2010

Prepared for

City of Longview
1525 Broadway Street
Longview, WA 98632

K/J Project No. 0997003*00

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List of Acronyms

Abbreviation	Definition
CARA	critical aquifer recharge area
City	City of Longview
DOH	Department of Health
Ecology	Washington State Department of Ecology
ESA	Environmental Site Assessment
gpm	gallons per minute

Section 1: Introduction

1.1 Introduction and Purpose

The City of Longview (City) proposes to develop a new wellfield that will become the City's sole source of supply for both its domestic water system and the Cowlitz County PUD water system. The wellfield will replace the Cowlitz River as the City's source due to ongoing silting problems with the City intake and numerous needed improvements at the City surface water treatment plant. The purpose of this Preliminary Wellhead Protection Plan is to prevent the contamination of the deep aquifer that supplies this wellfield and to comply with the regulatory provisions of the WAC.

1.2 Location

The wellfield is located in the western part of the city in an area known as the Mint Farm Industrial Park as shown on Figure 1.1. The site had been used for agricultural operations, including mint and grass farming, until about 1975. The wellfield is located near industrial and commercial businesses, a managed wetland, and undeveloped property. A Phase I and II Environmental Site Assessment (ESA) were conducted for the City of Longview's Mint Farm Industrial Park proposed well field (Site). A sentinel well network consisting of 17 paired shallow and deep sentinel wells was installed around the Site to facilitate characterization of the area's aquifer (Figure 1.2). Based on this work, the wellfield has been located in the southern portion of the former farm.

1.3 Deep Aquifer

Two distinct ground groundwater systems are present at the wellfield site, an unconfined shallow system and an underlying confined to semi-confined deeper system, which is the City's target aquifer. The deeper gravel unit ranges from about 150 to 100 feet thick and is thickest toward the southern end of the area. The shallow silty deposits above these porous gravels are confining toward the southern part of the Mint Farm area, to semi-confined in the northern portion of the Site and approximately 2 miles to the west and southwest of the Site. The fact that the static water level in the deep sentinel wells is 2 to 5 feet higher than in the adjacent shallow wells supports this observation. These silty deposits range from approximately 100 to 200 feet thick, with the thickest deposits in the vicinity of the wellfield. Water levels in the deep wells also exhibit a strong correlation with the tidal fluctuations in the Columbia River. The hydrogeologic characterization of the Mint Farm area, including the deep groundwater aquifer and Columbia River tidal influence, is provided in *Draft Hydrogeologic Characterization* (Kennedy/Jenks 2009) of PDR Part 2A.

1.4 Production Well PW-1

Test production well PW-1, the first well intended for the City's Mint Farm Wellfield, was drilled approximately 55 feet north of sentinel well DW-9. Figure 1.3, drawing of PW-1, shows the total depth of the 24-inch well (18-inch screen assembly) is 375 feet. Following well development activities, a step drawdown pump test was performed at pumping rates varying from 3,000 to

4,600 gallons per minute (gpm). A 36-day constant-rate pump test was also conducted at about 3,900 gpm, with 3.3 feet of initial drawdown. Observations at sentinel well DW-9, located approximately 55 feet from pumping well PW-1, indicated approximately 0.03 feet of pumping response. As shown on Figure 1.4, the pressure in the aquifer at PW-1 was reduced by about 3 feet, with the aquifer remaining fully saturated. Step-rate and constant-rate pumping test results, along with details of PW-1 design and construction, are provided in *Draft Hydrogeologic Characterization* (Kennedy/Jenks 2009) of PDR Part 2A. Appendix X is a copy of the Water Well Report (well driller's log) for PW-1.

1.5 Additional Production Wells

Plans call for initially installing three additional similar production wells on this site to meet maximum day demand with one well out of service. The three additional production wells will be designed to produce 4,000 gpm. The wellfield site is large enough for at least two additional wells when needed in the future, for a total of six wells. The site will also include iron and manganese treatment, chlorination, and pH adjustment facilities. The wellfield site will be served by City of Longview drinking water, sanitary sewer, and stormwater collection.

1.6 State of Washington WHPP Regulatory Requirements

Washington Administrative Code (WAC) 246-290-135 (3) requires water systems using ground water to develop and implement a wellhead protection program. The minimum elements of the program are also defined in the WAC, and include:

- Completed susceptibility assessment (Section 2)
- Wellhead protection area (WHPA) delineation (Section 3)
- Inventory of all known and potential ground water contamination sources located within the WHPA that have the potential to contaminate the source of water (Section 4)
- Notification of owners / operators of known or potential sources of groundwater contamination (To be completed at a later date)
- Notification of regulatory agencies and local governments of the boundaries of the WHPA and the findings of the contaminate inventory (To be completed at a later date)
- Contingency plan in event of contamination of the source (Section 6)
- Coordination with local emergency incident responders (Section 7).

Section 2: Susceptibility Assessment

The Washington State Department of Health (DOH) requires completion of a Susceptibility Assessment Survey Form for each new and existing well used as a source of drinking water. The form was developed to assist the water utility and the State in evaluating the hydrologic setting of the water source and assessing its contribution to the source's overall susceptibility to contamination from surface activities. The form is required for DOH approval of new sources before they are put into service, is a required element of the Preliminary Wellhead Protection Plan, and is a key factor for DOH when establishing ongoing source water quality monitoring requirements. DOH requires a separate Susceptibility Assessment form for each well in the wellfield because of variances between each well, such as depth, geological strata encountered when drilling the well, volumes pumped from each well, and so forth.

There is a slight duplication of information on the Susceptibility Assessment Survey Form and the Contaminant Inventory portion of the Preliminary Wellhead Protection Plan. The Contaminant Inventory is more comprehensive and must be updated every 2 years. The Susceptibility Assessment list of potential risk is shorter and must be completed once.

A preliminary Ground Water Contamination Susceptibility Assessment Survey from Washington State DOH has been completed for PW-1 and is attached (Appendix Y). In accordance with DOH procedure, a separate Susceptibility Assessment will be completed for each additional well when it is constructed.

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Section 3: Area Determination for Wellhead Protection

The hydrogeologic characterization of the Mint Farm area, including the deep groundwater aquifer, is provided in *Draft Hydrogeologic Characterization* (Kennedy/Jenks 2009) of PDR Part 2A.

As illustrated on Figure 1.4, the target zone is a deep gravel aquifer, above which is overlain a confining layer of clays, silts and sand and a minor amount of groundwater. The sentinel wells developed for this project, as well as the first production wells, established a significant amount of up-hole hydrostatic pressure. Based on the data developed in Section 1, the deep aquifer consistently rises up through the shallow aquifer when penetrated by a monitoring well or production well.

