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MARION COUNTY
Wastewater Facilities Planning Study

Mill City/Gates WWFPS

PREPARED BY

KELLER ASSOCIATES

KELLER ASSOCIATES, INC.
245 Commercial St. SE Suite 210
Salem, OR 97301
(503) 364-2002

PREPARED FOR

Marion County
OREGON

Marion County – Public Works Dept.
5155 Silverton Road, NE Bldg. 1
Salem, OR 97305
(503) 930-8502

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ACRONYMS, ABBREVIATIONS, AND SELECTED DEFINITIONS

AACE	Advancement of Cost Engineering
AADF	average annual daily flow
AAGR	average annual growth rate
ADL	average daily load
ADWF	average dry weather flow
AWWF	average wet weather flow
bgs	below ground surface
BLM	Bureau of Land Management
BMP	Biosolids Management Plan
BOD_5	5-day biochemical oxygen demand
CCTV	closed circuit television
CFR	Code of Federal Regulations
CWA	Clean Water Act
D	Disinfection
DO	dissolved oxygen
d/D	existing depth of full depth
DI	ductile iron
DEQ	Oregon Department of Environmental Quality
DMR	Discharge Monitoring Report
DSL	Division of State Lands
EDU	equivalent dwelling unit
EPA	Environmental Protection Agency
EQC	Environmental Quality Commission
F	Filtration
ft	feet/foot
FEMA	Federal Emergency Management Agency
gpm	gallons per minute
G&O	grease and oil
GM	geometric mean
GMP	guaranteed maximum price
GPD	gallons per day
HDPE	high density polyethylene
hp	horsepower
hr	hour
I/I	infiltration and inflow
LS	lift station
LWI	Local Wetlands Inventory
mg/L	million gallon per liter
ml	milliliter
MBRs	membrane bioreactors
MGD	million gallons per day
MMDWF	maximum monthly dry weather flow
MML	maximum month load
MMWWF	maximum monthly wet weather flow
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NSC	North Santiam Canyon
NSSA	North Santiam Sewer Authority
NTU	Nephelometric turbidity units
O	Oxidized
O&G	oil and grease
OAR	Oregon Administrative Rules
ODOT	Oregon Department of Transportation
OH&P	overhead and profit
O&M	operation and maintenance
ORVs	Outstandingly Remarkable Values
PDAF5	peak daily average flow (5 years)
PERs	preliminary engineering reports
PIF	peak instantaneous flow
PLC	programmable logic controller
ppd	pounds per day
POC	pollutant of concern
PSU	Portland State University
PVC	polyvinyl chloride
PWDS	Public Works Design Standards
PWkF	peak week flow
RAS	return activated sludge
RCP	reinforced concrete pipe
RDII	rainfall-derived infiltration and inflow
RIBs	rapid infiltration basins
RGF	recirculating gravel bed filter
RO	reverse osmosis
RPA	reasonable potential analysis
ROW	right of way
SBR	sequencing batch reactors
SCADA	supervisory control and data acquisition
SCFM	standard cubic feet per minute
SDC	System Development Charge
SHPO	State Historic Preservation Office
SLR	solids loading rate
SOCs	synthetic organic compounds
SP	sample point
STEG	septic tank effluent gravity
STEP	septic tank effluent pumped
TIN	total inorganic nitrogen
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load

TN	total nitrogen
TRC	Technical Review Committee
TSS	total suspended solids
UGB	urban growth boundary
US	United States
UV	ultraviolet
VOCs	volatile organic compounds
VFD	variable frequency drive
WAS	waste activated sludge
WLOTC	warning letter with opportunity to correct
WPCF	water pollution control facility
WWADL	wet weather average daily load
WWF	wet weather flow
WWMDL	wet weather maximum daily load
WWMMDL	wet weather maximum month daily load
WWTP	wastewater treatment plant

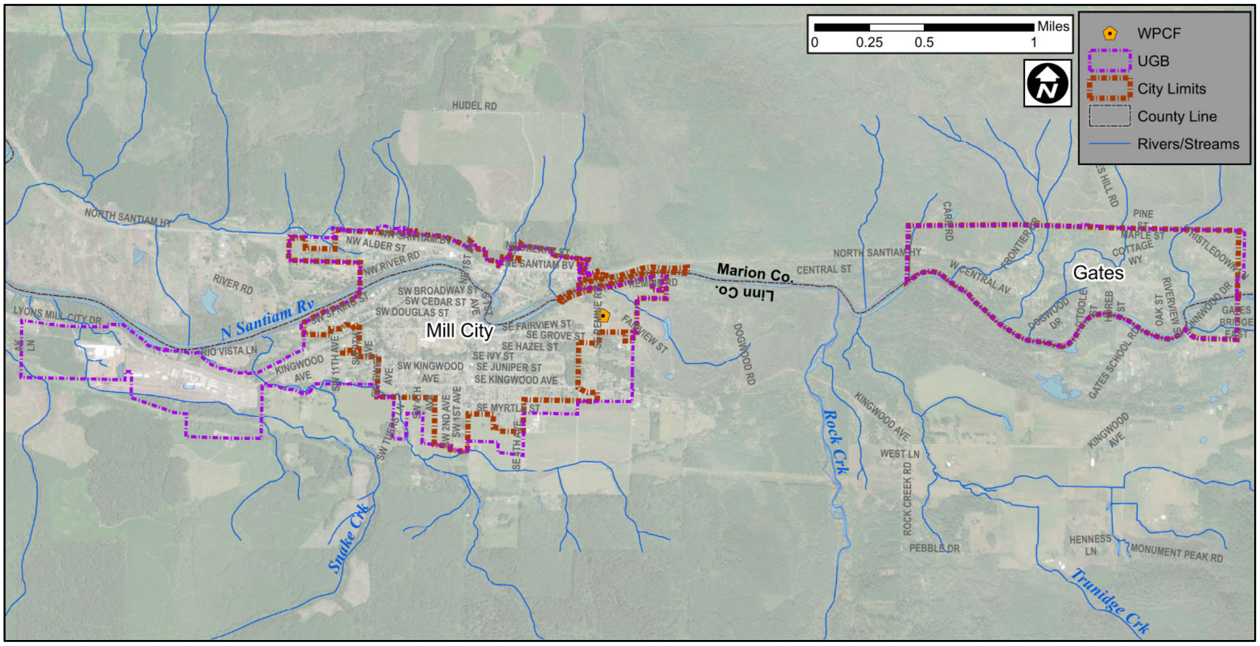
CHAPTER 1 - PROJECT PLANNING

This chapter provides an overview of the study area which includes the Cities of Mill City and Gates, associated environmental resources present, population projections, and regulatory requirements unique to the North Santiam Canyon.

1.1. LOCATION

The study area includes the cities of Mill City and Gates in the North Santiam Canyon located in Linn and Marion Counties, Oregon. Mill City is approximately 33 miles east of the City of Salem along State Highway 22, and Gates is approximately 3 miles east of Mill City. The North Santiam River is the boundary between Marion and Linn County, and approximately 70% of the study population resides in Linn County and 30% in Marion County. Figure 1-1 shows the study area with current city limits for Mill City and Gates. A full-size figure of the study area is shown in Figure 1-1 in Appendix A.

FIGURE 1-1: STUDY AREA



1.2. ENVIRONMENTAL RESOURCES PRESENT

An inventory of existing environmental resources was compiled to consider the environmental impacts of this master plan. The factors analyzed in this section include land use/prime farmland, floodplains, wetlands, cultural resources, coastal resources, and socio-economic conditions.

1.2.1. Land Use

A summary of land use in Mill City and Gates is shown in Table 1-1 below. Most of the property within the NSC communities is zoned for residential uses. Approximately 10% of land use in both Mill City and Gates is commercial zoning, mainly along North Santiam Highway 22. Mill City also has a significant amount of land designated for industrial zoning, about 27%, and 10% or less each of Public, Planned Development, Urban Transitional, Farm/Agricultural, and Forest Conservation zoning. Gates has approximately 6% of land use designated as Industrial and 1% set aside as Urban Transitional. The land use is illustrated in Figure 2 in Appendix A.

TABLE 1-1: SUMMARY OF NSC LAND USE

	Mill City		Gates	
Zone Designation	**Acres**	**% of Total**	**Acres**	**% of Total**
Commercial	78.1	10.1%	30.7	9.0%
Industrial	207.6	26.8%	21.5	6.3%
Residential	375.2	48.4%	287.3	83.8%
Public	73.7	9.5%	-	-
Planned Development	14.7	1.9%	-	-
Urban Transitional	7	0.9%	3.4	1.0%
Farm/Agricultural	11.9	1.5%	-	-
Forest Conservation and Management	6.9	0.9%	-	-
Total Acreage	775.1	-	342.9	-

1.2.2. Floodplains

The Federal Emergency Management Agency (FEMA) publishes flood insurance studies that classify land into different flood zone designations. As shown in Figure 3 (Appendix A), some portions of the study area are located inside the 100-year and 500-year floodplains of the North Santiam River and some of its tributary creeks. The topography is also shown in Figure 3 in Appendix A.

1.2.3. Wetlands

The Oregon Department of State Lands (DSL) keeps an inventory of the local wetlands created for areas in Oregon. Mill City had a local wetland inventory (LWI) approved on 12/16/2011. U.S. Fish and Wildlife National Wetlands Inventory was used to determine the wetland areas that could potentially be impacted. The map of delineated wetlands from the LWI and National Wetlands Inventory is shown in Figure 4 (Appendix A).

1.2.4. Cultural Resources

The State Historic Preservation Office (SHPO) maps above-ground cultural resources on their website. Maps developed from the SHPO website for Mill City and Gates are shown in Figure 5 (Appendix A). SHPO also keeps track of underground cultural resources. They only provide information from their database to professional archaeologists, with one exception; They will provide information for small project areas if provided the complete legal description of the project location, a United States Geological Survey (USGS) map of the project area, and a description of the project and ground disturbance. SHPO should be consulted as part of the environmental / design process of any proposed recommendation.

1.2.5. Biological Resources

The Bureau of Land Management (BLM) lists the endangered, threatened, and sensitive species for districts in the state. The communities in the NSC lie within the BLM's Northwest Region.

Species listed as federally threatened or federally endangered in this region include Marbled Murrelet, Streaked Horned Lark, Northern Spotted Owl, Coho Salmon, Steelhead, Chinook Salmon, Pacific Eulachon, Bull Trout, Golden Paintbrush, Willamette Daisy, Water Howellia, Bradshaw's Desert Parsley, Kincaid's Lupine, Nelson's Checkermallow, Taylor's Checkerspot, Fender's Blue Butterfly, and the Oregon Silverspot Butterfly.

1.2.6. Water Resources

The communities within the NSC have an abundance of surface and groundwater resources. The largest surface water resource is the North Santiam River itself, stretching 92 miles from its origin high in the Cascade Mountains to where it joins the South Santiam River just south of Jefferson. The North Santiam River basin drains approximately 766 square miles of land; and serves as a drinking water source, wildlife habitat, and recreation area. The North Santiam River provides the source water for more than 225,000 people per day, with most of those users located downstream of the canyon communities and outside of the North Santiam River watershed. The North Santiam River basin is subject to the Three Basin Rule (OAR 340-041-0350), which currently prohibits new surface wastewater discharge permits. The National Parks Service classifies the North Santiam River as a scenic river and has Outstandingly Remarkable Values (ORVs) for scenery, recreation, and fish.

The City of Gates uses the North Santiam River as their primary drinking water source. Mill City historically used the North Santiam River as its sole drinking water source until it switched to two groundwater wells within the city limits in 2005. Both wells are subject to a wellhead protection area that will need to be considered in all future developments.

The North Santiam River subbasin is part of the Willamette Basin Total Maximum Daily Load (TMDL) that was approved by the EPA on September 29, 2006, and administered by the Oregon Department of Environmental Quality (DEQ). None of the NSC communities are currently required to manage for the TMDL. Chapters 4 and 8 of the TMDL pertain to the North Santiam subbasin and describe the methodology of developing the temperature TMDL for the rivers within the subbasin. The temperature criteria for the North Santiam River are shown in Table 1-2 below:

TABLE 1-2: WILLAMETTE BASIN TMDL TEMPERATURE CRITERIA

River Mile	Season	Criteria
0 to 10	September 1 - June 30	Spawning: 12.8 °C
10 to 26.5	September 15 - June 30	Spawning: 12.8 °C
0 to 10	Summer	Rearing: 17.8 °C

All river miles in the table are downstream of the City of Stayton.

1.2.7. Coastal Resources

There are no coastal areas within the study area.

1.2.8. Socio-Economic Conditions

According to the U.S. Census Bureau, the population in Marion County is primarily (67.4%) Caucasian and Hispanic or Latino is the second most common, making up 27.7% of the population. Based on the 2019 ACS 5-year Estimates Data, the Marion County median household income was 59,625 in 2019. The Mill City median household income was $53,243 in 2019 and 60,434 in 2021. The population in Linn County is primarily (83.7%) Caucasian with Hispanic or Latino being the second most common, making up 9.8% of the population. The Linn County median household income was $55,893 in 2019. It is anticipated that income in the communities in the NSC falls well below the county-wide median household income.

1.2.9. Miscellaneous Issues

Other environmental resources considered were air quality and soils. The study area is not located in an area designated as an air maintenance or nonattainment area by DEQ. Soils maps are provided in Figure 6 (Appendix A); soils in Gates and Mill City are typically loamy but can vary widely.

1.3. POPULATION TRENDS

Population is generally a considerable constraint on economic growth. In the case of the NSC communities, the population is growing slowly or, depending on the community, declining. In the City of Gates, new residential developments are limited by the minimum lot sizes needed to facilitate the construction of privately owned, on-site septic systems and drain fields. Mill City's zoning code permits residential development on smaller residential lots; minimum lot sizes are 5,000 SF and 7,500 SF. These lots without private septic systems are connected to the city's Water Pollution Control Facility (WPCF). The treatment plant is at capacity, which precludes addition of future connections to the existing WPCF. The aforementioned population growth, minimum lot size, and WPCF capacity hinders the development of new residential, commercial or industrial facilities in the NSC. Table 1-3 shows the combined population growth in Mill City and Gates over the past 40 years as recorded by Portland State University (PSU). Historically, the cities of Mill City and Gates have seen an overall average growth rate of 0.41% since 1980. Over the past 20 years the average growth rate has been 0.85%.

TABLE 1-3: PSU HISTORIC POPULATION DATA (GATES AND MILL CITY COMBINED)

Year	Population	Growth Rate
1980	2,020	-
1990	2,054	0.17%
2000	2,010	-0.22%
2010	2,326	1.47%
2020	2,381	0.23%

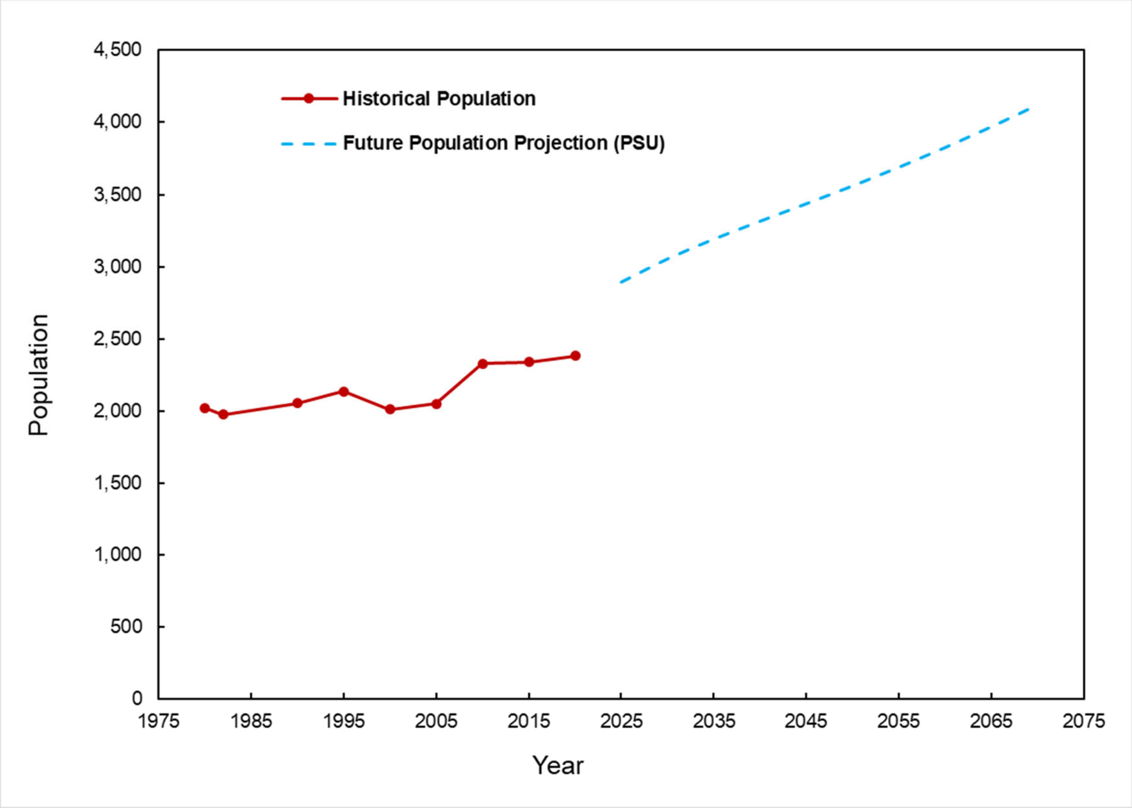
Mill City is experiencing challenges with allowing new construction because the existing WPCF is nearing capacity. Residents in the City of Gates maintain private, individual septic systems with the exception of trailer parks, motels and apartment/multifamily housing that are typically served by shared septic systems. The capacity to develop additional housing in Mill City and Gates is desired to allow new residents to move in, promote economic growth, and recover from recent wildfires. The populations of Mill City and Gates were projected through 2070 using the most recent population forecasts published by PSU's population research center. Table 1-4 and Figure 1-2 below provide the population projections.

It is typical for a planning study to establish the 20-year planning period for treatment systems which will be established as the 2045 population. The collection system, however, should consider a longer planning period due to the longer useful life of collection system pipelines and because of the difficulty with increasing the capacity of a collection system mainline once installed. For this reason, the 50-year population projection was used as the planning period for the collection system and corresponds to the 2070 projected population.

TABLE 1-4: PROJECTED POPULATION (GATES AND MILL CITY COMBINED)

Year	PSU Projection
2025	2,896
2030	3,056
2035	3,193
2040	3,318
2045	3,439
2070	4,124

FIGURE 1-2: PROJECTED POPULATION (GATES AND MILL CITY COMBINED)



1.4. COMMUNITY ENGAGEMENT

Internal communication efforts include Technical Review Committee (TRC) meetings and North Santiam Sewer Authority (NSSA) Board meetings. External communication efforts include meeting with Oregon Department of Environmental Quality (DEQ) representatives as well as public townhall meetings.