The importance of the source contribution zones cannot be understated. The primary water supply is drawn from the areas beneath the Columbia River as shown on Figure 3.1. The shallow and unconfined areas above the deep aquifer and between the river and the Mint Farm wells do not contribute to the target gravel unit. It is unlikely that a surface contaminant would penetrate into the deep aquifer. Through year 2059, at average daily demand, the higher pressure in the deeper aquifer would prevent a contaminant from traveling from the shallow aquifer to the deep aquifer.

Figure 3.2 provides an additional illustration of the source of supply to the Mint Farm wells. Water from the Columbia River percolates into the deep water-bearing gravel at the Mint Farm and up into the wells. Therefore, impact upon the City's wellhead protection plan should be focused as follows:

- Most spills of light non-aqueous phase liquid will float on the river surface and would not impact the deep aquifer. However unlikely, major spills consisting of dense non-aqueous phase liquid could sink to the river bottom and present some concern. In both cases, however, the compound will be flushed downstream rapidly. In any case, a method to quickly report spills in the Columbia River to the City should be developed as part of this program.

- Protective measures within the wellhead protection zone should focus on preventing construction or drilling methods that could penetrate to the deeper aquifer, such as pilings, piers, or other penetrations for new buildings and structures.

- The prevention of spills or surface contamination of any kind within the wellhead protection zone is essential, even if the likelihood of penetration to the deep aquifer is remote.

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Section 4: Inventory of Potential Sources of Groundwater Contamination

An inventory of potential sources of groundwater contamination in the delineated time-of-travel zones is an essential element of wellhead protection.

4.1 Previous Reports

Because of the industrial sites located between the wellfield and the Columbia River, their historical use of hazardous chemicals, and past farming and other practices in the vicinity, in 2008 the City retained GSI Water Solutions, Inc., to complete an environmental review of the Mint Farm area. This review identified potential contaminant sources and evaluated the risk these potential sources pose to the groundwater.

A Phase I / Phase II Environmental Site Assessment (ESA) for the Mint Farm Well Field was also completed in 2009 by Kennedy/Jenks Consultants to assess site conditions. This report assumed the wellfield would be located farther north on the Mint Farm site, but they also considered impacts from industrial areas south and west of the currently proposed wellfield. Due to property acquisition considerations and set-back requirements, the physical location of the wellfield was moved to the southern portion of the Mint Farm area and the Phase I/Phase II ESA was extended. The source of the deep aquifer water changed from a northeast to a generally southwest direction, as discussed in the *Hydrogeologic Characterization* Part 2A of this PDR.

Although numerous sites that may pose environmental risks were listed on various State and Federal records, no identified sites thoroughly penetrated the confining layers above the deep aquifer. Analytical soil and groundwater data results of the Phase II investigation indicated that organic and inorganic constituents are present in the soils and shallow groundwater in the area; with only a few exceptions, these concentrations are either below their respective comparison levels or are background concentrations.

The *Water Quality and Environmental Risk Assessment* Part 2B of this PDR, presents a thorough discussion of these findings, as well as the data gathering and analyses conducted as part of the monitoring well network constructed in 2009.

4.2 Potential Contamination Sources of Concern

Because of the depth of the confining layer above the deep aquifer in the 6-month and 1-year travel zones shown on Figure 3.1, the primary sources of potential contamination are facilities that extend through the confining layer such as wells, borings, or pilings, and the lower water of the Columbia River itself. The hydraulic gradient of the deep aquifer (the pressure in the water-bearing zone) also serves to protect the aquifer from a spill and effects of drilling or pile driving.

The Longview MODFLOW Model described in the *Hydrogeologic Characterization* did not identify any complete pathways between potentially contaminating activities in the Mint Farm area and the deep groundwater aquifer.

Spills, leaks or discharges of potential contaminants on or near the surface will not directly impact the deeper aquifer. However, these sources of contamination may enter the Columbia River through either the shallow aquifer or the drainage canals. The tremendous flow of the Columbia River, as well as the fact that the recharge area is at the bottom of the river, minimizes the potential threat presented by the shallow aquifer or drainage canals in this area.

Section 5: Wellhead Protection Area Management Strategies and Implementation

Although contamination of the deep aquifer is extremely unlikely, the City will adopt and implement strategies to address activities that may put the aquifer at risk. The key to this wellhead protection strategy will be communication with property owners and agencies (local, state, and federal) regarding potential problems that may affect the water quality of the deep aquifer. This communication will be supplemented by routine sampling and analysis of selected monitoring wells.

5.1 Communications

In addition to notifying regulatory agencies in both Washington and Oregon of development of the wellfield, the identified recharge areas and time of travel, and the potential threats to the deep aquifer, the City should initiate and maintain contact with emergency responders such as City and County Emergency Operation Centers, City and Fire District, and United States Coast Guard. Such regulatory notification is required by DOH.

5.2 Ordinances / Written Agreements

The City is preparing to adopt an ordinance or an overlay zone for those portions of the 6-month and 1-year time-of-travel zones that lie within the City limits (area northeast of Industrial Way). This ordinance is in preparation now. For those areas located within the jurisdiction of Cowlitz County (southwest of Industrial Way), the City should attempt to enter into agreements similar to sanitary control covenants with each property owner.

Both the ordinance / zoning overlay and the property agreements will address the potential threat that certain types of activities may pose to the deep aquifer. Activities of primary concern include construction pilings, borings, well drilling and excavations within the delineation of the source area as presented in Figure 3.1. Projects involving one or more of these activities should require a pre-construction conference and City approval of a mitigation plan that addresses the precautions to be taken during construction, and may include the construction and implementation of additional soil borings and/or monitoring wells.

5.3 Critical Aquifer Recharge Area (CARA)

The City of Longview has adopted a Critical Area Ordinance with provisions to designate and protect critical aquifer recharge areas (CARA). Many communities use such provisions to manage their wellhead protection programs. This option was considered as a portion of this plan but is not recommended because of the location and nature of the recharge area (primarily the Columbia River); exemptions to application of the ordinance (reconstruction of existing facilities, projects involving minimal site investigative work, reconstruction of damaged or destroyed structures within same footprint); and the confining layer between the land surface and lower water-bearing zone, which should prevent surface contamination from impacting the deep aquifer.

5.4 Existing Deep Aquifer Wells

The City should notify owners and operators of other area wells that penetrate the deep aquifer within the 5- to 10-year time-of-travel zone of the City's new wellfield of the importance of maintaining the high quality of the deep aquifer. The City should also request permission to inspect each deep well, and provide recommendations for well security, protection from traffic / heavy equipment, and sanitary improvements, if necessary. If the owner / operator of a deep well stops using the well, the City should request that it be decommissioned as required by Washington State Department of Ecology (Ecology) water well regulations.