1.5. REGULATORY REQUIREMENTS

Keller Associates had several conversations with DEQ regarding the Three Basin Rule. A new surface water discharge (NPDES permit) would not be allowed without a significant waiver from the Environmental Quality Commission (EQC). There is currently no process or mechanism for DEQ staff or the EQC to provide a waiver. An action of this type would need to involve the state legislature. The first step would be for the Sewer Authority to request the EQC to add this item to their agenda for consideration.

The DEQ may issue a WPCF permit for a new domestic sewage treatment facility in accordance with the Three Basin Rule, contingent on the following terms: **1) THERE IS NO WASTE** (waste meaning any discharge that requires an NPDES permit, WPCF permit, or 401 Certification) **DISCHARGE TO SURFACE WATER**; 2) all groundwater protection requirements of OAR 340-040-0030 are met; and 3) the Environmental Quality Commission (EQC) finds that the new domestic sewage treatment facility provides a preferable means of disposal compared to the current means of disposal. A preferable means must meet one of the following three criteria:

- There are a significant number of failing individual collection systems that would be replaced by the new domestic treatment facility that cannot be repaired adequately or cost effectively,

- The impact of all individual treatment systems to groundwater is greater than the anticipated impact of the new sewage treatment facility, or
- If an individual, or several, on-site collection system(s) would not normally be utilized (e.g., the system is frequently hydraulically overloaded due to flows exceeding the design flow of the system), a new sewage treatment facility may be allowed if the social and economic benefits outweigh the possible environmental impacts.

Applications for domestic wastewater WPCF permits must also not include wastes that would incapacitate the treatment system; be operated or supervised by a certified wastewater treatment plant operator per OAR 340-049-0005 (however, may be exempt per OAR 340-049-0075); and provide annual written certification of proper treatment and disposal system operation from a qualified Registered Sanitarian, Professional Engineer, or certified wastewater treatment system operator.

Once the DEQ has reviewed a domestic wastewater WPCF permit application, drafted a permit, and allowed the required time for public comment, the draft permit is placed before the EQC. The EQC serves as the DEQ's policy and rulemaking board and reviews all WPCF permits related to the Three Basin Rule. It is a five-member committee appointed by the governor, composed of citizens with backgrounds in politics, education, engineering, finance, etc. that serve four-year terms. The EQC will review the draft WPCF permit and may have additional comments or questions that need to be addressed. The EQC must approve the final WPCF permit.

1.6. NORTH SANTIAM RIVER WATER QUALITY

This section discusses some of the potential parameters that could be regulated based on the water quality in the North Santiam River if discharge were allowed. The Clean Water Act (CWA) and Oregon antidegradation policies (OAR 340-04-0004)) would be the main rules for compliance. The beneficial uses of the North Santiam River are: public domestic water supply, private domestic water supply, industrial water supply, livestock watering, anadromous fish passage, salmonid fish spawning, resident fish and aquatic life, fishing and hunting, salmonid fish rearing, water contact recreation, irrigation, wildlife, boating, aesthetic quality, and hydropower. Fecal coliform bacteria and turbidity have been concerns with the river's water quality in the past, but those issues are not likely to drive additional regulations for treatment for the North Santiam.

Dissolved Oxygen

The North Santiam River subbasin has stream segments that are listed under the CWA 303(d) list for dissolved oxygen. Currently, there is not a TMDL for the subbasin. There is potential for a TMDL to be developed in the future, but the timeline and if a TMDL would impact discharge limits are unknown at this time.

The discharge would have a 5-day biochemical oxygen demand (BOD_5) limit. Usually this is technology-based effluent limits based on the Basin Standards of OAR 340-041, but further evaluation of the water quality may lead to more stringent limits.

Temperature

The temperature requirements are set by the TMDL on the North Santiam River. The requirements are derived from a waste load allocation (WLA).

pH

There are pH requirements for the North Santiam River, which require the pH to be between 6.5 and 8.5 at the edge of the mixing zone of any surface water discharge to the river. pH requirements would likely be similar for effluent discharged to groundwater from the future WPCF.

Ammonia

In August 2015, EPA approved revisions to Oregon's ammonia water quality standards for the protection of aquatic life. This standard indicates that mussels and snails are the most sensitive species to ammonia. DEQ did not adopt criteria for ammonia, based on the absence of snails/mussels, but current information indicates that they are (or historically were) present throughout most of Oregon. DEQ did not preclude the development of site-specific criteria. A reasonable potential analysis (RPA) could be performed to indicate if a limit would be likely. In other words, could the discharge cause or contribute to harming the water quality of the receiving body of water.

Nutrients and Algae

Nitrogen and phosphorus are the typical concerns for nutrient impaired receiving water bodies. The North Santiam River subbasin is not currently water quality limited for nutrients. However, Detroit Lake has experienced blue-green algae (cyanobacteria) blooms. The algae can produce toxins that are unsafe for domestic consumption.

Other Toxic Pollutants

Any discharges must be evaluated for toxic pollutants of concern (POCs) that might cause an exceedance of the water quality standard in the receiving water body. The current water quality criteria for aquatic toxicity are listed in OAR 340-41 pollutant Tables 20, 33A and 33B, and for human health water quality criteria in OAR 340-41 pollutant Table 40. Mercury is a contaminate of concern throughout the Willamette Basin, of which the North Santiam River is a subbasin.

1.7. EFFLUENT REUSE REGULATIONS

Land application or subsurface disposal is governed by recycled water regulations, as outlined in OAR 340-055. OAR 340-055 defines five categories of effluent, identifies allowable uses for each category, and provides requirements for treatment, monitoring, public access, and setback distances. Fewer restrictions are imposed for higher-quality effluent, as shown in Table 1-5. For recycled water use, groundwater must be protected in accordance with the requirements of OAR 340-040.

TABLE 1-5: REUSE REQUIREMENTS BY EFFLUENT CATEGORY

	Class A	Class B	Class C	Class D	Non-disinfected
Treatment[1]	O,D,F	O,D	O,D	O,D	O
Total coliform, 7-day median #/100 mL	2.2 [2]	2.2 [2]	23 [3]	- [4]	Per permit
Turbidity, NTU	2	-	-	-	
Public access [5]		Limited	Limited	Controlled	Prevented
Setback to property line [6]		10 feet	70 feet	100 feet	Per permit
Setback to water supply source		50 feet	100 feet	100 feet	150 feet

[1] O = oxidized, D = disinfection, F = filtration, RWUP = Recycle Water Use Permit
[2] Must not exceed 23 total coliform organisms per 100 milliliters (ml) in any single sample
[3] Must not exceed 240 total coliform organisms per 100 ml in any two consecutive samples
[4] Rather than total coliform, Class D Recycled Water is required to sample for E. coli. E. coli is a subgroup of the total coliform organisms, so a total coliform analysis includes the E. coli organisms. For Class D Recycled Water, the 30-day log mean must not exceed 126 E. coli organisms per 100 ml; and must not exceed 406 E. coli organisms per 100 ml in a single sample
[5] Limited public access: no direct contact during irrigation cycle
[6] Sprinkler irrigation assumed

1.8. EXPECTED DISCHARGE PERMIT REQUIREMENTS

The expected effluent discharge requirements are based on several criteria, namely the need to protect surface and groundwater in the NSC, as well as design requirements of disposal technologies such as groundwater recharge through rapid infiltration. Generally, constituents of greatest concern in wastewater are BOD_5, TSS, ammonia, nitrate, and total coliform levels. Treatment of these constituents are taken into account both to protect NSC groundwater quality as well as ensure proper functioning of the effluent disposal system through rapid infiltration.

BOD_5 and TSS levels are of greatest concern for long term functioning of groundwater recharge through effluent disposal systems such as rapid infiltration, as higher concentrations can lead to more plugging of the soil, thus reducing their effective capacity. For proper functioning of infiltration basins, treated effluent sent for disposal should not exceed a monthly average of 30 mg/L for both BOD_5 or TSS, as well as 200 col/100 ml of fecal coliform.[1]

Ammonia and nitrate (summed to give total inorganic nitrogen, TIN) levels are of greatest concern for groundwater quality, and the permitted effluent is expected to be in-line with groundwater requirements and the Three Basin Rule. Specifically, this would mean that discharged effluent does not degrade groundwater quality, and that constituents of concern in wastewater effluent would not significantly contribute to levels above background concentration by the time they exit the property boundary in the groundwater table. Ammonia and nitrate would be treated to low levels to ensure these requirements are met.

While there are no requirements for the level of nitrate in discharged effluent from the current WPCF in Mill City, it is assumed that there will be strict requirements on nitrate discharged from the future WPCF per groundwater protection rules and to ensure protections associated with the Three Basin Rule. Keller has developed the preliminary expected discharge requirements listed in Table 1-6 based on groundwater quality requirements of the Three Basin Rule, OAR 340-040-0030, as well as the limits of technology with regards to nitrogen removal in wastewater treatment. It would not be possible to reliably remove ammonia to lower than 1 mg/L as N based on average monthly samples due to the reliable limits of technology. Nitrate can be reliably removed to 5 mg/L with the secondary treatment processes proposed in Chapter 4. Where permit limits require lower nitrate levels, tertiary treatment would be required. This additional process could reliably treat wastewater to an average nitrate limit of 1 mg/L through utilization of denitrifying sand filters.

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[1] Müşerref Türkmen, Edward F. Walther, A. Scott Andres, Anastasia A.E. Chirnside, William F. Ritter. 2008. *Evaluation of Rapid Infiltration Basin Systems For Wastewater Disposal: Phase I.* Newark: Delware Geological Survey, University of Delware.

TABLE 1-6: EXPECTED DISCHARGE REQUIREMENTS

Parameter	Limit	Sample Type
BOD_5 (mg/L)	20	Average Monthly
TSS (mg/L)	20	Average Monthly
Ammonia (mg/L N)	1*	Average Monthly
Nitrate (mg/L N)	5**	Average Monthly
Total Coliform (Organisms/100mL)	23	Daily Maximum
pH	6.5-8.5	Minimum-Maximum

** Represents approximately 93-99% removal based on 2022 monthly influent data*

*** If required, tertiary treatment could be added to bring effluent nitrate levels to 1 mg/L*

1.9. BIOSOLIDS

Both federal and state regulations apply to land application of biosolids from wastewater treatment plants. Title 40 of the Code of Federal Regulations, Part 503 (40 CFR §503) discusses standards for the use and disposal of biosolids. Oregon regulations include OAR 340-050, which were most recently revised in July 1995. They reference many of the federal technical biosolids regulations (40 CFR §503), including limits on trace pollutants and pathogens. Under state regulations, a Biosolids Management Plan (BMP) and Land Application Plan are required. Note that land application of biosolids is not anticipated to be a part of this project.

CHAPTER 2 - EXISTING FACILITIES

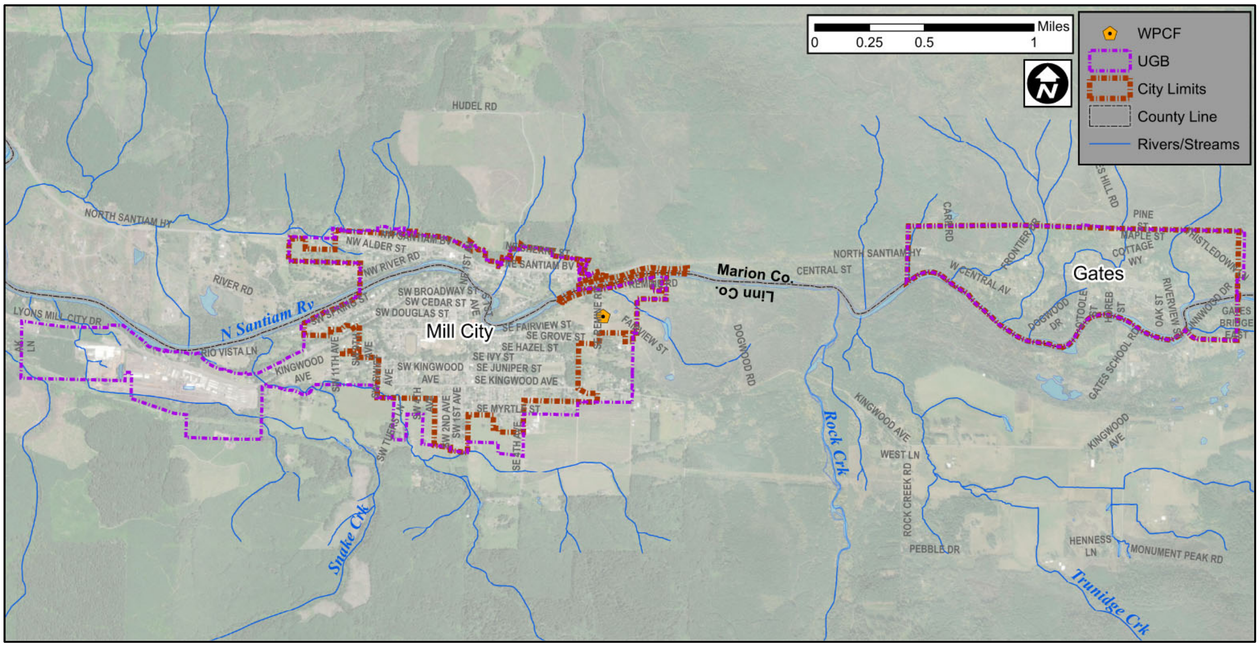
This chapter presents a description of Mill City's existing sewer collection and treatment systems, an evaluation of existing facilities, performance, and capacity, and references the valuation of the existing assets and liabilities.

2.1. TREATMENT SYSTEM OVERVIEW

The Mill City water pollution control facility (WPCF) was originally constructed in 1992. The facility is a recirculating gravel bed filter (RGF) treatment system consisting of a metering flume, static screen, recirculation and storage tank, gravel filter feed pumps, gravel filter, a splitter box, effluent pumps, and drainage fields located just south of the North Santiam River on the east side of Mill City. The system wide wastewater treatment process employs a combination of onsite treatment units located on individual properties using interceptor and septic tank systems, followed by dilution, equalization, and storage in the recirculation tank, followed by pumping through the recirculating gravel filter for treatment, and disposal via the drainage fields. Six disposal units are in operation at all times, with six held in reserve. Each disposal unit has three drainage fields (A, B, and C) that are dosed with treated effluent at the same time.

2.2. LOCATION MAP

FIGURE 2-1: STUDY AREA



2.3. HISTORY

The City of Mill City is the only city in the study area that operates a community sanitary sewer system. The majority of the collection and treatment system was built in 1992. In 2009, all three collection system pump stations were replaced, as well as some treatment system components. In 2010, a wastewater O&M manual was produced by CH2M Hill to document Mill City's wastewater collection, treatment, and disposal facilities, permit requirements, as well as the system upgrades completed in 2009.

Residents in the City of Gates maintain private, individual septic systems, with the exception of the trailer parks, motels and apartment/multi-family housing that are typically served by shared septic systems. The most recent sanitary survey was performed in 1999 by Edgewater Environmental, which presented the following information regarding the condition of the on-site sewage systems.

At the time of the study, there were 192 dwelling units within the city. Due to historical permitting processes for Marion County, and Gates, septic permits could not be located, and the sizes of the systems could not be determined. A local septic tank pumping contractor, however, did indicate that there were no chronic repeat customers (more than one pump-out per year) in Gates.

The results of the survey included 105 septic systems, 88 were found to be operational/ satisfactory, 10 marginal, and 7 failing. 87 systems were not able to be surveyed, where the condition remains unknown. The results of water sampling in nearby creeks and ditches were inconclusive in determining if failing septic systems had caused groundwater contamination in the City.

Keller Associates produced a Regional Wastewater Analysis in 2017 and a North Santiam Sewer Authority Wastewater Master Plan in 2021 to provide a feasible approach and associated cost for wastewater facilities serving communities in the NSC.

2.4. CONDITION OF EXISTING FACILITIES

This section provides an evaluation of existing conditions and capacity of the Mill City wastewater collection and treatment systems and updates the 2021 master plan existing flows and loadings based on two new years of DMR data (2021 and 2022).

2.4.1. Wastewater System Management, Classification, Operators and License

Permit Number 100696 has been issued to the City of Mill City by the State of Oregon to discharge a maximum of 185,000 gallons per day of treated wastewater effluent by subsurface disposal. The required operator classification for both the collection system and treatment systems is Grade I.

Influent to the treatment system shall not exceed 300 mg/L BOD_5, 25 mg/L grease and oil (G&O), 150 mg/L TSS, and 150 mg/L TKN. Effluent from the treatment system to the drainage fields is not to exceed 20 mg/L BOD_5, or 20 mg/L TSS.

NO_3-N at sample point (SP) 2 shall not exceed the background results at SP1. SP1 was established upstream from the disposal fields and downstream from a point in the river perpendicular to the Boy Scout Camp disposal field. SP2 was established at the foot of the boat ramp near Monitoring Well 1 (MW 1). SP3 is located between 50 and 100 ft downstream from SP2.

2.4.2. Existing Treatment Plant Conditions

The WPCF is located adjacent to Kimmel Park on Remine Road. Mill City's WPCF (Figure 2-2) consists of influent flow monitoring, a recirculation/equalization tank (with two compartments), a recirculating gravel filter, and disposal drain fields. The influent flow is measured in the influent Parshall flume. Following the flume, the influent passes through a static screen into the recirculation/equalization tank. The screen is cleaned manually. Filter feed pumps transport the wastewater from the recirculation/equalization tank to the gravel filter. A biofilm on the gravel filter treats the wastewater. After passing through the filter, approximately 80% of the filtrate water is recirculated in the recirculation/equalization tank back to the gravel filter. The remaining 20% is routed to the effluent pumps. Manual slide gates are used to adjust and control the flow to the effluent pumps. The effluent pumps dispose of the treated wastewater in the City's drain fields.