5.5 Monitoring Wells Sampling

Existing monitoring wells located along Industrial Way, such as DW-1, DW-2, DW-5, DW-6, and DW-7, are within the primary flow path from the river to the Mint Farm. Sampling and analyses of these wells will provide an early warning system to the City if an unanticipated contamination of the deep aquifer occurs. The wellhead protection program will utilize monitoring wells as an early identification of potential adverse changes in groundwater quality within the target aquifer.

The City will regularly sample select monitoring wells for chemicals identified in the State and Federal drinking water requirements. As noted in the *Water Quality and Environmental Risk Assessment* of this PDR, these chemicals are identified as Tier 2 analytes.

Monitoring wells should be sampled annually for the first year after the wellfield is put into production. If a contaminant is detected, the sampling should be increased to a quarterly schedule, at least for that specific contaminant or group of contaminants.

One additional deep sentinel well, located to the southeast of the wellfield within the 5-year source area, is recommended to be installed and added to the initial sentinel well sampling and analysis program.

Section 6: Contingency Plan

A contingency plan that outlines or suggests possible courses of action in the event of potential contamination of one or more wells in the wellfield will help guide the City in its follow-up actions. Due to the characteristics of this aquifer, it is very unlikely that one or more wells would be impacted by a contamination event requiring immediate suspension of its use. A more likely scenario would be detection of a slight quantity of a drinking water contaminant in a monitoring well and/or production well.

After a quality assurance / quality control review of the sampling and handling procedures, a confirmation sample must be collected as soon as possible. If the presence of a contaminant is confirmed, the City should consult with the Department of Health (DOH), and consideration should be given to sampling other wells in the wellfield, selected sentinel wells, and the treated water. Even if a drinking water Maximum Contaminant Level (the level at which consumers' health may be impacted after a prolonged exposure) is exceeded, the City will likely have time to address the problem without impacting public health.

6.1 Implement Operational Modifications

Depending on the level and extent of contamination, various operational options should be considered, including using other wells in the wellfield, alternating wells, and changing the length of time that each well is in operation.

6.2 Reduce System Demands

Reducing water system demands, especially summer irrigation demands, will reduce the amount of water required to be pumped until remedial actions can be taken. Options to reduce demand include implementation of the City's Emergency Response Plan as approved by DOH, activating the emergency intertie with the City of Kelso, equipping the City's Prudential Boulevard Well, and/or obtaining water from another approved source of water. Although unlikely because of the common source of aquifer recharge, other deep wells may not be affected to the same extent by the contamination.

6.3 Address the Source of Contamination

If a sentinel well or nearby area well is impacted by contamination the City will work with Ecology and DOH to locate the source of contamination. While cleanup efforts may require extended time, the City may consider alternatives such as providing temporary treatment of water from one or more of the production wells. Treating and lowering the contaminant level in one production well may allow the City to blend this water with water containing a higher concentration of contaminant to produce water containing a reduced average level. Blending is a common treatment technique for chemical contamination of wells.

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Section 7: Spill and Incident Response Planning

As previously stated, a spill or other contamination of the soil or shallow groundwater likely will not directly affect the deep aquifer. However, because of the potential for this contamination to migrate to the Columbia River, the City must be notified of any event that may cause contamination of shallow groundwater or the drainage system. Current first response containment procedures should be followed rather than washing or flooding the spill into the ground or drainage system. Likewise, the City should be notified of spills or discharges to the river that are not permitted or that exceed permit levels. Depending on the nature of the spill or discharge, it should be tracked as it is washed downstream. The City should maintain an awareness of new developments or discharges to the Columbia River and also monitor permit renewals and discharges to other nearby rivers.

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References

GSI Water Solutions, Inc. 2007. City of Longview -- *Proposed New Wellfield, Mint Farm Area, Longview Washington - A Second Opinion.* 14 December 2007. (Memorandum Report).

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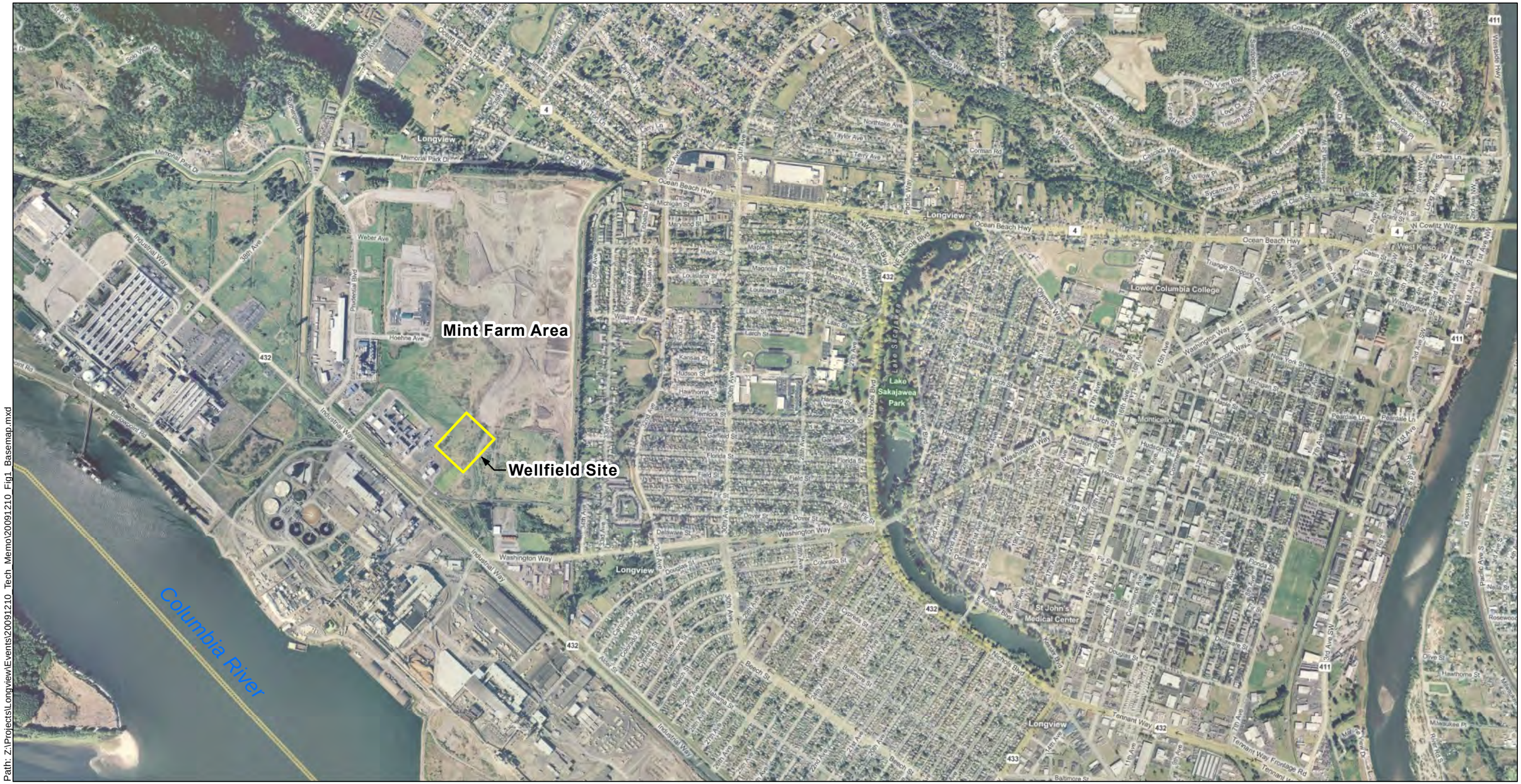
Figures