FIGURE 2-2: MILL CITY WPCF

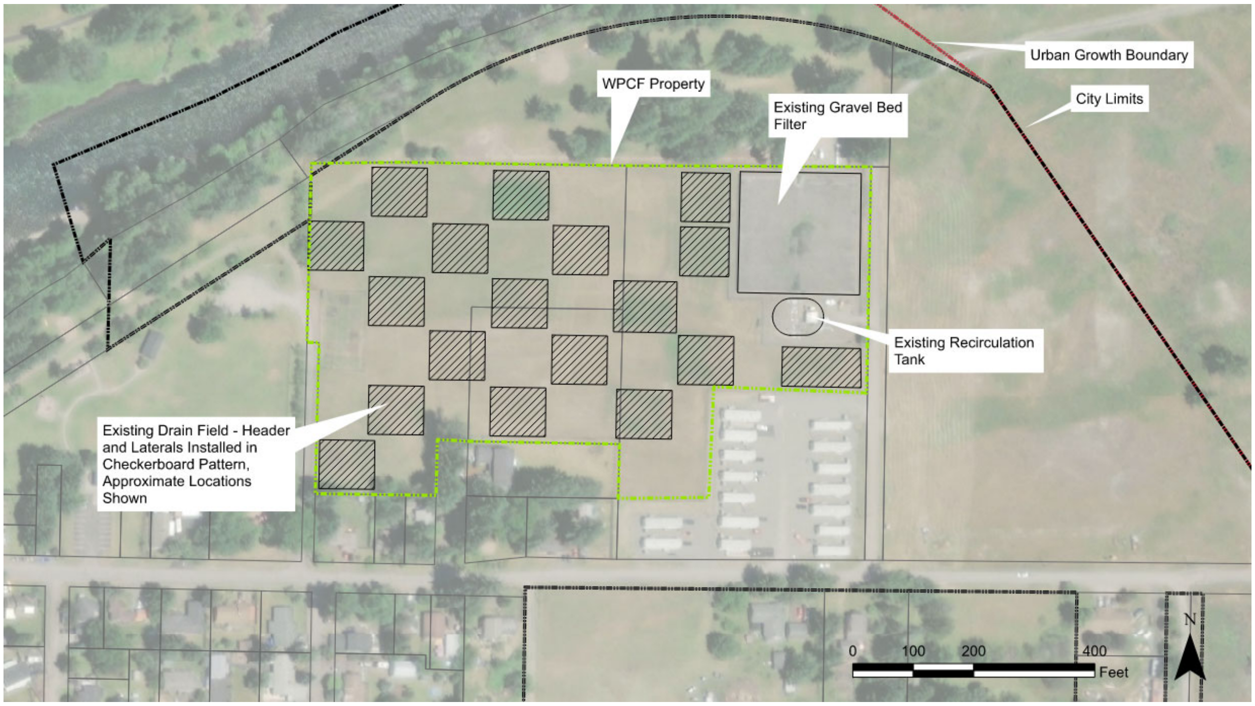


FIGURE 2-3: MILL CITY'S WATER POLLUTION CONTROL FACILITY

Automatic samplers collect the influent and effluent wastewater samples. The influent sample is taken from the influent flow metering manhole. The effluent sample is taken from the effluent pump chamber. The samples are sent to Waterlab Corporation (Salem, OR) for testing. Solids from the WPCF are periodically removed from the recirculation/equalization tank and disposed of by a licensed sewage disposal service. The removal frequency is approximately every five years. Odorous air is drawn from the influent metering manhole, energy absorption manhole, and recirculation/equalization tank influent chamber and are treated using a biofilter. A permanent diesel generator with an automatic transfer switch is installed at the WPCF for use in the event of power loss. The City's SCADA system monitors the collection system pump stations and WPCF. Backup power at each connection is not necessary as most discharge by gravity with a small group of STEP systems. These STEP systems provide some storage. During a prolonged power outage, this may require limiting wastewater discharge by users or providing backup power to STEP users.

The pumps, composite samplers, biofilter, and Parshall flume ultrasonic level sensor were replaced in 2009. Most of the current issues at the WPCF are electrical. Several of the electrically actuated valves in the drain field failed and were replaced recently. The wiring and relays in the control room burned out and were also recently replaced. The PLC and operating software was replaced in August 2023. The heater in the WPCF Office is also broken. Most recently, the bearings on the odor control blower have failed, as well as a seal of one of the effluent pumps. In general, the equipment is wearing down and requires more expensive repairs.

The City of Mill City received a warning letter with opportunity to correct (WLOTC) following a DEQ site visit in June 2023. The following deficiencies were noted by DEQ during the inspection and upon review of the discharge monitoring reports for the last three years:

- Effluent was found to be ponding on the surface of the recirculating gravel filter.
- Effluent was found to be leaking from piping penetrating the concrete wall of the recirculating gravel filter and discharging onto the ground surface.
- Maximum daily design flow was exceeded on Dec 21, 2020, and January 6 & 7, 2022.

FIGURE 2-4: MILL CITY'S FILTER

- Deficiencies
  - The recirculating gravel filter pools with influent.
  - Untreated influent leaks from piping penetrating the gravel filter concrete walls.
  - Maximum daily flows have been exceeded several times over the past 3 years.
  - The office heater is broken.

Keller and the City are working with DEQ staff to address the issues listed above.

2.4.3. Historical Flows

The existing sanitary sewer system in Mill City is comprised of septic tank effluent gravity (STEG) and septic tank effluent pumped (STEP) systems. The STEP/STEG system is comprised of small diameter pipes that transport effluent from residential septic tanks to gravity collection mains. These mains have very few manholes, instead utilizing smaller clean outs and inspection ports. As seen in the following analysis of Mill City's existing STEG system, STEG systems generally have less infiltration and inflow (I/I) influence than a traditional gravity collection system, but more I/I influence than a septic tank effluent pumping (STEP) system.

The wastewater flow analysis looks at historic wastewater flows to develop flow projections for the planning period. This section summarizes results of the analysis of historical flows. Flow data came from discharge monitoring reports from 2016-2022 provided by Mill City. Rainfall data (2016-2022) is sourced from five different NOAA Stations. Two of the stations are in Mill City, two of the stations are in Gates, and one of the stations is near the Detroit dam.

Average Annual Daily Flow (AADF)

The average annual daily flow (AADF) is the average daily flow for the entire year. An AADF was calculated for each year of data. The years with a complete data set (2016-2022) were averaged to obtain the design AADF.

Average Dry-Weather Flow (ADWF)

The average dry-weather flow (ADWF) is the average daily flow for the period of May through October. An ADWF was calculated for each year of data. The years with a complete data set (2016-2022) were averaged to obtain the design ADWF.

Average Wet-Weather Flow (AWWF)

The average wet weather flow (AWWF) was calculated as the average daily flow for the period encompassing January-April, and November-December for each year of data. Seven years' worth of data (2016-2022) was averaged to obtain the AWWF.

Max Month Dry-Weather Flow ($MMDWF_{10}$)

The maximum monthly dry-weather flow ($MMDWF_{10}$) represents the month with the highest flow during the summer months. DEQ's method for calculating the $MMDWF_{10}$ is to graph the January through May monthly average flows for the most recent year against the total precipitation for each month. DEQ states that May is typically the maximum monthly flow for the dry-weather period (May through October). Selecting the May 90% precipitation exceedance most likely corresponds to the maximum monthly flow during the dry-weather period for a 10-year event. The May 90% precipitation exceedance value (8.47 inches) was extrapolated from the NOAA Summary of Monthly Normal from 1981 to 2010.

Data from 2016–2022 was used according to the DEQ guidance to produce Figure 2-5. Table 2-1 summarizes the data points illustrated in the chart.

Max Month Wet-Weather Flow ($MMWWF_5$)

The maximum monthly wet-weather flow ($MMWWF_5$) represents the highest monthly average during the winter period. DEQ's method for calculating the $MMWWF_5$ is to graph the January through May average daily flows against the monthly precipitation. DEQ states that January is typically the maximum monthly flow for wet weather (November through April). Selecting the January 80% precipitation exceedance value most likely corresponds to the maximum monthly flow during the wet-weather period for a 5-year event. The January 80% precipitation exceedance value (17.24 inches) was extrapolated from the NOAA Summary of Monthly Normal from 1981 to 2010. The DEQ method and $MMWWF_5$ result are illustrated in Figure 2-5 and summarized in Table 2-1.

FIGURE 2-5: MONTHLY AVERAGE FLOW VS. RAINFALL ($MMDWF_{10}$ AND $MMWWF_5$)

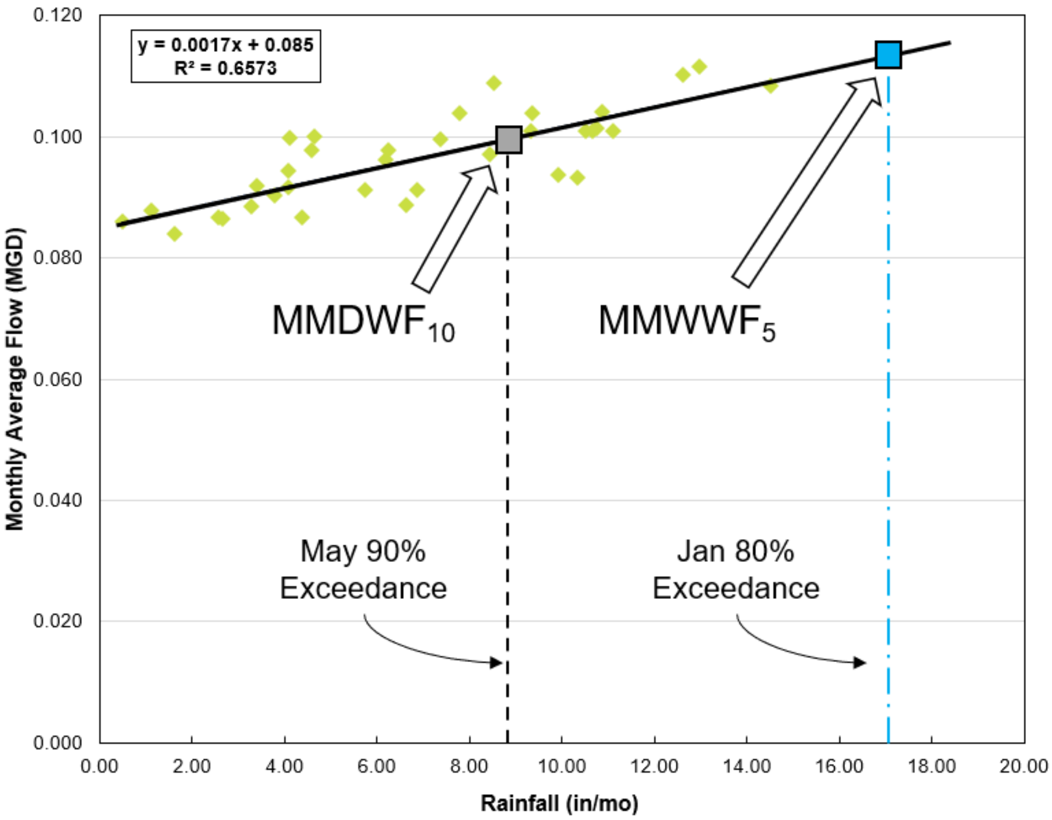


TABLE 2-1: MONTHLY AVERAGE FLOW VS. RAINFALL ($MMDWF_{10}$ AND $MMWWF_5$)

Month	Monthly Average Flow (MGD)							Rainfall (in/mo)						
	2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
January	0.093	0.104	0.104	0.092	0.101	0.104	0.109	10.4	9.4	7.8	4.1	10.7	10.9	8.5
February	0.096	0.108	0.100	0.101	0.100	0.110	0.089	6.2	14.5	4.1	9.3	4.7	12.6	3.3
March	0.097	0.112	0.098	0.090	0.091	0.098	0.089	8.4	13.0	6.2	3.8	5.7	4.6	6.6
April	0.087	0.102	0.100	0.101	0.092	0.088	0.094	4.4	10.7	7.4	10.5	3.4	1.1	9.9
May	0.084	0.094	0.086	0.087	0.091	0.086	0.101	1.6	4.1	0.5	2.6	6.9	2.7	11.1
$MMDWF_{10}$	0.099							8.47						
$MMWWF_5$	0.114							17.24						

Peak Week Flow (PWkF)

The peak week flow (PWkF) was calculated using a 7-day rolling average for each year. The maximum of all the year PWkF values was used as the PWkF.

Peak Daily Average Flow ($PDAF_5$)

As outlined by the DEQ, the peak daily average flow ($PDAF_5$) corresponds to a 5-year storm event (DEQ Flow Projection Guidelines[1]). The DEQ's method for determining $PDAF_5$ is plotting daily plant flow against daily precipitation for significant storm events, using data only for wet-weather seasons when groundwater is high. The $PDAF_5$ is the 5-year, 24-hour storm event (4.5 inches per the NOAA isopluvial maps for Oregon (Appendix B)) from a trend line fitted to the data. A significant storm event was considered more than 1-inch of rainfall in 24-hours. Antecedent conditions were evaluated on a case-by-case basis, and wet conditions were assumed if any day in the preceding three had a storm event of 0.5-inches or larger. Data was also considered based on cumulative rainfall for 30 days before the storm event. The cutoff for 30-day cumulative rainfall (for purposes of this analysis) was 4.5-inches. Figure 2-6 below shows the results of the DEQ analysis.

An analysis per the DEQ method using data from 2016-2022 resulted in a $PDAF_5$ of 0.178 MGD. The peak daily average flow observed in discharge monitoring reports (DMR) data was 0.221 MGD in 2022. The observed flow of 0.221 MGD was used for the design $PDAF_5$ flow.

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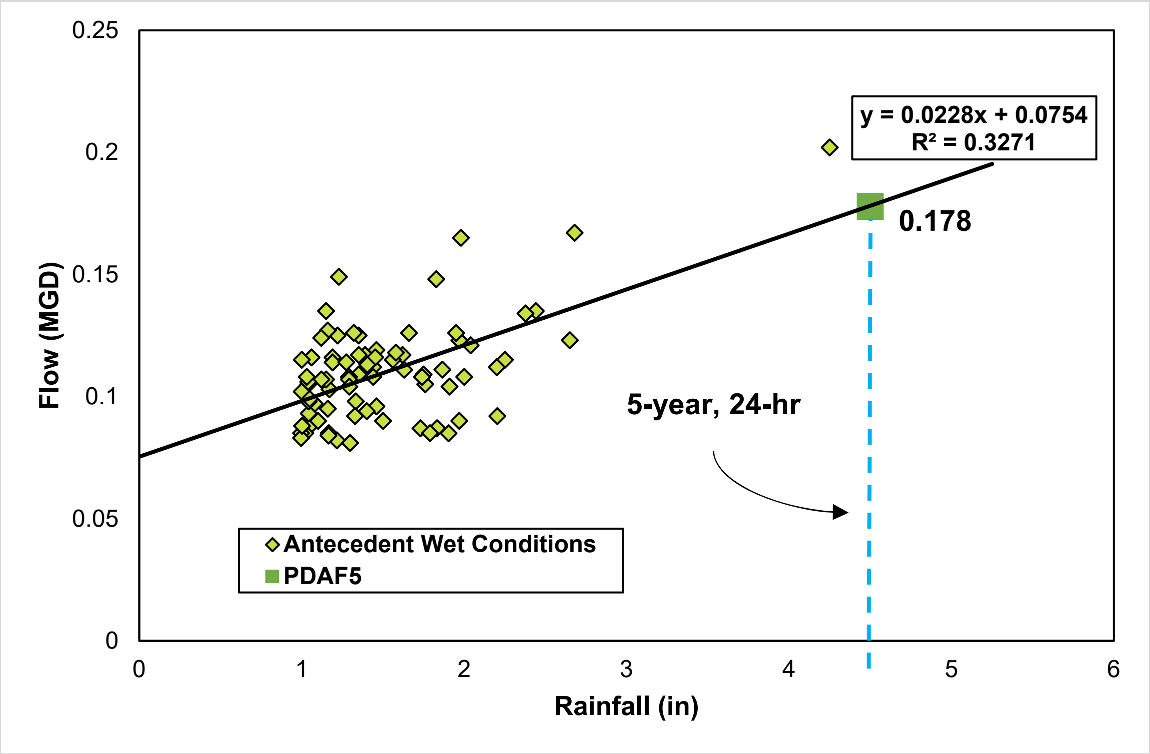
[1] Oregon Department of Environmental Quality. (n.d.). *Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon.* State of Oregon.

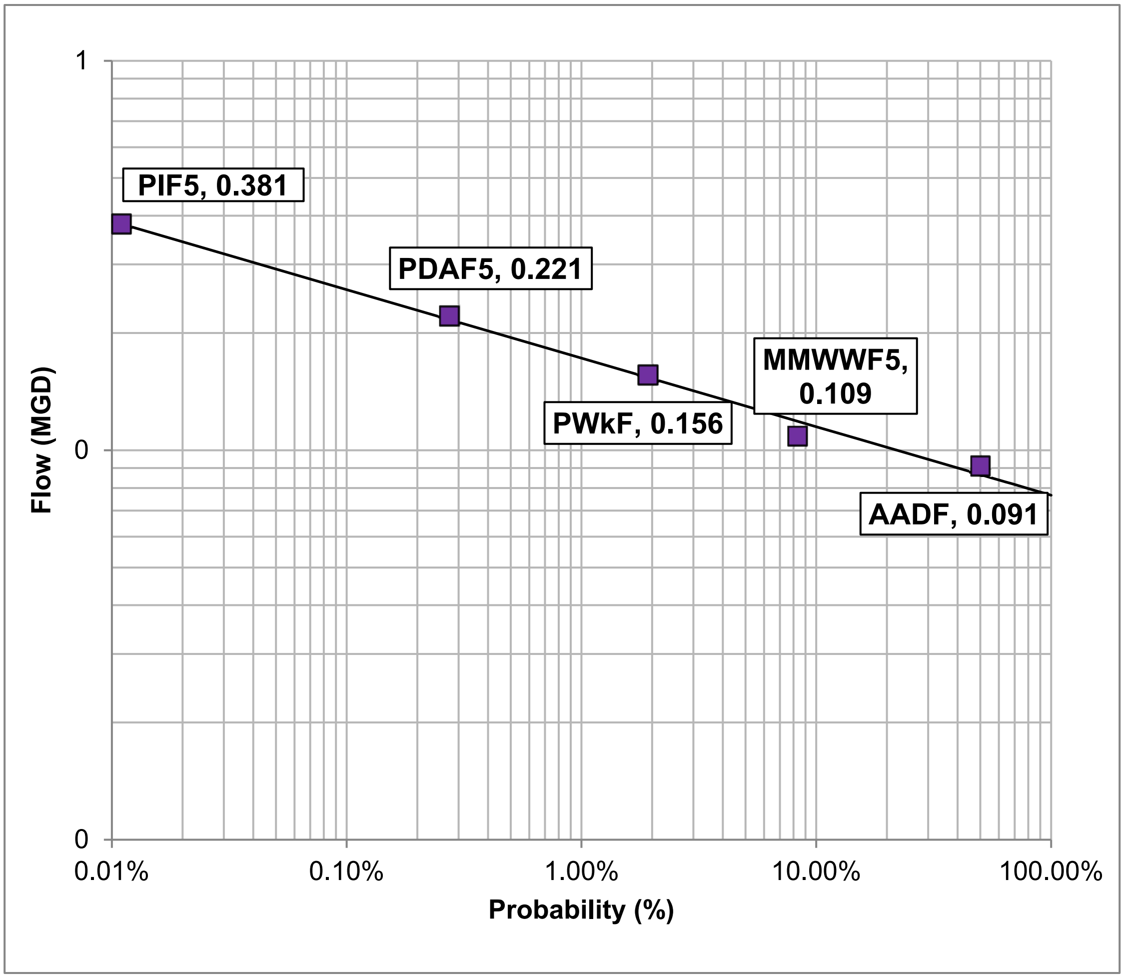
FIGURE 2-6: FLOW VS. RAINFALL ($PDAF_5$)



Peak Instantaneous Flow (PIF_5)

The peak instantaneous flow (PIF_5) represents the peak flow recorded at the WPCF. The DEQ recommends evaluating hourly or instantaneous flow data for high-flow days if available. Mill City does not record instantaneous flow data. As an alternative, DEQ recommends estimating PIF_5 by extrapolation. A probability graph, where the PIF_5 was extrapolated from a known $PDAF_5$ was produced. Figure 2-7 shows the results.

FIGURE 2-7: FLOW VS. PROBABILITY (PIF_5)



Per the DEQ extrapolation method, the PIF_5 was found to be 0.381 MGD. However, if both the Spring Street and 1st street lift stations are pumping at the same time, the actual PIF_5 is approximately 0.52 MGD (Table 2-7). Section 4-2 provides additional discussion regarding pump station vs. calculated peak instantaneous flows.

Table 2-2 summarizes the observed flows in Mill City for each year from 2016-2022. The historical flows were derived as described in the preceding paragraphs.

TABLE 2-2: MILL CITY HISTORICAL FLOWS

Mill City Historical Flows (MGD)								
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Average**
Population	1,860	1,860	1,865	1,880	1,894	1,965	2,007	-
ADWF	0.087	0.089	0.086	0.085	0.088	0.086	0.087	0.087
$MMDWF_{10}$	0.100	0.097	0.089	0.089	0.092	0.092	0.101	0.094
AADF	0.092	0.097	0.092	0.089	0.092	0.094	0.091	0.093
AWWF	0.097	0.105	0.098	0.093	0.097	0.103	0.095	0.098
$MMWWF_5$	0.110	0.114	0.105	0.102	0.104	0.116	0.109	0.109
PWkF	0.116	0.130	0.110	0.136	0.124	0.151	0.156	0.132
$PDAF_5$	0.141	0.176	0.125	0.169	0.202	0.194	0.221	0.175
PIF_5	0.228	0.284	0.201	0.272	0.326	0.313	0.381	0.283

For Gates, the ADWF was estimated by averaging the community's wet weather water usage from the water system (January to March and November to December) and adjusting usage by the Mill City adjustment factor, 0.911 (NSC Wastewater Master Plan, 2021, Keller Associates). Table 2-3 provides the assumed wastewater flows for Gates based on their water system meter data.

TABLE 2-3: GATES HISTORICAL FLOWS

Gates Historical Flows (MGD)			
Year	**2018**	**2019**	**2020**
Population	*485*	*485*	*481*
ADWF	0.028	0.032	0.034
AADF	0.030	0.035	0.037
AWWF	0.032	0.037	0.039
$MMWWF_5$	0.037	0.043	0.045
$PDAF_5$	0.066	0.075	0.080
PIF_5	0.102	0.116	0.123

2.4.4. Historical Loading

Depending on the discharge location, a different level of treatment may be required. Key contaminants in wastewater that may need to be monitored and treated include the following:

5-day Biochemical oxygen demand (BOD_5): the amount of oxygen required by microorganisms to break down organic material in the wastewater. Higher BOD_5 concentrations in receiving waters will lead to a reduction in dissolved oxygen and will produce more microbes.

Total suspended solids (TSS): the total solids not dissolved in the wastewater. High TSS concentrations in receiving waters can be detrimental to water quality and aquatic life.

Nitrogen and Phosphorus: nutrients found in wastewater that can lead to poor water quality, growth of algae (which results in a reduction of dissolved oxygen) and can be toxic to aquatic life. Nitrogen is often found in organic compounds, as well as ammonia and nitrates. Total Kjeldahl Nitrogen (TKN) is a common measurement for wastewater nitrogen which includes organic nitrogen as well as ammonia.

Turbidity: this is the relative clarity of the water. The more turbid the water, the more likely there is inorganic and organic materials present.

E. Coli: bacteria commonly used as a marker to identify the number of pathogens in wastewater.

These contaminants, when not adequately treated, can be detrimental to water quality and aquatic life. Mill City's historical loading data (2016 to 2022) was analyzed. The wastewater influent loading analysis follows a similar methodology as was used for the influent flow determinations. However, Mill City utilizes a STEP/STEG system, and influent at the time of sampling has already undergone partial treatment in the septic tanks before entering the WPCF. Thus, the actual loading produced at each source is unknown.

The historical wastewater loading data was used to develop future loading projections for the planning period. An estimate was also made for influent loadings without a STEG or STEP system. This section summarizes the results of the BOD_5, TSS, and TKN load analysis. Dry weather (May 1 – October 31) and wet weather (November 1 – April 30) loads were evaluated. The following definitions summarize the terminology of the loading conditions:

Average Daily Load

The average daily load (ADL) is the average load during a period. The average daily load was calculated for both the 6-months of dry weather (DWADL) and the 6-months of wet weather (WWADL) for each year of data.

Maximum Month Load

The maximum month load (MML) is the month with the largest average daily load. The maximum month load was reported for both the 6-months of dry weather (DWMML) and the 6-months of wet weather (WWMML) for each year of data. The maximum month data is from the DMRs and represents the samples taken during the month rather than a 30-day rolling average.

The BOD_5, TSS, and TKN historical loadings (pounds per day (ppd)) observed in Mill City are summarized in Table 2-4.

TABLE 2-4: MILL CITY HISTORICAL LOADS

Year	2016	2017	2018	2019	2020	2021	2022	Avg.	Max
Population	*1860*	*1860*	*1865*	*1880*	*1894*	*1965*	*2007*	-	-
BOD$_5$ (ppd)									
WWADL	99.8	74.0	88.7	101.5	100.5	95.9	93.6	93.4	101.5
WWMML	113.6	82.7	114.9	138.8	171.7	138.3	164.7	132.1	171.7
DWADL	97.2	62.2	92.5	82.4	78.3	125.3	104.5	91.8	125.3
DWMML	99.6	65.9	107.8	100.7	111.5	248.7	130.0	123.5	248.7
TSS (ppd)									
WWADL	30.2	25.4	28.7	30.0	22.7	26.9	21.94	26.6	30.2
WWMML	31.4	30.4	34.1	35.6	44.5	37.2	32.62	35.1	44.5
DWADL	36.3	21.5	30.2	29.3	25.0	34.0	28.26	29.2	36.3
DWMML	41.1	25.2	47.0	40.1	36.8	72.7	46.79	44.2	72.7
TKN (ppd)									
WWADL	36.8	35.8	39.9	41.9	40.9	39.5	40.3	39.3	41.9
WWMML	46.1	39.8	46.0	44.0	51.1	51.4	57.4	48.0	57.4
DWADL	46.1	35.6	40.3	42.0	34.2	57.1	50.1	43.6	57.1
DWMML	46.8	36.4	46.5	53.7	47.3	100.3	56.3	55.3	100.3

2.4.5. Existing Treatment Plant Capacity

Mill City's current WPCF permit requirements are shown in Table 2-5.

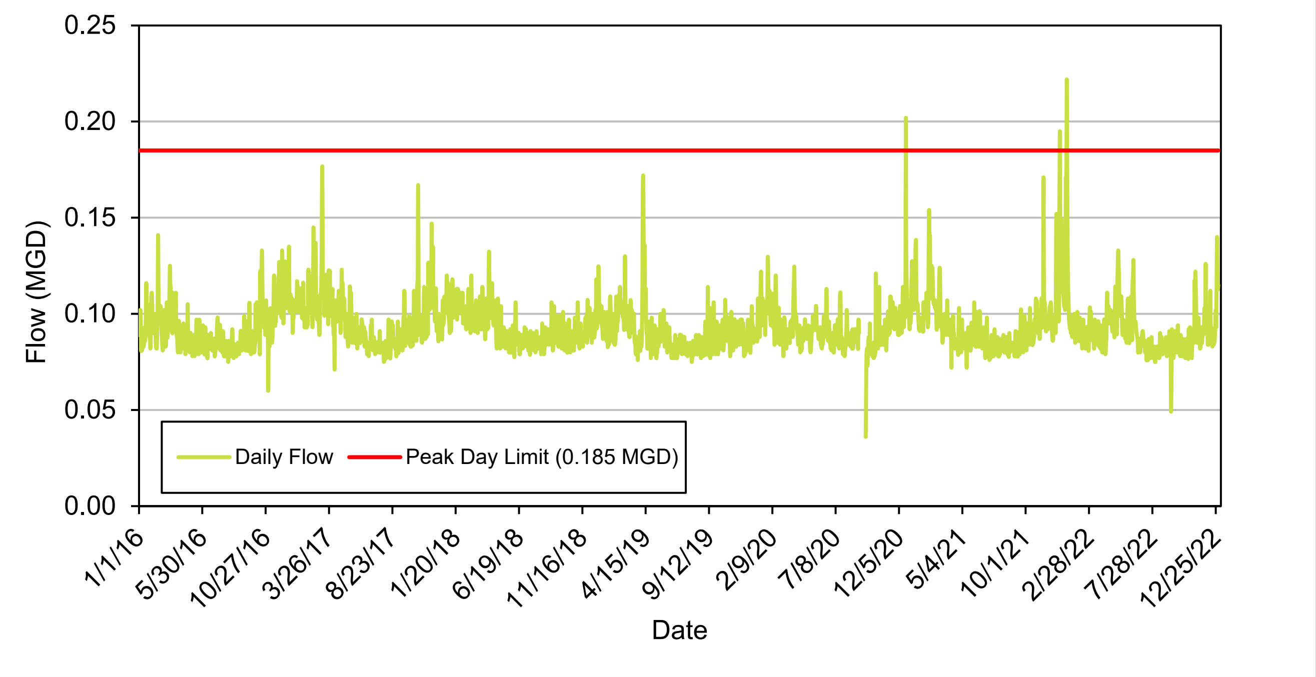
TABLE 2-5: WPCF PERMIT REQUIREMENTS

Parameter	Maximum Daily Limit
Influent Max. BOD$_5$ (mg/L)	300
Influent Max. O&G (mg/L)	25
Influent Max. TSS (mg/L)	150
Influent Max. TKN (mg/L)	150
Influent Flow (MGD)	0.185
Effluent Max. BOD$_5$ (mg/L)	20
Effluent Max. TSS (mg/L)	20

BOD$_5$ = five-day biochemical oxygen demand
mg/L = milligrams per liter
MGD = million gallons per day
TSS = total suspended solids
TKN = total Kjeldahl nitrogen
O&G = oil and grease

The City's WPCF data from 2016 through 2022 was analyzed as a part of this planning study. A comparison of the historical influent flow is compared to the WPCF permit conditions in Figure 2-8 below. From 2016 to 2022, with the exception of a few days, the WPCF was in compliance with influent flow permit requirements, with most of the flows well below 80% of the WPCF capacity. On December 21, 2020, Mill City received approximately 4.25 inches of rain and the influent flow was 0.202 MGD (0.017 MGD higher than the permit limit). The permitted influent limit was also violated on other occasions including December 21, 2021, when the flow reached 0.194 MGD, and on January 6 and 7, 2022, when the daily flows reached 0.221 and 0.187, respectively.

FIGURE 2-8: WPCF MAXIMUM DAILY FLOW



The influent concentrations of BOD_5, TKN, TSS, and O&G were in compliance with permit requirements as shown in Figure 2-9, Figure 2-10 and Figure 2-11. Since the collection system includes treatment that clarifies the wastewater, the influent TSS and BOD_5 measured at the WPCF are lower than typical domestic influent.