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Aerial Source: (c)2009 Microsoft Corporation

N

0 750 1,500

Scale: Feet

Kennedy/Jenks Consultants

Mint Farm RWTP Design
Longview, Washington

Basemap

KJ 0997003*00
December 2009

Figure 1.1

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Aerial Source: (c)2009 Microsoft Corporation

Legend

- Well Location
- Surface Water Sample Location
- Well Field Site

N

0 400 800

Scale: Feet

Kennedy/Jenks Consultants

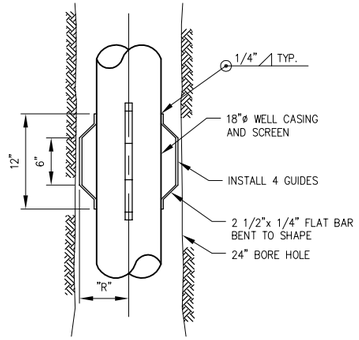
Mint Farm RWTP Design
Longview, Washington

Monitoring Well Sites

KJ 0997003*00
January 2010

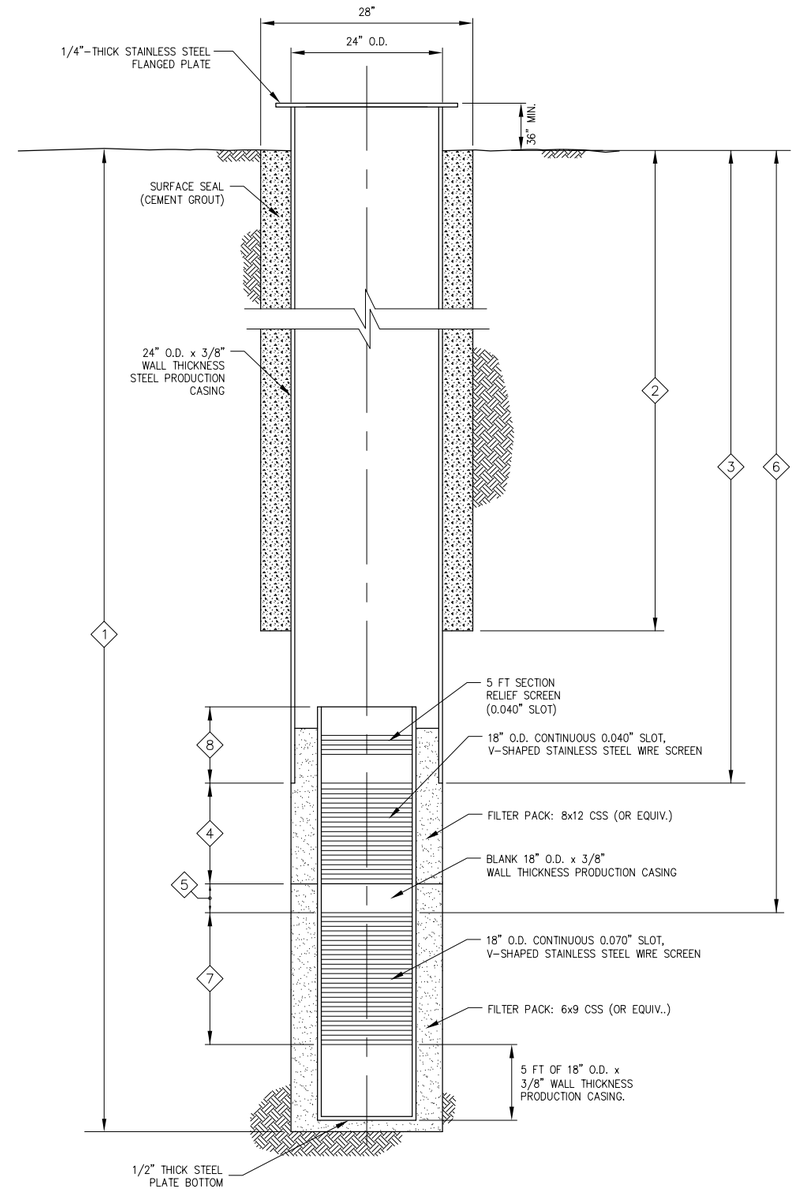
Figure 1.2

WELL LEGEND		
ITEM	DESCRIPTION	QUANTITY
1	TOTAL BOREHOLE DEPTH	385 FT BGS
2	DEPTH OF SURFACE SEAL	150 FT BGS
3	DEPTH TO TOP OF UPPER SCREEN / BOTTOM OF PRODUCTION CASING	230 FT BGS
4	UPPER SCREEN LENGTH (0.040"-SLOT)	55 FT
5	LENGTH OF 18" INTERMEDIATE BLANK CASING	14 FT
6	DEPTH TO TOP OF LOWER SCREEN SECTION	299 FT BGS
7	LOWER SCREEN LENGTH (0.070"-SLOT)	71 FT
8	LENGTH OF 18" RISER (ABOVE SCREEN)	35 FT



NOTES:
1. 4 GUIDES ARE EQUIDISTANT AROUND CIRCUMFERENCE.
2. SHOP FABRICATED CASING GUIDES ARE INSTALLED AT APPROXIMATELY 195', 230', 262', 299', 330', 348', AND 370'.
3. "R" = RADIUS OF BORE MINUS 1/2".

CASING GUIDE DETAIL
N.T.S.



PRODUCTION WELL SECTION
N.T.S.