FIGURE 2-9: WPCF INFLUENT BOD CONCENTRATIONS

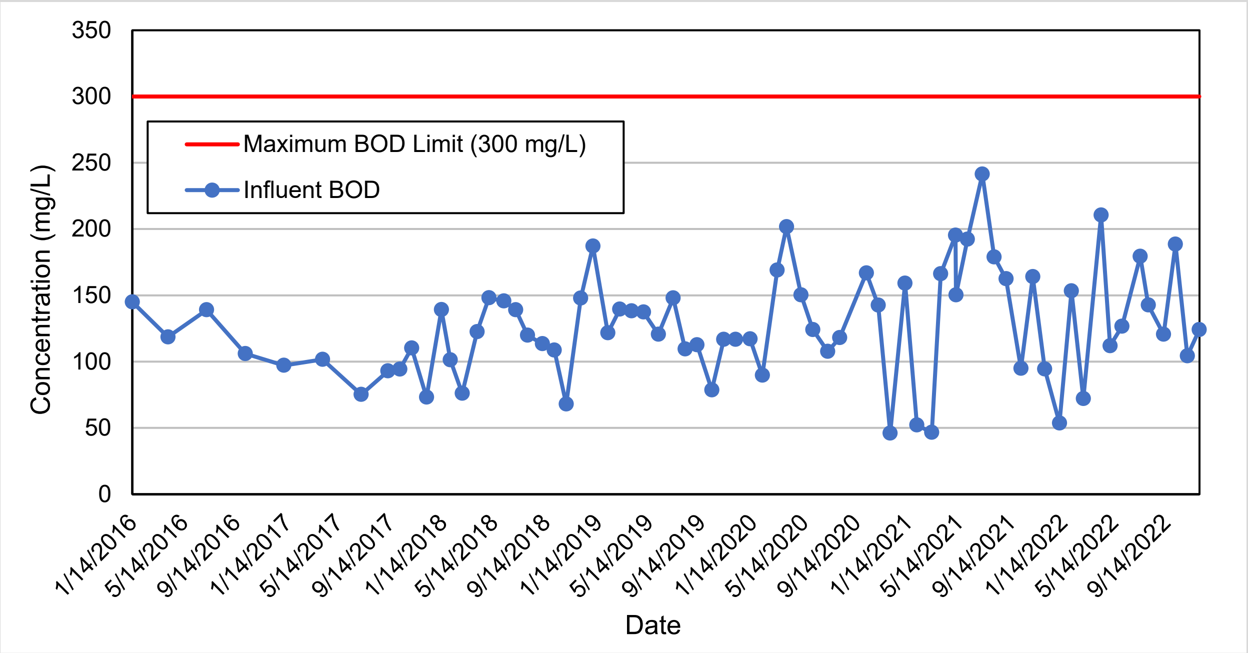


FIGURE 2-10: WPCF MONTHLY AVERAGE INFLUENT TSS AND TKN CONCENTRATIONS

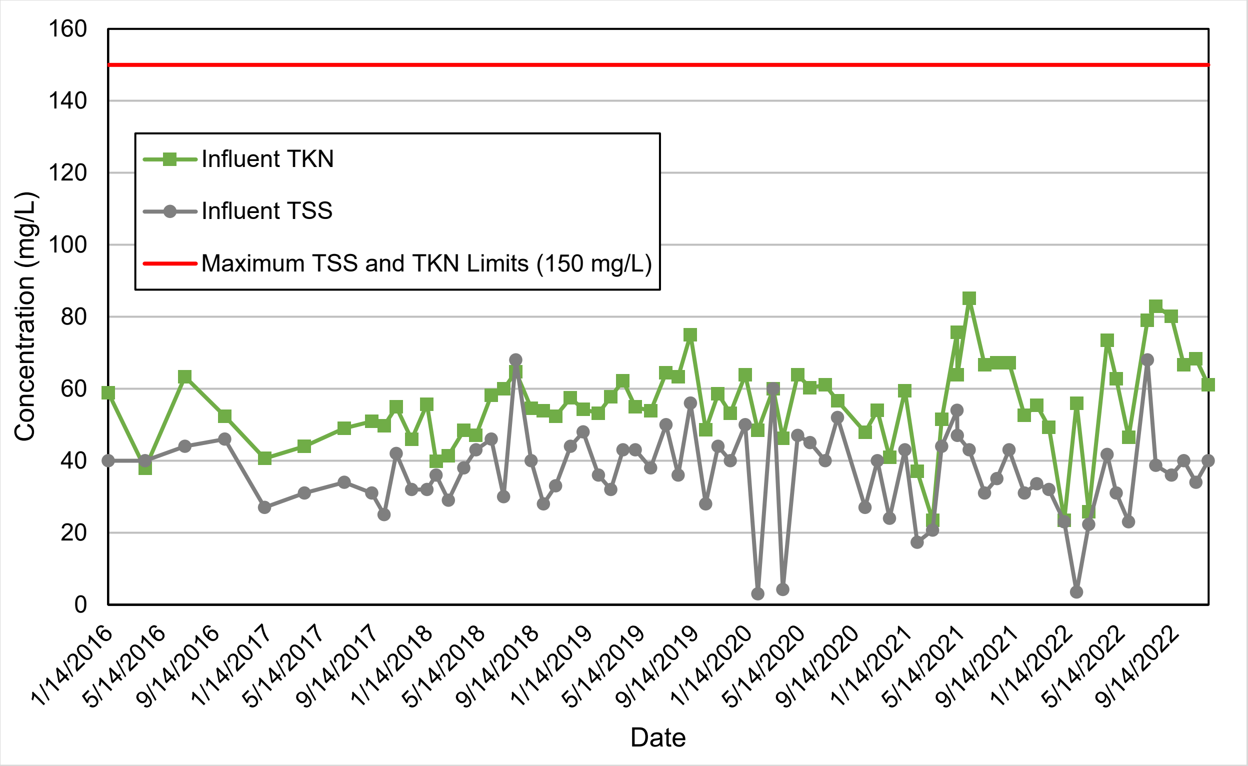
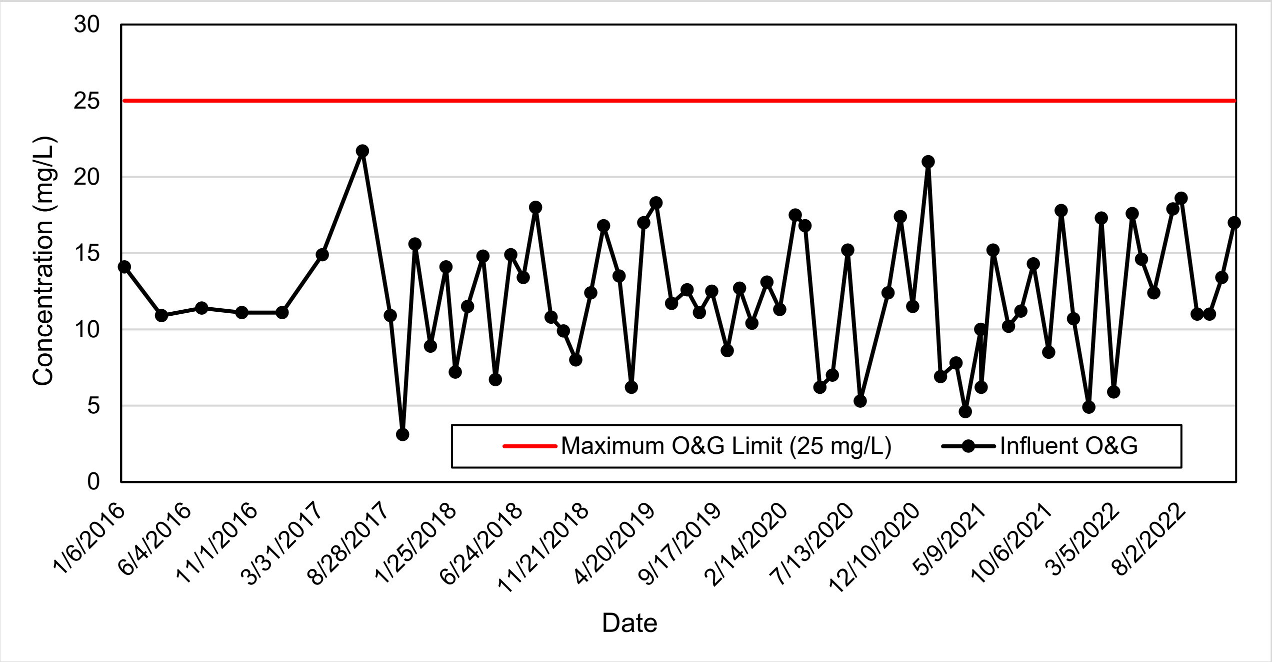
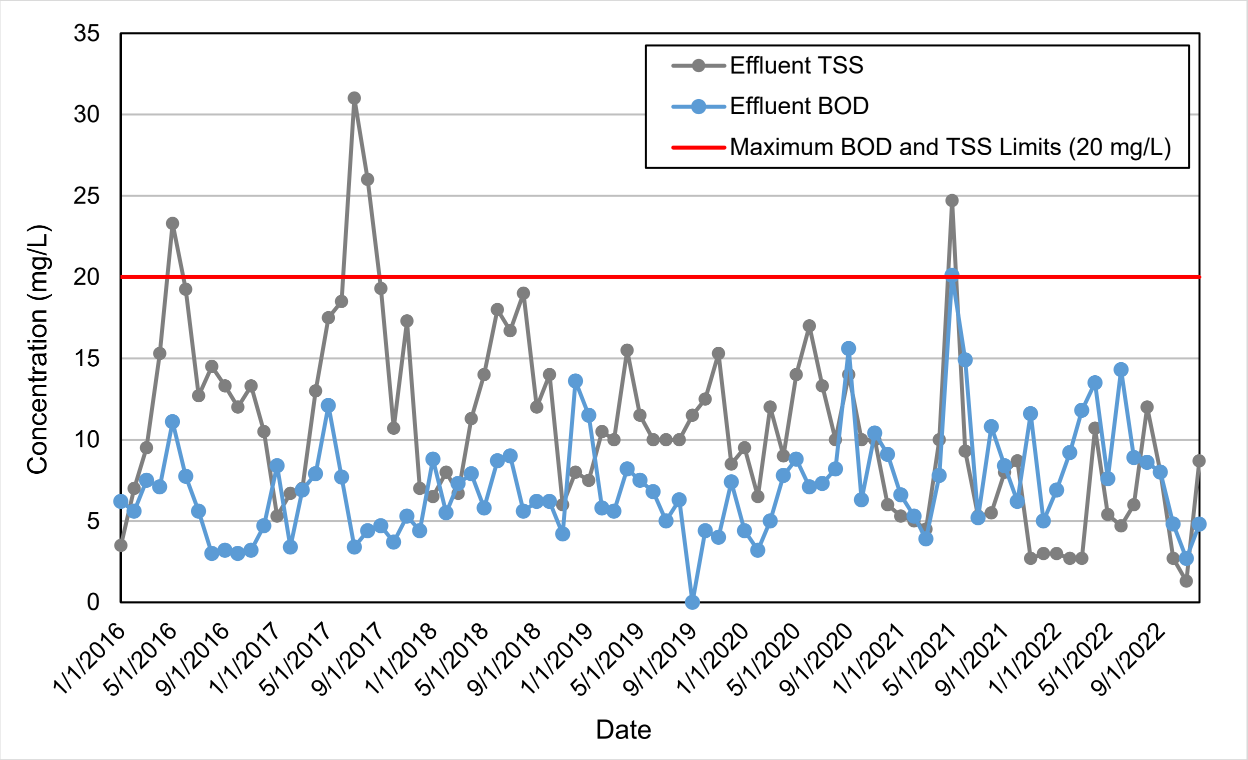


FIGURE 2-11: WPCF INFLUENT O&G CONCENTRATIONS



The Mill City WPCF effluent data for the years 2016 to 2022 is shown in Figure 2-12 and Figure 2-13.

FIGURE 2-12: WPCF EFFLUENT BOD AND TSS CONCENTRATIONS



There were several instances between 2016 and 2022 where effluent TSS concentrations exceeded permit limitations and one case in which effluent BOD_5 concentration exceeded the permitted limit. The Mill City WPCF operator believes the high TSS concentrations were a result of the gravel filter becoming clogged with organic material, as the filter is not covered.

FIGURE 2-13: WPCF EFFLUENT NITRATE CONCENTRATIONS

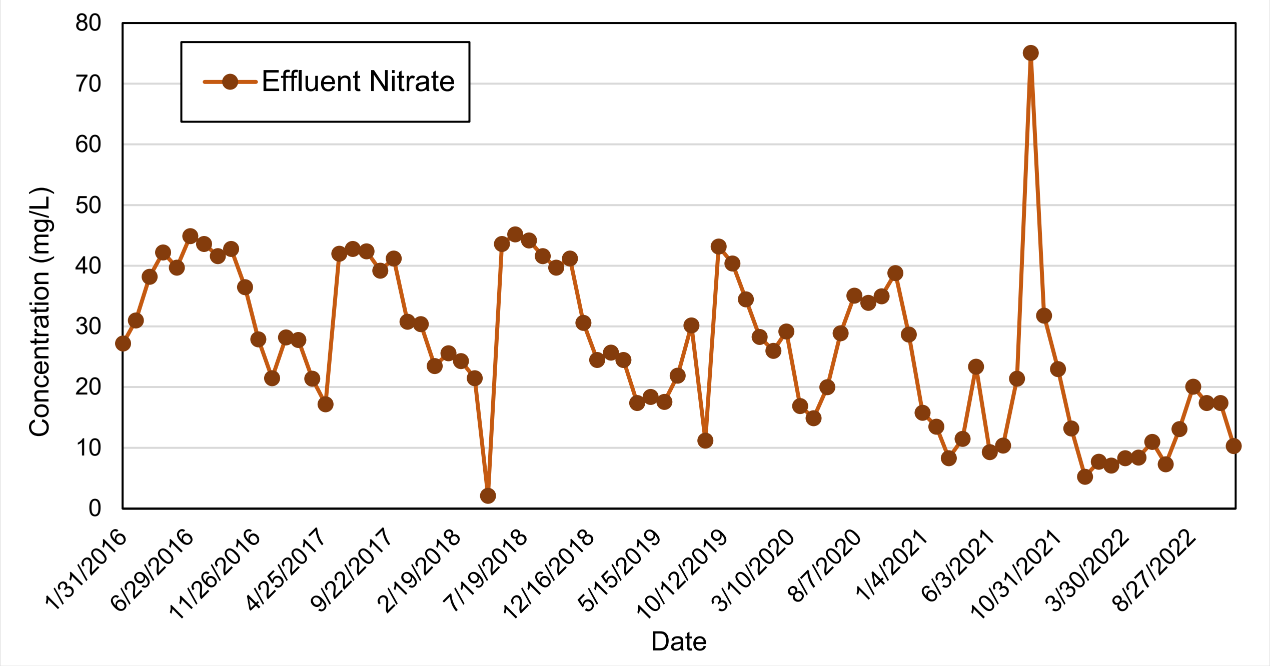


Table 2-6 compares the original rated capacity to current influent flows. Mill City's historical flows are discussed in Section 2.4.3. The rated capacity was established from the 1992 WPCF design documents. Planning flows have been updated from the 2021 WWMP utilizing new discharge monitoring report (DMR) data from 2021 and 2022.

TABLE 2-6: DESIGN CAPACITY VS. CURRENT INFLUENT

Component	Permit Limit	2016-2022 Flows
Influent		
Average Annual Weather Flow (gpd)	92,500	93,000
Average Wet Weather Flow (gpd)	170,000	98,000
Peak Day Wet Weather Flow (gpd)	185,000	221,000
Influent Max Permitted Biochemical Oxygen Demand (BOD_5, mg/L)	300	242
Influent Max Permitted BOD_5 (lbs/day)	463	446
Recirculation/Equalization Tank		
Volume (gallons)	185,000	--
Hydraulic Retention Time @ Peak Day Wet Weather Flow (hr)	24	28.7
Gravel Filter		
Surface Area (ft^2)	36,864	--
Average Dry Weather Hydraulic Loading ($gal/ft^2/day$)	2.5	2.4
Average Wet Weather Hydraulic Loading ($gal/ft^2/day$)	4.6	2.7
Peak Day Wet Weather Hydraulic Loading ($gal/ft^2/day$)	5.0	6.0
Drainfield		
Area (acres)	10	--
Design Max Hydraulic Loading (gal/ft/day)	12.5	5.7 (ADWF) 6.5 (AWWF) 14.6 (PDWWF)
Linear Feet	15,200	--

Based on historical flows and the historically rated WPCF design capacity, the recirculation/equalization tank and the gravel filter design flows are insufficient for the current peak day wet weather flow occurrence in Mill City. The defined capacity of the drainage fields is also less than the observed peak day wet weather flows.

2.5. EXISTING COLLECTION SYSTEM INVENTORY

The collection system consists of a combination of gravity and pressure sewer lines and three lift stations. This section summarizes the lift station and pipeline characteristics.

2.5.1. Lift Stations

The collection system consists of three lift stations: River Road Lift Station (LS), First Avenue LS, and Spring Street LS. An inventory of the three lift stations is included in Table 2-7.

An in-depth conditions assessment of the lift stations was not included within the scope of this study; however, the lift stations were visited, and general observations were noted. There were no apparent deficiencies based on the site visits and the three lift stations appear to be in good working order. The Mill City operators did not report any historical issues with operation or capacity. Pump tests were completed while onsite to document current pumping capacities. The reported capacities presented in Table 2-7 represent the results from the pump testing. Pump curves and previous reported capacities indicate the current pumping capacity may be different than the original design flow rates. The wastewater system operations and maintenance (O&M) manual reports the firm capacity of the River Road LS, First Avenue LS, and Spring Street LS to be 60 gpm, 125 gpm, and 350 gpm respectively. The River Road LS is pumping at about 40 gpm higher than the previously reported capacity while the Spring Street LS is pumping about 120 gpm lower than the previously reported capacity. The First Avenue LS appears to be pumping at a consistent rate to its previously reported capacity. The discrepancy between the pumping capacities cannot be determined without additional investigation, however, some potential reasons could include, excess impeller wear, changing pipe roughness, incorrect pump curves, or oversized pump installation. For this study, the pumping capacities observed during the pump testing will be used as the reported capacity. The pump testing details are provided in Appendix D. It should be noted that Mill City replaced the existing pump controllers at each of the lift stations in September 2023 as a part of the short-term improvements identified in the previous master plan.

Additionally, each of the lift stations have an onsite generator with an automatic transfer switch in the event of a power outage. The lift stations have redundant level sensors and alarms. There are not any provisions for bypass pumping in the event of a line break, however the wetwell overflow pipeline consists of additional storage to allow for time to repair the lift station. The overflow volume and time to fill are also included in the table below.

TABLE 2-7: LIFT STATION INVENTORY

Lift Station Name	River Rd Lift Station	First Ave Lift Station	Spring St Lift Station
Type	Duplex; Submersible	Duplex; Submersible	Duplex; Submersible
Year Constructed	1990	1990	1990
Motor Size (HP)	7.5	10	20
Reported Capacity (gpm)[1]	100	130	230
Design Head (ft)[2]	65	50	75
Wetwell Diameter (ft)	8	8	10
Wetwell Depth (ft)[3]	11.8	9.7	15.75
Lead Pump On (ft)	2.50	3.00	4.5
Lead Pump Off (ft)	1.50	1.50	1.5
Lag Pump On (ft)	2.75	3.50	n/a
Lag Pump Off (ft)	1.75	1.75	n/a
Overflow Level (ft)[4]	6.2	5.25	8.25
Level Indicator Type	Pressure Transducer	Pressure Transducer	Pressure Transducer
Flow Meter (Y/N)	Yes	Yes	Yes
Pressure Gauge (Y/N)	No	No	No
Back-up Power	Yes, Onsite	Yes, Onsite	Yes, Onsite
Transfer Switch	Automatic	Automatic	Automatic
Odor/H2S Control	No	No	No
Force Main Diameter (in)	4	4 to 8	8
Force Main Length (ft)[5]	1,900	5,300	5,850
Overflow Storage (gal)	2,050	1,950	7,800
Time to Fill Overflow (minutes)[6]	361	134	156

1) Reported capacities based on observed pumping rates from April 2023. Pump curves were not available.

2) Design head calculated based on reported capacity, elevation gain, and major losses.

3) From sump elevation to top of slab elevation.

4) Distance from sump elevation to overflow pipe invert.

5) Approximate length based on GIS.

6) Based on average annual flow rates within each lift station basin.

2.5.2. Pipelines

The collection system gravity pipes range in diameter from 4-inches to 8-inches. There are very few manholes throughout the system and most contain cleanouts. A summary of the pipeline sizes and material is shown in Table 2-8. The majority of the system's pipeline was installed at the same time in 1992. Areas that have developed since 1992 have connected into the existing collection system.

TABLE 2-8: GRAVITY PIPELINE INVENTORY

Pipe Length (ft) (Rounded)							
	Material[1]	DI	HDPE	PVC	Not Specified	Total	% of Total
Diameter (in)	4	600	0	50,600	500	51,700	86%
	6	0	0	2,700	100	2,800	5%
	8	0	0	5,700	0	5,700	9%
	Total	600	0	59,000	600	60,200	100%
	% of Total	1%	0%	98%	1%	100%	-

1) DI = Ductile Iron; HDPE = High-Density Polyethylene; PVC = Polyvinyl Chloride

The collection system also consists of approximately 12,900 feet of pressure sewer pipe ranging in diameter from 2-inch to 8-inch. The pressure sewer pipe is primarily for conveying flows from lift stations to either the next gravity collection basin, or straight to the WPCF. There are some segments of the pressure sewer lines with service laterals connecting into it. These services have individual pumps which pump into the pressure mainlines.

2.6. MODEL DEVELOPMENT

A hydraulic model was developed to evaluate the existing and future collection system to identify potential bottlenecks and capacity deficiencies. InfoSWMM Suite 14.7 Update #2 was selected as the modeling software for this project. InfoSWMM is a fully dynamic model which operates in conjunction with Esri ArcGIS and allows for evaluation of complex hydraulic flow patterns. A variety of sources were used in developing the hydraulic model and are described below:

- Pipes: The record drawings from the collection system installation in 1992 were used as the primary source for developing the pipeline characteristics including diameter, slopes, connectivity, and manholes/cleanout locations. Record drawings from development that occurred since the original collection system installation were used to input the additional collection pipelines.
- Pumps: Some information from the original collection system record drawings were used to input lift station characteristics, however, major improvements were made to all three lift stations in 2009-2010. Record drawings from these improvements were the primary source for lift station characteristics including wetwell dimensions, elevations, overflow provisions, and connectivity. Pump curves for the lift stations were used to model the pumps, however, an adjusted pump curve was used for the Spring LS because the pump testing results were lower than what the pump curve suggests. The pumps were calibrated so the model outputs matched the pump test results. The Mill City operators provided the current operating setpoints (on/off settings) for each lift station and were used in the model.
- Flows: Several flow scenarios were included in the model evaluation and include the ADWF and the PDF_5. The ADWF's were assigned based on the lift station basins. More detailed flow data was unavailable; therefore, the lift station basin's flows were spread evenly across model junctions. Supervisory Control and Data Acquisition (SCADA) data was not available at the lift stations nor WPCF therefore no diurnal curve was developed specifically based on Mill City flows. A representative diurnal curve was developed based on flow data from the City of Stayton which is located approximately 20 miles to the west of Mill City. The diurnal curve was modified to match the peak flows identified in the planning criteria. Rainfall-derived infiltration and inflow (RDII) flows were assigned to junctions based on representative sewer sheds. The RDII characteristics were adjusted to match the expected peak flows. Additional discussion regarding the flow analysis will be discussed in the next section.

It is important to note that one of the basic assumptions of the hydraulic model is that all pipelines are free from physical obstructions such as roots and accumulated debris. Such maintenance issues, which certainly exist, must be discovered and addressed through consistent maintenance efforts. The modeled capacities discussed in this chapter represent the capacities assuming the wastewater collection lines are in good working order. Note, the City is currently in the process of cleaning and inspecting the entire sewer collection system and is anticipated to be completed by May 2024.