USE OF DOCUMENTS

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NO.	REVISION	DATE	BY

DESIGNED: DRO
DRAWN: SLG
CHECKED: DL

CITY OF LONGVIEW
LONGVIEW, WASHINGTON
MINT FARM WELLFIELD

Kennedy/Jenks Consultants
200 SW MARKET STREET, SUITE 500, PORTLAND, OREGON 97201

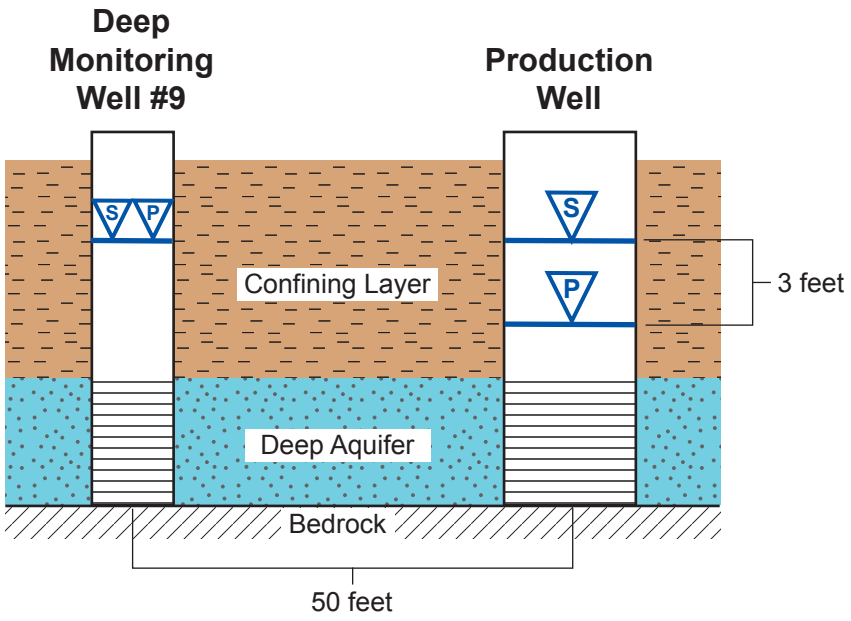
PRODUCTION WELL NO 1 SECTION AND DETAIL

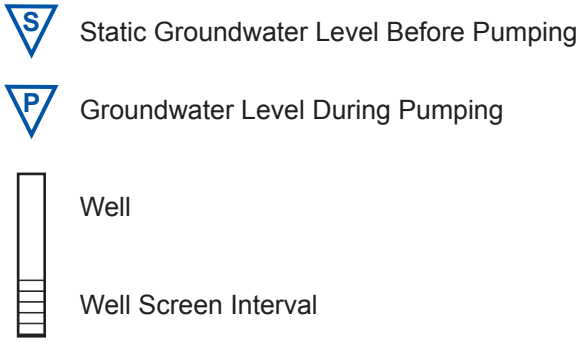
FILE NAME
JOB NO. 0997003.00
DATE 08/19/2009
SHEET OF
FIG 1.3

P:\cad\09\0997003_00_LONGVIEW\VOLUME_3\0997003-PDR_FIG3.dwg STEPHANIE GOTSCH 12/11/2009 10:36 AM

Mint Farm Confined Aquifer

Pumping the confined aquifer lowers the pressure in the aquifer;
but, the aquifer remains fully saturated and under pressure





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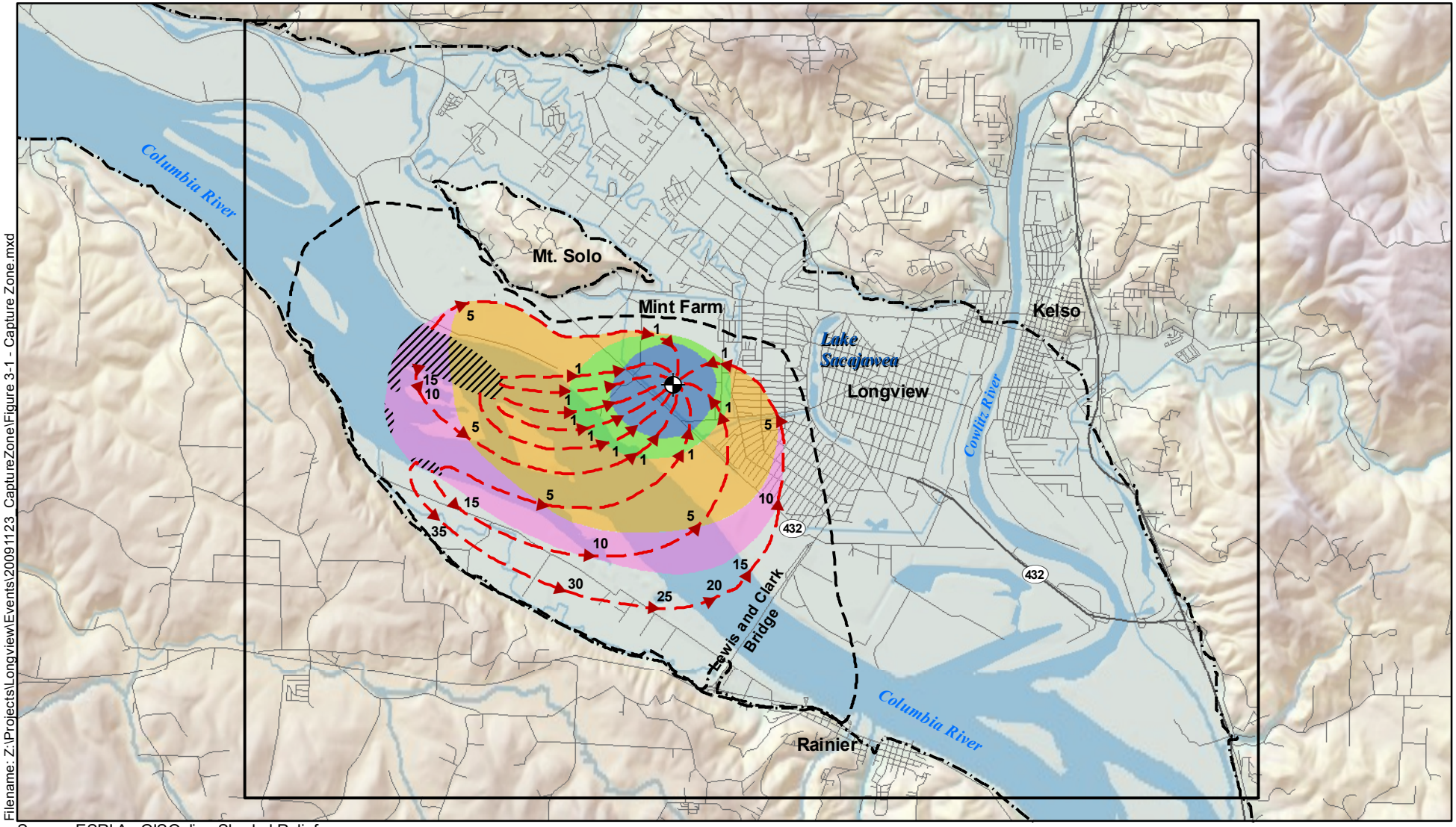
Mint Farm RWTP Design
Longview, Washington