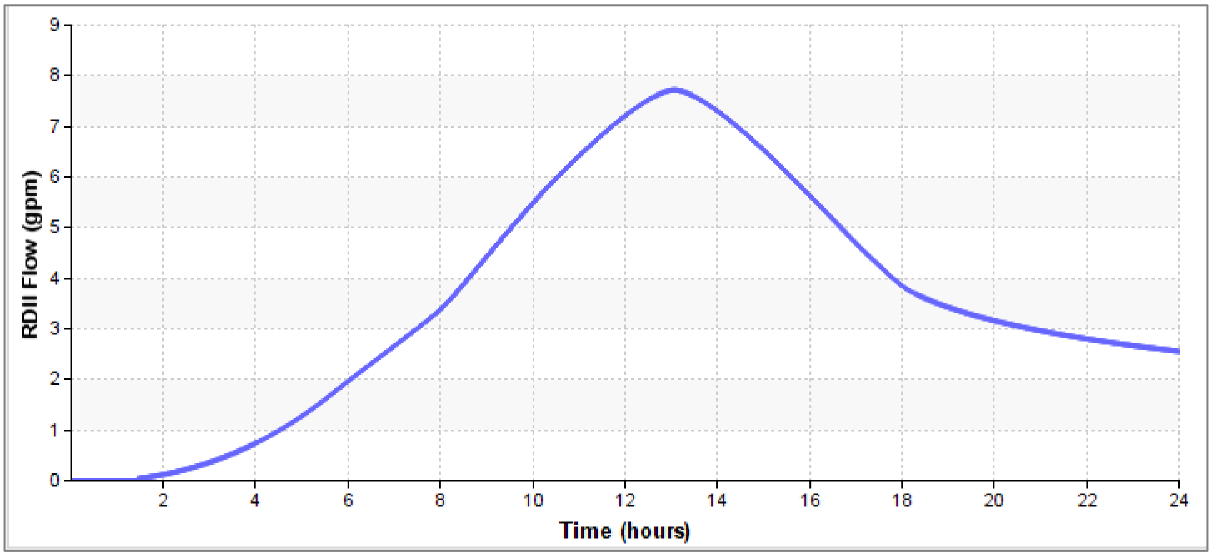
2.7. MODEL CALIBRATION

Typical practice for calibrating a collection system model is to complete flow monitoring at a handful of locations throughout the system for a period of time to record flow patterns, peak flows, and daily volumes within each flow monitor basin. Flow monitoring was not completed as a part of this study due to the lack of appropriate locations to install flow monitoring equipment, therefore additional assumptions had to be made regarding the model calibration. Two scenarios were used to calibrate the model: ADWF and PDF_5. The ADWF (also referred to as the base flows) were assigned by distributing the ADWF planning criteria of 0.087 MGD (60.4 gpm) to junctions within the collection system.

The flows were assigned individually by lift station basins. Based on 2022 lift station flows, the Spring Street LS accounts for an average of 81% of daily flows in the dry season and 71% of daily flows in the wet season. The First Avenue LS accounts for 19% of the daily flows in the dry season and 29% of daily flows in the wet season. The River Road LS is upstream of the First Avenue LS and accounts for 45% of the daily flows during the dry season but only 33% during the wet season. These flow splits were used to assign the system wide flows into each lift station basin. The diurnal curve from Stayton discussed previously was assigned to each flow junction. The data points used for calibration included the total daily volume at the WPCF and lift stations, matching peak inflows at the lift stations, and the WPCF, and lift station pumping rates. The model outputs were compared to these known data pumps and adjustments to the model flows, patterns, and pump curves were made until the results were matching. The model was considered calibrated if the flows were within +10% or -5% of the known values.

The next scenario used to calibrate the model was the PDF_5. This scenario was also used to evaluate the system's capacity. The base flows account for approximately 40% of the PDF_5 indicating the remaining 60% is due to infiltration and inflow. In the PDF_5 scenario, the base flows were kept the same, and the RDII values were adjusted to match total flow volumes and peak flow rates. The RDII flows are calibrated by adjusting several input values which relate to the percentage of rainfall infiltrating into the collection system, the time it takes to infiltrate, and the time it takes to recede. An example of the resulting RDII inflow curve is illustrated in Figure 2-14.

FIGURE 2-14: RESULTING RDII INFLOW CURVE



2.8. EXISTING COLLECTION SYSTEM EVALUATION

The PDF_5 system flows were run in the calibrated model to assess flow velocities, capacity deficiencies, and compare with lift station pumping capacities.

Figure 2-15 illustrates the maximum flow velocities experienced under the PDF_5 flow scenario. As shown in the figure, the majority of the system has maximum flow velocities below 2 fps. The majority of the collection system consists of 4-inch pipe and would need approximately a 1% slope to achieve 2 fps at 75% full. The collection system was not all installed at or above the 1% slope, and therefore has maximum flow velocities that are lower than recommended. This may lead to increased build-up of sediment and debris and result in additional operational efforts to keep the pipelines clean.

FIGURE 2-15: EXISTING PEAK DAY FLOW VELOCITIES

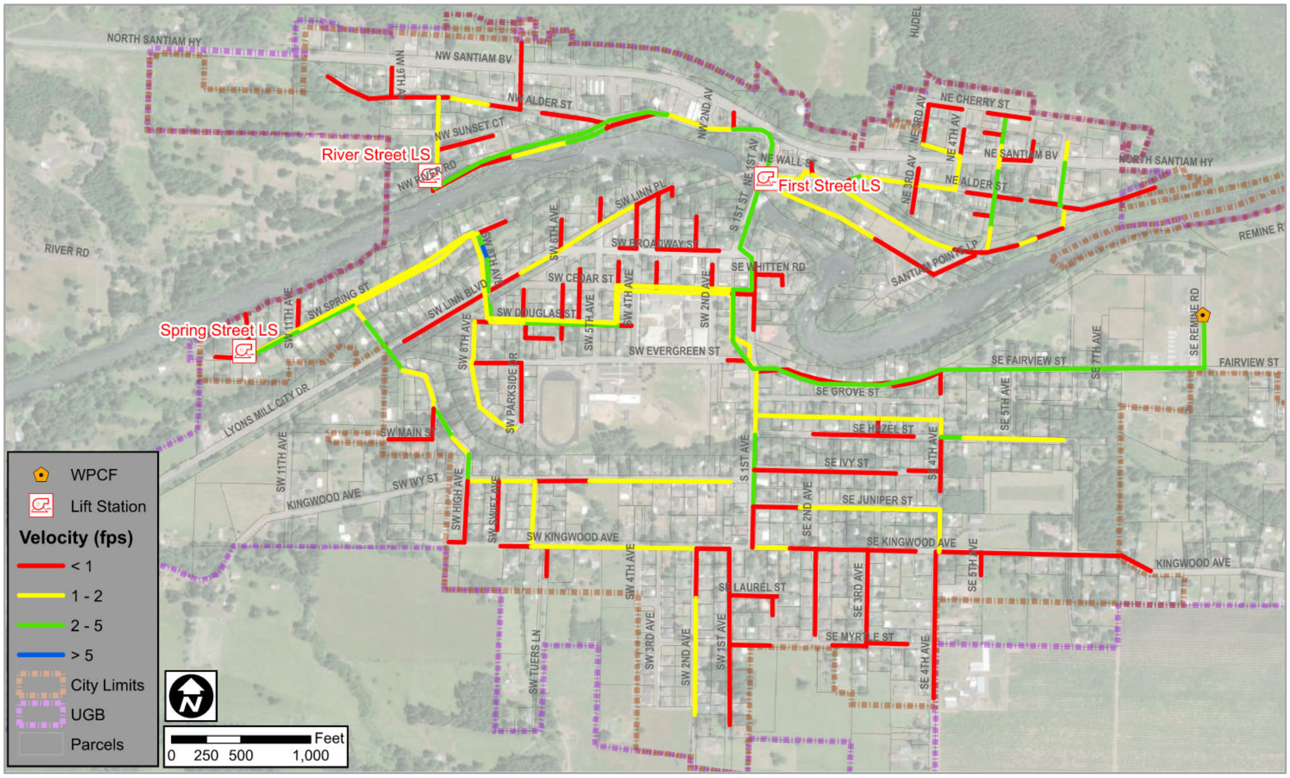
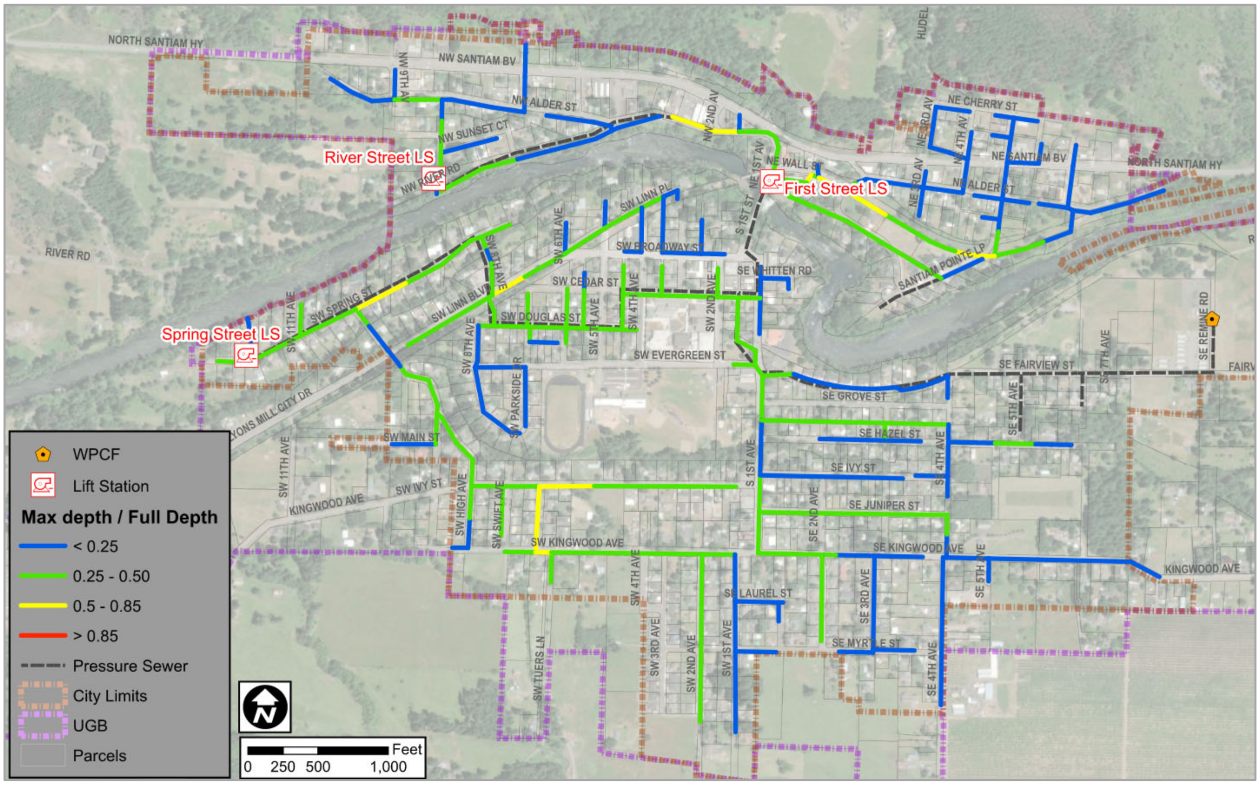


Figure 2-16 illustrates the existing depth of full depth (d/D) of the collection system under peak day demands. Most of the system shows sufficient capacity to convey the peak day flows, however there are some pipe segments which are between 50% and 85% full. These pipes should be monitored and if surcharging is observed, they should be upsized.

FIGURE 2-16: EXISTING PEAK DAY MAX DEPTH OVER FULLD EPTH



The peak inflows into the lift stations were compared to the firm pumping capacities based on the pump testing. The results are presented in Table 2-9. There are no existing deficiencies in the lift station capacities and there is room for additional growth within each lift station basin.

TABLE 2-9: EXISTING PEAK INFLOW VS. FIRM CAPACITIES

Lift Station Name	Firm Capacity (gpm)	Peak Inflow (gpm)	Surplus/Deficit (gpm)	Allowable Growth (capita)[1]
Spring Lift Station	230	207	23	231
First Lift Station[2]	133	91	42	426
River Lift Station	103	27	77	770

1) Based on the peak instantaneous flow in gallons per capita flow rate established in the planning criteria.

2) The First Lift Station peak inflow includes the flows discharged into this basin from the River Baisn. Therefore the allowable growth reported in this baisn includes growth in both the River and First Lift Station basins.

2.9. TREATMENT PLANT OPERATIONS

Recent operations concerns reported by staff include clogging and back up of the gravel filter and failure of the WPCF control system. As shown in Table 2-6, the peak day wet weather flow may exceed the hydraulic capacity of the gravel filter, leading to pooling of water on the filter surface. This negative effect may be magnified due to the gravel filter being uncovered and filling with precipitation during the rainy season, airborne organics from trees, as well as increased peak wet weather flows. Operators have reported that the filter back up generally occurs during the winter rainy season.

2.10. FINANCIAL STATUS OF EXISTING FACILITIES

The budget adopted for the City of Mill City 2020-2021 sewer fund included revenue of $437,577 and expenses of $323,475 for a net revenue of $114,102, with 433,243 coming from sewer monthly charges. Materials and service costs for the 2020-2021 fiscal year adopted for the Mill City sewer fund totaled $132,975. The budget approved for 2021-2022 included $452,816 in revenue and 316,650 in expenses, for a net revenue of $136,166, with $448,400 coming from sewer monthly charges. Materials and service costs for the 2021-2022 fiscal year adopted for the Mill City sewer fund totaled $127,150. Financial documents can be found in Appendix C.

2.11. WATER/ENERGY/WASTE AUDITS

No audits have been conducted for the Mill City wastewater collection or treatment systems in the past three years.

2.11.1. Treatment Plant Energy Evaluation

Effluent from the treatment plant is disposed of through subsurface drainfields located west of the WPCF. The Effluent Pump Chamber consists of three effluent pumps for disposal. Each effluent pump has a 3 horsepower (hp) motor and is rated at 300 gpm at 22 feet total dynamic head. The pumps are controlled by a level transmitter in the Effluent Pump Chamber, and the high-level float switch in the Influent Pump Chamber. Normal automatic operation is for one pump to operate at a time and to discharge to a single drainfield at a time. During high flow conditions, a high-level float in the Influent Chamber activates effluent pumps 1 and 2 to run simultaneously. At this time, changing the gravel filter feed pumps and effluent pumps to variable frequency drive (VFD) motors would not result in significant cost savings for the treatment plant, since the pumps are run intermittently to match the capacity of the gravel beds and drainfields.

2.11.2. Collection System Energy Evaluation

The only components of the collection system that consume energy are the three existing lift stations. The lift station pumps do not currently have VFDs and are operated at full speed once turned on. Generally, VFDs provide greater operational flexibility and improved efficiency across a wide range of flows. They can also be used to decrease the number of pump starts in a system which will reduce the wear on the pump and motor. However, the existing lift station pumps are relatively small compared to other wastewater systems and the pumps are sized adequately to convey peak flows, while not operating with excessive pump starts and stops. Incorporating VFDs would not likely lead to significant energy savings, however, as flows increase and the lift stations need to be upsized for higher flows, VFDs or soft starts should be considered.

CHAPTER 3 - NEED FOR SYSTEM IMPROVEMENTS

This chapter intends to summarize the deficiencies based on the existing facility evaluation, and in anticipation of future flows and loadings to the WPCF. Concerns surrounding health, sanitation, security, aging infrastructure, and reasonable growth should be addressed to meet the needs of the system throughout the planning period.

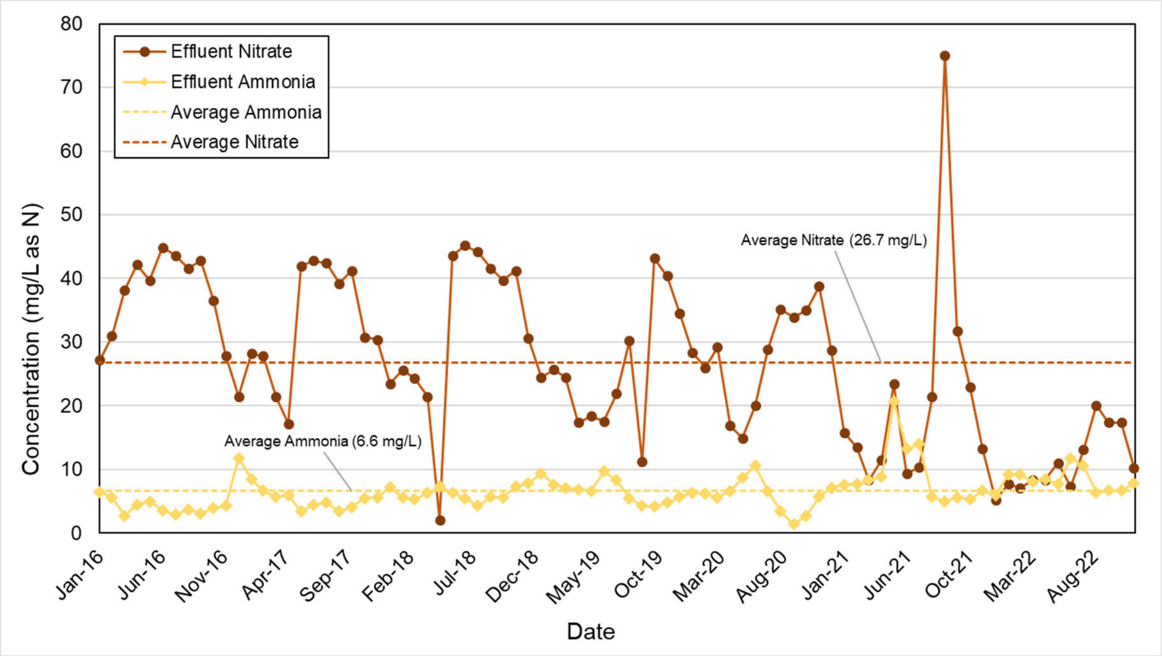
3.1. HEALTH, SANITATION, ENVIRONMENTAL REGULATIONS, AND SECURITY

The Oregon DEQ permits the operation of a WPCF on the east side of Mill City, just south of the North Santiam River with discharge into drainfields east of Kimmel Park (Permit number 101736). Maximum daily influent flow is permitted at 185,000 gpd. Influent limitations include a maximum of 300 mg/L BOD_5, 25mg/L greases and oils, 150 mg/L TSS, and 150 mg/L TKN. Effluent from the pollution control facility may not exceed 20 mg/L BOD_5 or TSS, and total effluent flow should be approximately 50% of the maximum daily or peak flow to the system. Mill City's treatment permit requires influent and effluent monitoring as well as groundwater monitoring at several sampling points near the WPCF. Per the Three Basin Rule (OAR-340-041-0350), discharge to surface water is prohibited for newly permitted pollution control and treatment facilities. All groundwater protection requirements of OAR-340-040-0030 must also be met.

Current peak day wet weather flows have already exceeded the design and permitted capacity of 185,000 gpd. With flows projected to increase in the 20-year planning period, Mill City will need a pollution control facility with higher influent capacity. Current effluent flow has also already exceeded the peak day wet weather hydraulic loading design capacity of the gravel filter and the drainfields.

Currently, there is no limit on nitrate or ammonia levels in treated effluent leaving the facility. A new WPCF that includes secondary treatment basins for removal of ammonia as well as nitrate would increase the quality of the discharged effluent. This in turn would increase the quality of groundwater as well as surface water in the NSC compared to the current treatment technology at the Mill City WPCF. Figure 3-1 provides levels of nitrate and ammonia in the current WPCF effluent. As discussed in Chapter 1 and throughout the report, a new WPCF as well as the treatment technologies proposed in Chapters 4, 5, and 6 would greatly reduce the levels of contaminants discharged to NSC groundwater. Additionally, as the proposed discharge site will be located further from the North Santiam River, natural subsurface processes would facilitate attenuation of the contaminants to lower levels than the current effluent discharge scheme by the time the effluent reaches the River, as the current drainfields are located directly adjacent to the River.

FIGURE 3-1: CURRENT WPCF NITRATE AND AMMONIA EFFLUENT CONCENTRATIONS



The average effluent ammonia and nitrate concentrations from 2016 to 2022 are approximately 6.6 and 26.7 mg/L, respectively, for a total inorganic nitrogen concentration of 33 mg/L. The proposed WPCF technologies described in Chapters 4, 5, and 6, would be designed to treat total inorganic nitrogen concentrations down to 6 mg/L (5 mg/L nitrate and 1 mg/L ammonia with secondary treatment alone) or, where permitting limits require, down to 2 mg/L (1 mg/L nitrate and 1 mg/L ammonia with secondary treatment and tertiary treatment) on average. This would represent a decrease of 6 times the concentration of discharged ammonia and a decrease of over 5 times the concentration of nitrate with secondary treatment at the future proposed facility. If tertiary treatment for additional nitrate removal is also chosen, the average concentration of nitrate discharged from the treatment facility would be over 20 times less than the current process. The treatment technologies, discharge requirements, and cost to the community should all be taken into consideration when selecting the final treatment processes and equipment for the future WPCF.

The populations of both the City of Mill City and the City of Gates are limited by wastewater infrastructure and development. In the City of Gates, new residential developments are limited by the minimum lot sizes required for construction of on-site septic systems and drainfields. Development in Mill City is constrained as the WPCF has reached its design capacity, making it difficult for new residents to obtain new connections. The minimum lot size requirements in Gates and the design capacity of the Mill City WPCF hinder the development of new residential lots as well as industrial or commercial facilities in the NSC.

3.2. COLLECTION SYSTEM REGULATORY AND EVALUATION CRITERIA

The existing collection system was evaluated against the following criteria. These criteria consist of a combination of regulatory requirements, general industry standards, and Mill City's Public Works Design Standards.

Lift stations must meet the DEQ's requirements which include the following:

- Redundant Pumping Capacity – The DEQ design criteria requires the lift station firm capacity (largest pump out of service) to be capable of conveying the larger of the 10-year dry-weather or 5-year wet-weather event.

- Hydrogen Sulfide Control – Hydrogen sulfide can be corrosive (especially to concrete materials) and lead to odor problems. Where septic conditions may occur, provisions for addressing hydrogen sulfide should be in place.
- Alarms – The alarm system should include high level, overflow, power, and pump fail conditions. The DEQ also requires an alarm condition when all pumps are called on (loss of redundancy alarm) to keep up with inflow into the pump station.
- Standby Power – Standby power is required for every pump station because extended power outages may lead to wastewater backing up into homes and sanitary sewer overflows. Mobile generators or portable trash pumps may be acceptable for pump stations, depending on the risk of overflow, available storage in the wet well and pipelines, alarms, and response time.
- The DEQ has also established guidelines for wet well volumes, overflows, maximum force main velocities, and location/elevation relative to mapped floodplains.

Lift stations should be designed to handle peak flows with the largest pump out of service (defined as firm capacity).

Pipes should be considered full at 85% depth (d/D).

Capacity should be based on Manning's Equation with "n" = 0.013 and pipe flowing at full depth.

Force main velocities should not be less than 2 fps nor greater than 8 fps under design flows.

Pipelines in recommended improvements will be evaluated with the minimum slopes shown in These pipe slope recommendations are the same as recommended pipe slopes provided in the Ten State Standards[1].

TABLE 3-1: RECOMMENDED MINIMUM PIPE SLOPES

Pipe Diameter (in)	10 State Standards Minimum Slope (%)
8	0.4
10	0.28
12	0.22
15	0.15
18	0.12
21	0.1
24	0.08
30	0.058
36	0.046
42	0.037

Pipeline Regulatory Rules (CMOM Guidance). CMOM refers to Capacity Management, Operation, and Maintenance of the entire wastewater conveyance system. The vast majority of all sanitary sewer overflows originate from three sources in the collection system: 1) I/I, 2) roots, and 3) fats, oil, and grease (FOG). I/I problems are best addressed through a program of regular flow monitoring, T.V. monitoring, and pipeline rehabilitation and replacement. Blockages from roots or FOG are also addressed via a routine cleaning program. A FOG control program may also involve public education and regulations (e.g., requirements for installation and regular maintenance of grease interceptors). All new facilities believed to contribute FOG should be equipped with grease interceptors. The DEQ prohibits all sanitary sewer overflows.

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[1] Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environment Managers, 2014

The Oregon sanitary sewer overflow rules include both wet-weather and dry-weather design criteria. The DEQ has indicated that they have enforcement discretion and that fines will not occur for overflow resulting from storm events that exceed the DEQ design criteria (i.e., greater than a winter 5-year storm event or a summer 10-year storm event). In December 2009, the DEQ developed a Sanitary Sewer Overflow Enforcement Internal Management Directive that provides guidance for preventing, reporting, and responding to sanitary sewer overflows. The DEQ updated this document in November 2010. The Community's discharge permit also includes requirements for an Emergency Response and Public Notification Plan.

Excessive Infiltration & Inflow. EPA defines excessive I/I as the quantity that can be economically eliminated from a sewer system by rehabilitation. Some guidelines for determining excessive I/I were developed in 1985 by EPA based on a survey of 270 standard metropolitan statistical area cities (EPA Infiltration/Inflow Analysis and Project Certification, 1985). Non-excessive numeric criteria for infiltration were defined as average daily dry-weather flows that are below 120 gpcd. Similarly, a guideline of 275 gpcd average wet-weather flow was established as an indicator below which is considered non-excessive storm water inflow.

Pipeline surcharging occurs as flows exceed the capacity of a full pipe, causing wastewater to back up into manholes and service laterals. Surcharging of gravity pipelines is generally discouraged because of 1) the increased potential for backing up into residents' homes, 2) the increased potential of exfiltration, and 3) health risks associated with sanitary sewer overflows.

Any illicit cross connections, often from stormwater infrastructure, should be removed.

3.3. AGING INFRASTRUCTURE

Mill City's WPCF was originally constructed in 1992 as an upgrade to prior septic use. The pollution control facility was updated in 2010 by CH2M HILL, Inc. The 2021 North Santiam Sewer Authority WWMP produced by Keller Associates, Inc. identified deficiencies based on existing facilities evaluation, and future projected flows and loadings to the WPCF.

Several components of the existing WPCF have failed or are at the end of their useful life. Further updates and improvements needed at the Milll City WPCF in addition to the capacity issues. Conditional issues at the current facility include replacement of PLC, cleanout of the gravel filter, covering the gravel filter to prevent clogging and backup during winter, and installing septic tank specific alarms in the SCADA system to notify operators when a problem arises.

There are also a number of failing individual septic systems in the City of Gates that would not be needed with a new WPCF. Due to the amount of failing individual septic systems, the cost would be high to repair or replace them all.

3.4. REASONABLE GROWTH

Wastewater facility improvements are needed to stay ahead of potential increased population. Chapter 1 of this report discusses population growth projections for the 20-year and 50-year planning period and Chapter 4 provides projected wastewater flows and loadings associated with this growth. This section documents where the growth is anticipated to occur within the City limits and UGB. Figure 3-2 shows the locations of the projected growth areas and the number of people associated with each area. Additional details regarding each of the growth areas is included in Table 3-2.

The growth areas assume an equivalent dwelling unit (EDU) density of 4.5 homes per gross acre and a household size of 2.5 people per EDU. These values were developed with input from the City planner. 2020-2022 winter water consumption data was reviewed for residential and commercial account types and it was determined that 2.0 EDUs per commercial lot was representative of future commercial flows. The commercial growth areas were split into the number of lots expected with input from the City planner.

FIGURE 3-2: STUDY AREA GROWTH AREAS

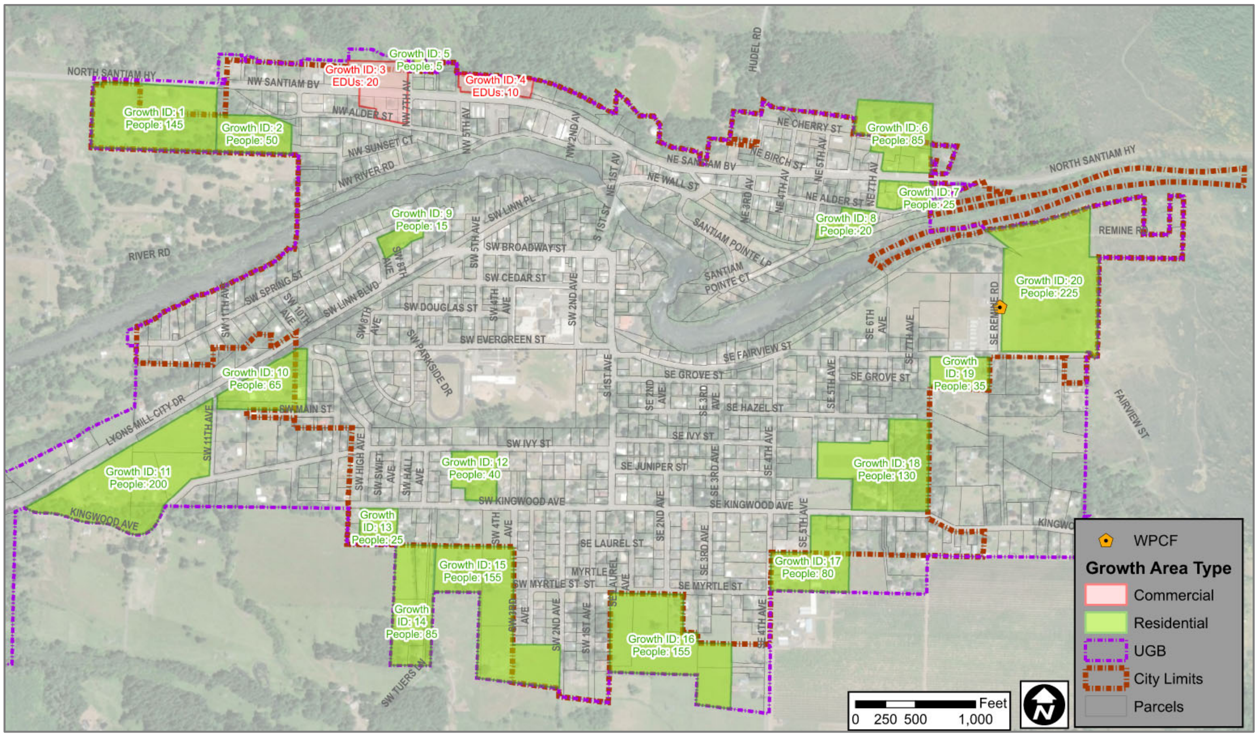


TABLE 3-2: GROWTH AREA DETAILS

Growth Area ID	Gross Area (ac)	EDUs	Type	EDUs per Acre	People per EDU	New Persons	PDF Load (gpm)[2]
1	12.8	51	Residential	4.0	2.5	128	17.28
2[1]	4.3	54	Residential	-	2.5	135	18.19
5	0.2	1	Residential	4.0	2.5	2	0.27
6	7.3	29	Residential	4.0	2.5	73	9.83
7	2.0	8	Residential	4.0	2.5	20	2.69
8	1.8	7	Residential	4.0	2.5	18	2.42
9	1.4	6	Residential	4.0	2.5	14	1.89
10	5.7	23	Residential	4.0	2.5	57	7.68
12	3.2	13	Residential	4.0	2.5	32	4.31
13	2.1	9	Residential	4.0	2.5	21	2.83
14	7.6	30	Residential	4.0	2.5	76	10.24
15	13.6	55	Residential	4.0	2.5	137	18.45
16	13.7	55	Residential	4.0	2.5	137	18.45
17	7.1	29	Residential	4.0	2.5	71	9.56
18	11.8	47	Residential	4.0	2.5	118	15.90
19	3.0	12	Residential	4.0	2.5	30	4.04
20	19.9	79	Residential	4.0	2.5	199	26.81
11	17.5	70	Residential	4.0	2.5	175	23.57
3	4.7	0	Commercial	n/a	n/a	0	7.03
4	2.1	0	Commercial	n/a	n/a	0	3.20
Total	**142**	**577**	**-**	**-**	**-**	**1,443**	**205**

1) Growth Area 2 is the Beech St. Apartments and consists of 54 units.

2) Based on existing planning criteria flows of 0.135 gpm per capita.

CHAPTER 4 - ALTERNATIVES CONSIDERED

4.1. TREATMENT ALTERNATIVES CONSIDERED

4.1.1. Description

In the development of viable treatment solutions for Mill City and Gates in the NSC, the primary objective is to assist in the effective and reliable treatment of its wastewater in an economical manner. Solutions are developed on a case-by-case basis and recommendations are made after consideration of the best siting and treatment solutions available, and extensive communication with City, County, and State staff.

Each design alternative is planned to meet the needs for a 20-year minimum period for treatment facilities. It is important to note that the 20-year design horizon relies on assumptions that were made for the demands and populations within each time period. These population and demand projections are estimates based on the best information available but may vary due to the unpredictable nature of growth and human movement. Equivalent development benchmarks could reasonably occur earlier or later than the proposed time periods; however, in all cases, the information presented herein meets or exceeds the industry and governing agency’s standard for these types of predictions. 20-year and 50-year projections for Mill City and Gates are based on Portland State University population projections.

Discussion in this section is presented in general terms regarding project alternatives for treatment system improvements in order to provide a background for the various solutions available for Mill City and Gates. Various alternatives exist to address the treatment needs. The alternatives discussed in the remainder of this report are evaluated based upon their ability to resolve the needs of Mill City and Gates, anticipated costs, environmental impacts, and operation and maintenance requirements.

4.1.2. Secondary Treatment Alternatives

Secondary treatment of wastewater must be capable of removing BOD_5, TSS, nitrifying ammonia, and denitrifying nitrate to meet permit limits in the North Santiam Canyon. The selection of the secondary treatment process influences the evaluation of other treatment processes, including headworks screening, disinfection, and tertiary treatment. Thus, this process is evaluated, and a recommendation provided prior to discussing other treatment processes.

Secondary treatment typically consists of a biological reactor and a clarification or sludge separation process. In the biological reactor, an aerobic environment is provided to allow heterotrophic and autotrophic bacteria to grow. This reactor may also have a recycled sludge flow to help maintain a healthy microbial population. The sludge separation process typically consists of a gravity clarifier or a physical membrane filtration barrier that separates sludge from the water. The technologies considered below are commonly used both nationally as well as regionally.

Size and Redundancy

The secondary treatment process will be sized to hydraulically pass the peak hour flow with one biological reactor. There will also be sufficient biological aeration capacity for peak aeration needs with one unit out of service. Per EPA requirements, secondary clarifiers will be sized to treat 75% of the peak hour flow with one clarifier offline. The biological reactors will be designed to treat the maximum month loading, with redundancy in mechanical equipment such as blowers, aerators, mixers and pumps.

Performance Requirements

The secondary treatment process will be required to meet the BOD_5, TSS, ammonia, and nitrate limits as determined by Oregon DEQ in accordance with the Three Basin Rule. The process will be designed to be expandable for future flows as well as future permit limits. Other performance criteria include flexibility in operation and minimal maintenance and operator inputs.

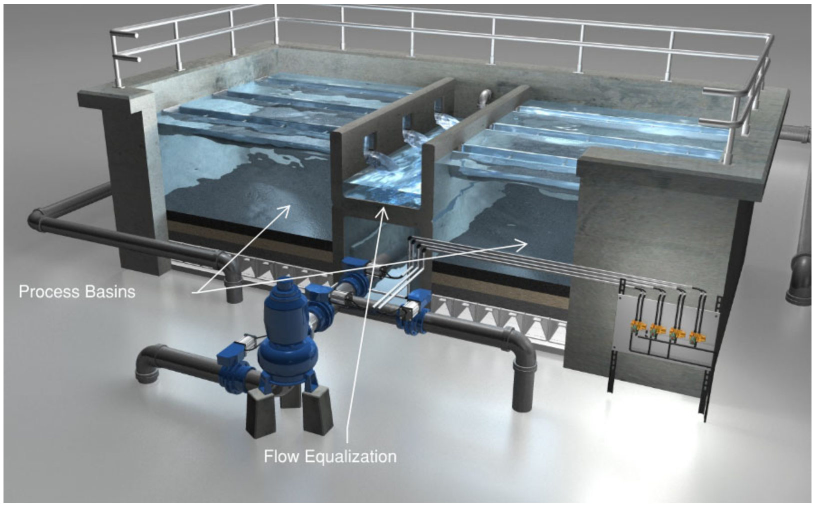
Three technologies were evaluated for secondary treatment:

- Sequencing batch reactors
- Oxidation ditches with clarifiers
- Membrane bioreactors

Sequencing Batch Reactors

The first secondary treatment technology considered is the sequencing batch reactor (SBR) system. The system consists of redundant process basins, with diffused aeration at the bottom of the basins. While there are sometimes variations in the process design, generally the basins are sequenced such that one basin is filling with screened influent while the other is treating a batch of wastewater. When one basin is filled completely with influent, aeration is initiated, and the wastewater is treated biologically. At the end of the aeration step, aerators are turned off and sludge is allowed to settle during the clarification step. An SBR system acts as an all-in-one treatment basin for aerobic and anoxic treatment, as well as a sludge settling basin. This treatment method precludes the need for many activated sludge basins as well as separate gravity clarifiers for solids removal. Many plants utilizing SBR secondary treatment technology are also present in Western Oregon. However, there are less options for process flexibility and optimization as there are not separate aerobic, anaerobic, and anoxic zones, and no internal recirculation is provided. The main process variations available for an SBR system are limited to aeration intensity and time, as well as decanting time (the time allowed for settling of produced sludge). A treatment facility utilizing SBRs for the secondary treatment system would likely be classified as a Class II wastewater treatment facility.

FIGURE 4-1: SEQUENCING BATCH REACTOR TREATMENT SYSTEM



*Headworks, pump/blower buildings, and solids handling are not shown here.

Oxidation ditches

Another secondary treatment technology alternative considered is the oxidation ditch system, coupled with secondary clarifiers. Oxidation Ditch systems consist of an oval concrete structure in which wastewater is cycled with aerator impellers that provide both the aeration and mixing of the tank. Circular secondary clarifiers, with spiral sludge blades, would also be required. For both the process basins, as well as the secondary clarifiers, multiple tanks would be provided to allow for hydraulic and treatment redundancy. For additional aeration redundancy, a standby mechanical aerator/mixer will be provided with the treatment design. Return activated sludge (RAS) pumps would be provided and installed in a nearby building, with a redundant RAS pump included. Control of the system would be simple, with the speed of the aerators being adjusted to maintain a set dissolved oxygen concentration in the process basins and the RAS pumps' speed being adjusted to maintain a particular ratio of RAS flow back to the basins. This design provides slightly more operational flexibility than the SBR system. Oxidation ditch systems are quite common throughout the US. However, there are not many located in Western Oregon. A treatment facility utilizing oxidation ditches for the secondary treatment system would likely be classified as a Class II wastewater treatment facility.