Schematic Drawing of Relative Drawdown at Mint Farm Wellfield

December 2009

Figure 1.4



Filename: Z:\Projects\Longview\Events\20091123_CaptureZone\Figure 3-1 - Capture Zone.mxd

Source: ESRI ArcGISOnline Shaded Relief

Legend

- Wellfield
- Gravel Aquifer Flow Path
- 20 Flow Direction Arrow with Years of Travel to Mint Farm Wellfield
- Longview-Kelso Basin
- Extent of Study Area
- Gravel Aquifer Boundary
- Unconfined Aquifer Conditions
- 6-Month WHPP Source Area
- 1-Year WHPP Source Area
- 5-Year WHPP Source Area
- 10-Year WHPP Source Area

N

0 7,000

Scale: Feet

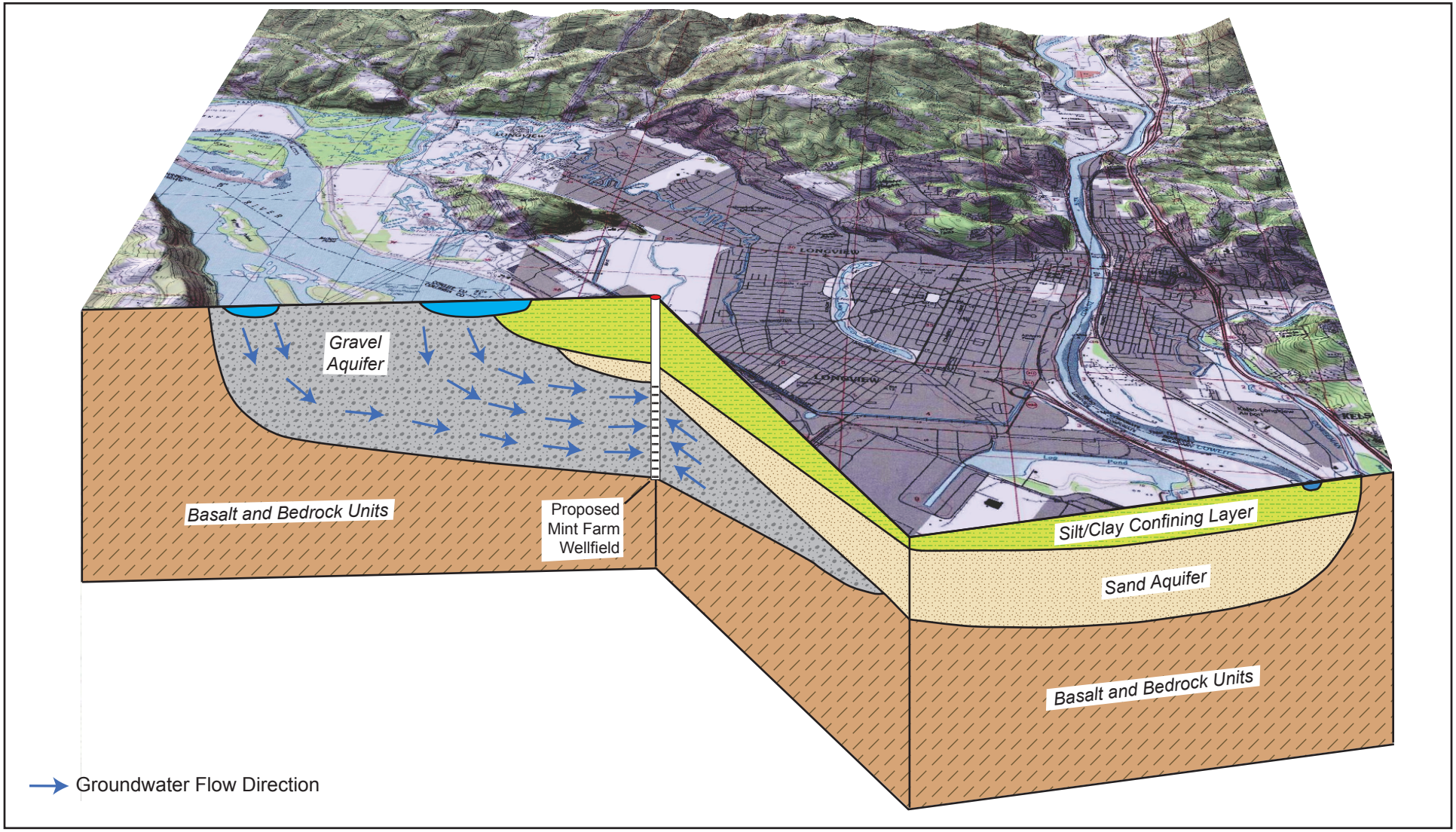
Kennedy/Jenks Consultants

Mint Farm RWTP Design
Longview, Washington

Delineation of Source Area for the Mint Farm Wellfield

December 2009

Figure 3-1



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Mint Farm RWTP Design
Longview, Washington

Groundwater Flow Paths to the Mint Farm Wellfield in the Longview-Kelso Basin

December 2009

Figure 3.2

Appendix X

PW-1 Washington State Water Well Report

WATER WELL REPORT

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

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☒ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) PW1

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☒ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 24 inches, drilled 385 ft. Depth of completed well 375 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 24" Diam. from +3 ft. to 230 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. From _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☒ Yes ☐ No ☐ K-Pac Location _____

Manufacturer's Name Johnson

Type Stainless Model No. Free Flow 600

Diam. 18PS Slot size 40 from 230 ft. to 285 ft.

Diam. 18PS Slot size 70 from 299.2 ft. to 370.8 ft.

Gravel/Filter packed: ☒ Yes ☐ No Size of gravel/sand 8-12 & 6-9

Materials placed from 195 ft. to 375 ft.

Surface Seal: ☒ Yes ☐ No To what depth? 150 ft.

Material used in seal cement

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level 12 ft.

Static level 5.25 ft. below top of well Date 11-09

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? BLC / KJ

Yield: 3850 gal./min. with 3.0 ft. drawdown after 864 hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
0.00	7.58	2.00	5.48	5.00	5.44
1.00	5.71	2.30	5.52	8.0	5.40
1.30	5.63	3.00	5.50	60.00	5.25

Date of test 11-09

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☒ Yes ☐ No

CURRENT

Notice of Intent No. WE10396

Unique Ecology Well ID Tag No. BAM420

Water Right Permit No. G2-30521

Property Owner Name Weyerhaeuser Real Estate Development Co.

Well Street Address 1155 Weber Avenue

City Longview County Cowlitz

Location SE1/4-1/4 NW1/4 Sec 31 Twn 08 R 02 EWM ☐ Or WWM ☒

(s, t, r Still REQUIRED)

Lat/Long Lat Deg _____ Lat Min/Sec _____
Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 101930300

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
brown silt	0	5
brown/gray silt and clay	5	20
gray silty sand, water	20	34
gray silt	34	65
brown/gray/tan silt peat wood	65	73
gray silt and fine sand	73	
peat wood white silt		138
gray silt wood	138	165
gray silt and fine sand	165	174
fine to med. sand	174	210
sand gravel cobbles boulders	210	286
sandy gravel	286	304
sand gravel cobbles	304	313
sand gravel cobbles boulders	313	336
sandy gravel	336	385+
24" drive shoe/casing remnant	378	385
pea gravel/bentonite chips	375	385
18" s/s blank casing	195	210
18" s/s relief screen .040"	210	215
18" s/s blank casing	215	230
18" s/s blank casing	285	299.2
18" s/s blank casing	370.8	375
8-12 colorado silica	195	285
6-9 colorado silica	285	375

Start Date 8-15-09 Completed Date 11-20-09

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Wade Iversen

Driller/Engineer/Trainee Signature Wade Iversen

Driller or trainee License No. 0597

IF TRAINEE: Driller's License No:

Driller's Signature:

Drilling Company Boart Longyear

Address P.O. Box 1890

City, State, Zip Milton, WA, 98354

Contractor's Registration No. BOARTLC941RA Date 11/20/09

Appendix Y

Ground Water Contamination Susceptibility Assessment Survey Form (PW-1)

Washington State Department of Health
Environmental Health Programs
Division of Drinking Water

Preliminary
Ground Water Contamination
Susceptibility Assessment Survey Form

Complete **one** form for **eac**h ground water source (well, wellfield, spring) used in your water system (photocopy as necessary).

PART I: System Information

Well owner/manager: **City of Longview**

Water system name: **Longview Water Department**

County: **Cowlitz**

Water system ID number: **48100** Source number: **Pending**

Well depth: **375** feet

Source name: **PW-1 (1 well of 4 planned wells in a wellfield)**

WA well identification tag number: BAM420

❑ Well not tagged

Number of connections: **17,869** Population served: **50,174**

Township: **8N** Range: **2W**

Section: **31** ¼ ¼ Section: **SE,NW**

Latitude/longitude (if available): _____/_____

How was latitude/longitude determined?

_____Global positioning device_____survey_____topographical map
_____other:_____

*Please refer the instructions for details and explanations of all questions in Parts II through V.

PART II: Well Construction and Source Information

1) Date well originally constructed: **_11__/20___/09___**month/day/year

last reconstruction: ___/___/___month/day/year

❑ Information unavailable

2) Well driller: **Boart Longyear**

❑ Well driller unknown

3) Type of well: ___ Drilled: ❑ rotary ❑ bored ☒cable (percussion) ❑ Dug

___ other: ❑ spring(s) ❑ lateral collector (Ranney)

❑ driven ❑ jetted ❑ other:_____

4) Well report available ☒Yes (attach copy to form) ❑ No

5) Average pumping rate: **_____3800 (planned)_____**(gallons/min)

Source of information **Preliminary Engineering Report**

If not documented, how was pumping rate determined? **Designed pump rate based on pump test results (Preliminary Engineering Report**

❑ Pumping rate unknown

6) Is this source treated?

If so, what type of treatment:

☒disinfection ☒filtration ❑ carbon filter ❑ air stripper ☒other

Purpose of treatment (describe materials to be removed or controlled by treatment):

Reduce iron and manganese adjust pH (corrosion control) and maintain disinfection residual in distribution system

7) If source is chlorinated, is a chlorine residual maintained: ☒Yes ❑ No

Residual level:_____ (At the point closest to the source.)

System has not yet been installed.

PART III: Hydrogeologic Information

1) Depth to top of open interval: [check one]

<20 ft ❑ 20-50ft ❑ 50-100ft ❑ 100-200ft ☒>200ft

❑ information unavailable

2) Depth to ground water (static water level):

☒<20ft ❑ 20-50ft ❑ 50-100ft ❑ >100ft

❑ flowing well/spring (artesian)

How was water level determined?

❑ well log ❑ X other **Water level probe**

❑ depth to ground water unknown

3) If source is a flowing well or spring, what is the confining pressure:

_____ psi (pounds per square inch) **or**

_____feet above wellhead

4) If source is a flowing well or spring, is there a surface impoundment, reservoir, or catchment associated with this source: ❑ Yes ❑ No

5) Wellhead elevation (height above mean sea level): **15.2**___ feet

How was elevation determined? ❑ topographic map ❑ Drilling/Well Log ❑ altimeter

☒other: Surveyed

❑ information unavailable

6) Confining layers: (This can be completed only for those sources with a drilling log, well log or geologic report describing subsurface conditions. Please refer to assistance package for example.)

X evidence of a confining layer in well log

_____ no evidence of a confining layer in well log

If there is evidence of a confining layer, is the depth to ground water more than 20 feet above the **bottom** of the **lowest confining layer**? ☒Yes ❑ No

❑ information unavailable

7) Sanitary setback:

❑ < 100ft* ☒100-120ft ❑ 120-200 ft ❑ >200ft

* If less than 100ft, describe the site conditions:

_____

_____

_____

8) Wellhead construction:

☒wellhead enclosed in a wellhouse **(Small wellhouse planned)**

☒controlled access (describe): **Entire wellfield site will be fenced**

_____

❑ other uses for wellhouse (describe): _____

_____

❑ no wellhead control

9) Surface seal: **150 feet**

❑ 18 ft

❑ <18 ft (no Department of Ecology approval)

❑ <18 ft (Approved by Ecology, include documentation)

❑ depth of seal unknown

❑ no surface seal

10) Annual rainfall (inches per year):

❑ <10 in/yr ❑ 10-25 in/yr ☒>25 in/yr

PART IV: Mapping Your Ground Water Resource

1) Annual volume of water pumped: **758 million gallons**

PW-1 will be one of four wells in the wellfield that will supply the City of Longview and Beacon Hill Sewer District (formally Cowlitz Co. PUD). The average daily demand in 2029 is estimated to be 8.33 MGD (3,033,000,000 million gallons per year). Assuming this well will produce 25% of the annual flow, it would pump 758 million gallons per year.

How was this determined?

❑ meter

❑ estimated: ❑ pumping rate (_____)

❑ pump capacity (_____)

❑ other:_____

2) "Calculated Fixed Radius" estimate of ground water movement:
(see Instruction Packet)

Not applicable – see attached figure for hydogeologic map. Data included in Section One of Preliminary Design Report

6-month ground water travel time: _____feet

1-year ground water travel time: _____feet

5-year ground water travel time: _____feet

10-year ground water travel time: _____feet

Information available on length of screened/open interval?

❑ Yes ❑ No

Length of screened/open interval: _____feet

3) Is there a river, lake, pond, stream, or other obvious surface water body within the 6- month time of travel boundary?

❑ Yes ☒No (mark and identify on map)

4) Is there a stormwater and/or wastewater facility, treatment lagoon, or holding pond located within the 6-month time of travel boundary?

☒Yes ❑No (mark and identify on map)

Comments: **Drainage canal network is located above the confining layer within the 6 month time of travel boundary**

PART V: Assessment of Water Quality

1) **Regional sources of risk to ground water**:

Please indicate if any of the following are present within a circular area around your water source having a radius up to and including the five-year ground water travel time. If you do not know if one of the following is present, mark the "unknown" space.

	6-month	1-year	5-year	unknown
• likely pesticide application	**X (more than 20 years ago)**			_____
• stormwater injection wells	_____	_____	_____	_____
• other injection wells	_____	_____	_____	_____
• abandoned ground water well	_____	_____	_____	_____
• landfills, dumps, disposal areas	**X (above the confining layer)**			_____
• known hazardous materials clean-up site	**X (above the confining layer)**			
• water system(s) with known quality problems	_____	_____	_____	_____
• population density >1 house/acre	_____	_____	_____	_____
• residences commonly have septic tanks	_____	_____	_____	_____
• Wastewater treatment lagoons	_____	_____	_____	_____
• sites used for land application of waste	_____	_____	_____	_____

Mark and identify on map any of the risks listed above which are located within the 6-month time of travel boundary. (Please include a map of the wellhead and time of travel areas with this form. Please locate and mark any of the following.)

If other recorded or potential sources of ground water contamination exist within the ten-year time of travel circular zone around your water supply, please describe:

No recorded or potential sources of ground water contamination exist in the gravel aquifer.

There have been ground water contamination detections in the shallow aquifer above the confining layer at Weyerhaeuser (mercury), Chinook Ventures (fluoride and cyanide), and Flexible Foam Products (formerly Prudential Steel)(VOCs). Remedial action is underway at Weyerhaeuser, and the Chinook Ventures site is undergoing remedial investigation/feasibility study. The Department of Ecology has issued a letter of No Further Action for the Flexible Foam Products site.

2) **Source-specific water quality records**: For each type of test below, **mark the row that applies to the sample results for this source**. Consider all the sample results from the past 12 years. (MCLs are noted next to the specific test or listed in assistance package.)

A. **Nitrate:** (Nitrate MCL = 10 mg/l)

Results greater than MCL	_____
<2 mg/liter nitrate	**X**_____
2-5 mg/liter nitrate	_____
<5 mg/liter nitrate	_____
Nitrate sampling records unavailable	_____

B. **VOCs:** (VOC detection level is 0.5 ug/l or 0.0005 mg/l)

Results greater than MCL or SAL	_____
VOCs detected at least once	_____
VOCs never detected	**X**_____
VOC sampling records unavailable	_____

C. **EDB/DBCP:**
(EDB MCL = 0.05 ug/l or 0.00005 mg/l. DBCP MCL = 0.2 ug/l or 0.0002 mg/l.)

EDB/DBCP detected below MCL at least once	_____
EDB/DBCP detected above MCL at least once	_____
EDB/DBCP never detected	**X**_____
EDB/DBCP tests required but not yet completed	_____
EDB/DBCP tests not required	_____

D. **Other SOCs (Pesticides):**

Other SOCs detected (pesticides and other synthetic organic chemicals)	_____
Other SOC tests performed but none detected (list test methods in comments)	**X**_____
Other SOC tests not performed	_____

If any SOCs in addition to EDB/DBCP were detected, please identify and date. If other SOC tests were performed, but no SOCs detected, list test methods here:

Samples were taken from PW-1 before and after the 36 day pump test, and analyzed for the complete drinking water package with no detections of VOCs or SOCs.

E. **Bacterial contamination:**

Any bacterial detection(s) in the past 3 years in samples taken from the source (not distribution sampling records)? **na**.

Has source (in past 3 years) had a bacteriological contamination problem found in distribution samples that was attributed to the source? **na**

Source sampling records for bacteria unavailable _____

Coliform bacteria was not present in the sample collected at the conclusion of the pump test.

PART VI: Geographic or Hydrologic Factors Contributing to a Non-Circular Zone of Contribution

The following questions will help identify those ground water systems which may not be accurately represented by the calculated fixed radius (CFR) method described in Part IV. For these sources, the CFR areas should be used as a preliminary delineation of the critical time of travel zones for that source. As a system develops its Wellhead Protection Plan for these sources, a more detailed delineation method should be considered.

1) Is there evidence of obvious hydrologic boundaries within the 10-year time of travel zone of the CFR? (Does the largest circle extend over a stream, river, lake, up a steep hillside, and/or over a mountain or ridge?)

☒ Yes ❑ No

Describe with references to map produced in Part IV:

Please refer to Section One of the Preliminary Design Report

2) Aquifer Material**: Gravel**

A) Does the drilling log, well log or other geologic/engineering reports identify that the well is located in an area where the underground conditions are identified as fractured rock and/or basalt terrain?

❑ Yes ☒ No

B) Does the drilling log, well log or other geologic/engineering reports indicate that the well is located in an area where the underground conditions are primarily identified as coarse sand and gravel?

☒ Yes ❑ No

3) Is the source located in an aquifer with a high horizontal flow rate? (These can include sources located on flood plains of large rivers, artesian wells with high water pressure, and/or shallow flowing wells and springs.)

☒ Yes ❑ No

4) Are there other high capacity wells (agricultural, municipal and/or industrial) located within the CFRs?

a) Presence of ground water extraction wells removing more than approximately 500 gal/min within…

	YES	NO	unknown
<6-month travel time	**X (city plans 3 additional wells in wellfield)**		
6 month—1 year travel time	**X**		
1—5 year travel time	**X**		
5—10 year travel time			

b) Presence of ground water recharge wells (dry wells) or heavy irrigation within…

	YES	NO	unknown
<1-year travel time		**X**	
1—5 year travel time		**X**	
5—10 year travel time		**X**	

Please identify or describe additional hydrologic or geographic conditions that you believe may affect the shape of the zone of contribution for this source. Where possible, reference them to locations on the map produced in Part IV.

Groundwater modeling was conducted to evaluate the sustainability of long-term pumping from the deep gravel aquifer for the Mint Farm Wellfield. Drawdown at the wellfield in the simulation scenario was approximately 6 feet, which is small compared to the approximately 150-foot gravel aquifer thickness. The source of water to the wellfield was found to be over 99 percent from the Columbia River, transmitted through the gravel aquifer. Source water enters the aquifer at locations where the Columbia River channel intersects the gravel unit west of the Mint Farm site.

FORM COMPLETED BY:

_____ _____

Print Name Date

_____

Signature

Attach: **Capture Zone Base Map (figure 5 from PDR2)**
Well log
Section 1 of Preliminary Design Report 2