FIGURE 4-2: OXIDATION DITCH TREATMENT SYSTEM

Membrane bioreactors

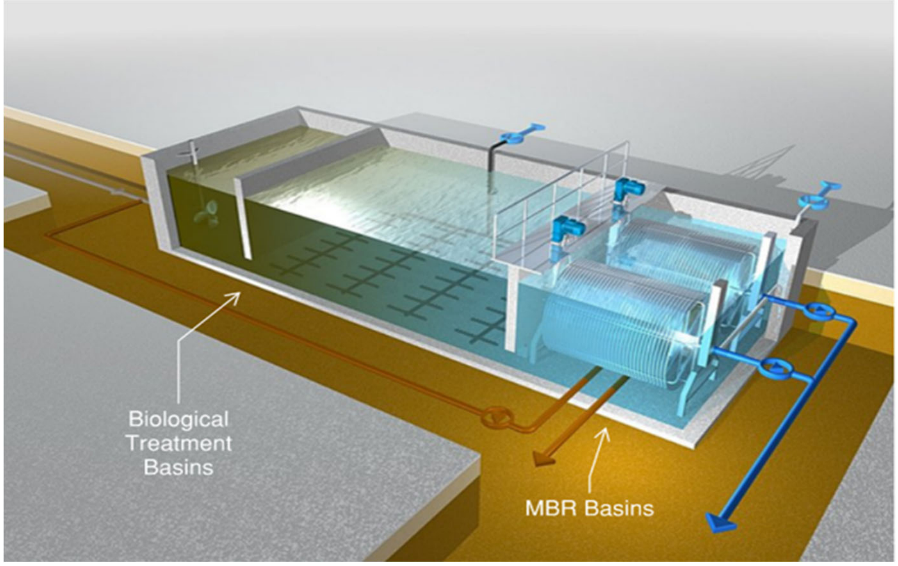
Membrane bioreactors (MBRs) vary somewhat from the previously presented alternatives. While this process continues to use an aerated reactor with blowers and diffusers, the sludge separation process uses filtration membranes instead of gravity clarification. This allows for much higher concentrations of sludge in the basins that would not otherwise be possible with the other process technologies, as the clarifiers are limited in the ability to separate sludge by gravity. A higher concentration of sludge results in smaller process volumes, and consequently a smaller footprint. Note, however, that the membrane bioreactors are typically required to be installed in a climate-controlled building and include their own set of blowers and a chemical dosing system to keep the membranes sufficiently clean for optimal filtration. Furthermore, the capacity of the membranes is derated with low water temperatures.

Equipment and infrastructure to be provided in this option include aeration basins, diffusers, mechanical mixers for basins without aeration requirements, aeration and membrane scour blowers, membrane modules, permeate pumps, RAS pumps, chemical dosing and storage, connecting air piping and water piping. Redundancy would be provided with multiple basins, standby membranes and redundant mechanical equipment (pumps and blowers). In addition to the equipment noted above, the membrane system requires an additional stage of headworks screening with smaller openings to prevent build-up of solids that may result in damage of the membranes.

Membrane bioreactor processes provide the highest level of flexibility in treatment capabilities and modularity, while also producing the highest quality of effluent. However, they also carry the highest annual costs, in both power and chemical usage, as well as the replacement costs of the membranes (which typically have a life of 10 years). In order to keep the membranes functioning properly over their expected useful lives, additional fine screening processes would be installed in the headworks, which adds to the capital costs of the MBR option.

Because membrane bioreactors utilize smaller process basins than the other options, and the most expensive component of the system is the mechanical components, this option favors modularity in expansion. This means that a smaller system can be provided to meet current flows and loadings, and as these increase over the design period, additional membranes can be added. This additional equipment may incrementally incur less cost than adding on additional equipment for the other options with future increases in service population, flows, and loadings to the wastewater treatment plant. As PSU's population research center projects a combined population of Mill City and Gates of around 3,500 people in 2045, there may not be a large benefit to the community in terms of process modularity savings, since the communities in the NSC will still be relatively small over the next 20 years. Additionally, a treatment facility utilizing MBRs for the secondary treatment system would likely be classified as a Class III wastewater treatment facility due to the inclusion of pressurized membrane filtration units.

FIGURE 4-3: MEMBRANE BIOREACTOR TREATMENT SYSTEM



*Headworks, pump/blower buildings, and solids handling are not shown here.

4.1.3. Headworks

Headworks treatment consists of processes to remove deleterious material and grit, flow meter and sample influent prior to flows entering downstream processes. Depending on site configurations, this process may also include pumping downstream of the above-mentioned processes (in the case of this particular design, it is anticipated that pumping will be required to lift flows into the secondary treatment process).

Size and Redundancy

Each headworks treatment process will be sized to hydraulically pass the peak hour flow and will include redundancy as required by Ten State Standards. This includes a manual bypass screen and a bypass of the grit removal process. A standby pump will be provided in the influent lift station.

Performance Requirements

The automatic influent screen must meet the following requirements:

- Automatic mechanical screening
- Automatic screening washing, compacting (dewatering), and transport
- Require limited maintenance
- Minimum screening size of ¼”

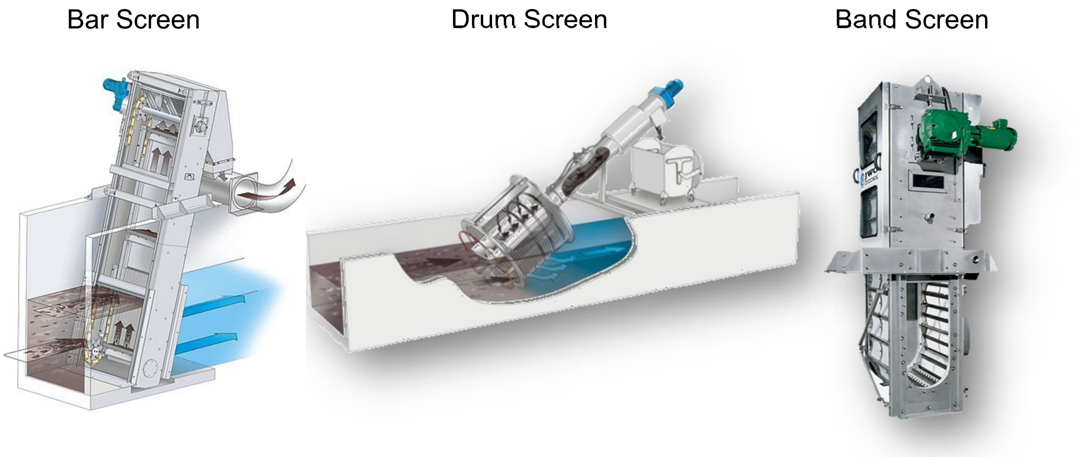
The grit removal and dewatering systems must meet the following requirements:

- Automatic grit removal
- Automatic grit classification
- Maximized grit removal efficiency
- Small footprint
- Require limited maintenance

Screening

Screening of raw wastewater is necessary to avoid clogging of mechanical equipment and pumps, and accumulation of debris in downstream basins. This is accomplished with a mechanical screen with openings no larger than ¼”. The existing screen at the WPCF is a manually cleaned static screen, which requires monitoring and maintenance to ensure it does not become clogged. Keller recommends upgrading the influent screening to one with an automatic washer/compactor. The equipment would automatically remove debris accumulating on the screen and would dewater it and compact it to minimize costs associated with hauling and disposal of screened material. Multiple types of screens are available for this process, including bar screens, drum screens, and band screens. These options are shown in Figure 4-4. For a plant utilizing a membrane bioreactor for secondary treatment, a fine screen should also be included to protect the sensitive membrane equipment later in the treatment process. This additional screening cost is taken into account in the capital costs for the MBR secondary treatment option. The cost for screening and washing/compacting equipment is included in the headworks cost estimates summary in Chapter 5.

FIGURE 4-4: SCREEN ALTERNATIVES


Bar Screen

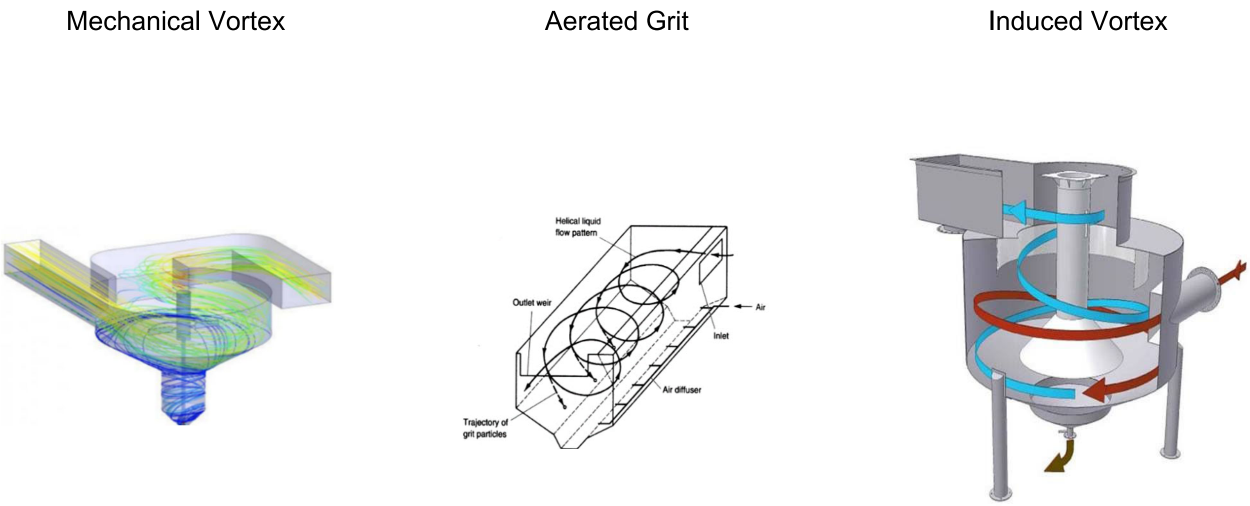
Drum Screen

Band Screen

Grit Removal

Raw wastewater contains inorganic material, such as grit, gravel, and sand that must be removed in a separate process from screening. Grit can wear out pumps prematurely and can deposit in the process basins. A grit removal process typically consists of a grit trap, which produces velocities or flow patterns that allow grit to settle out and separate from the wastewater stream, a grit slurry pump or conveyor, which moves the separated grit away from the trap, and a grit classifier or washer, which dewaters the grit prior to disposal. Among other options, grit trap systems are discussed here: aerated grit, mechanical vortex and induced vortex. These systems are shown in Figure 4-5.

FIGURE 4-5: GRIT REMOVAL TECHNOLOGIES


Mechanical Vortex

Aerated Grit

Induced Vortex

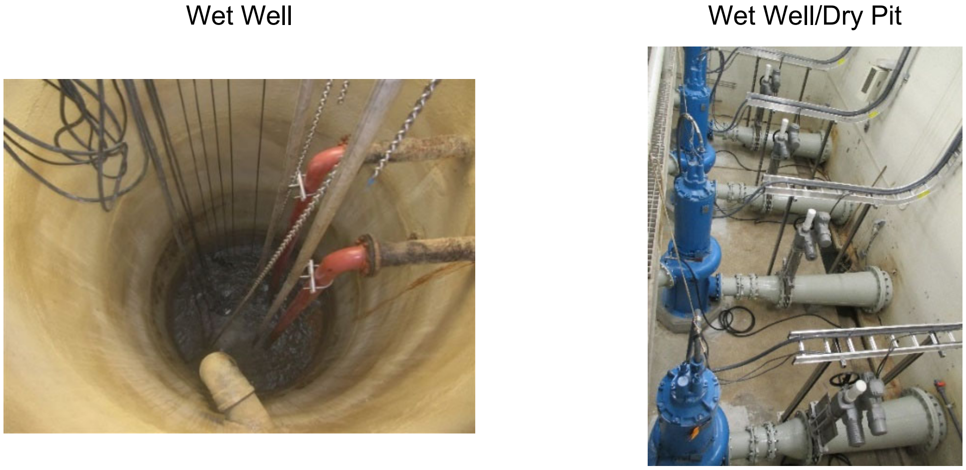
Aerated grit systems are not as efficient in grit removal as the mechanical and induced vortex systems. Additionally, aerated grit systems require blowers and can generate odors in the headworks building. Certain manufacturers of mechanical and induced vortex grit traps are able to achieve grit removal efficiencies of up to 95% of grit particles 140 micron and larger.

Because of this, and due to the relatively simple operation of these systems, it is recommended that the design be based around one of these two options. A preliminary review of currently available equipment suggests that the induced vortex grit removal technology may be more cost effective than mechanical vortex. With the mechanical vortex technology, manufacturer equipment is provided, but the concrete structure that creates the vortex flow pattern and houses the mechanical equipment must be designed and constructed, while manufacturers of the induced vortex option offer prefabricated units that may be placed into a precast manhole which generally results in cheaper and more simple construction compared to the mechanical vortex option. The design will also include a grit slurry pump (either a self-priming pump or a vacuum primed centrifugal pump) as well as a grit classifier.

Influent Pumping

Where the headworks processes would have a water surface elevation lower than the downstream treatment processes, pumping would be required. This would typically be done with dry pit pumps and a wet well, or submersible pumps installed directly in the wet well. Figure 4-6 shows these two options. In a wet well/dry pit lift station configuration, pumps and valves are housed in a pump room (dry pit or dry well), that is easily accessible. A wet-well is included adjacent to the dry-pit that serves as the wastewater receiving well. An advantage of dry-pit lift stations is that they allow easy access to the pumps for visual inspection and maintenance. Pumps located in a dry-pit configuration are generally easier to repair than submerged pumps. One advantage of submersible lift stations is that they typically cost less than wet well/dry pit configurations and are designed to operate without frequent pump maintenance. Submersible lift stations also do not usually require large aboveground structures and tend to blend in with their surrounding environment in residential areas. They require less space and are easier and less expensive to construct for wastewater flow capacities of 10,000 GPM (14.4 MGD) or less.[1] Based on the expected size of the WPCF, a wet well with submersible pumps is recommended for this project.

FIGURE 4-6: LIFT STATION CONFIGURATION ALTERNATIVES


Wet Well

Wet Well/Dry Pit

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[1] United States Environmental Protection Agency. (2000). *Collection Systems Technology Fact Sheet*. Washington, D.C.: Office of Water.

Flow Metering and Sampling

It is anticipated that flow to the headworks processes will be pumped in a closed conduit. Based on this, it is recommended that magnetic flow metering be used for recording of wastewater influent flows in the headworks (where influent flow is open channel, it is more favorable to use a Parshall flume for influent flow monitoring). Influent sampling can be accomplished with a refrigerated, automatic sampler that can take composite samples and store them until the plant staff is ready to collect them.

4.1.4. Disinfection

The current WPCF permit does not have specific limits on E. coli present in the effluent. However, a monitoring well system is in use at the Mill City WPCF drain fields, and fecal coliform at monitoring well 1 is not to exceed 200 organisms per 100 mL. It is expected that the future WPCF permit will include limits on E. Coli in the discharged effluent, which is to be controlled with disinfection. There are several options for disinfection, including UV, chlorination, and peracetic acid. Each of these options is able to reduce the E. coli levels to the levels that would likely be required by the WPCF permit. In order to avoid the use of expensive, hazardous and potentially difficult to acquire chemicals, and in order to avoid possible issues with meeting total residual chlorine levels in the effluent, it is recommended to proceed with a design based around a UV disinfection system.

Size and Redundancy

The new UV system will be able to handle the peak hour flow with one channel or unit out of service.

Performance Requirements

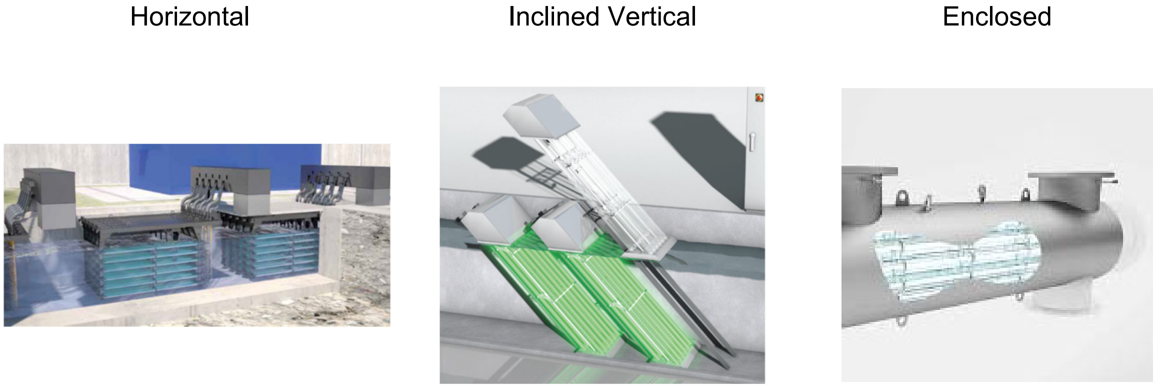
The UV Disinfection System will meet the following requirements:

- Capable of dimming lamps for dose pacing based on influent flow to save energy.
- Automatic wiping system to reduce the frequency of chemical cleaning.
- Easy access to equipment for maintenance and repair.
- Equipment shall be validated for performance as per National Water Research Institute (NWRI) guidelines; calculations shall not be permitted to verify delivered dose.
- Low pressure, high output system based on the anticipated power consumption of other options.
- A UV transmittance monitor will be installed as part of the control package to monitor water quality and provide alarms if the system is operating out of compliance.
- UV Transmittance: 65%
- Minimum Lamp Aging Factor: 0.7
- Minimum Lamp Fouling Factor: 0.8
- Minimum Lamp Life, hours: 9,000

Multiple types of UV disinfection equipment configurations are available and those being considered are shown in Figure 4-7. This section discusses the advantages and disadvantages of three configurations and provides a recommended disinfection technology for final design. They include:

- Horizontal Lamp Systems
- Inclined Vertical Lamp Systems
- Closed Vessel Systems

FIGURE 4-7: UV DISINFECTION ALTERNATIVES



Horizontal

Inclined Vertical

Enclosed

Open Channel Horizontal

Open channel UV systems are among the most commonly used UV systems in wastewater treatment plants. As such, there are several manufacturers that provide this type of equipment, and service and parts are generally common. These systems typically consist of multiple racks of bulbs that are oriented parallel to the water flow in steel or concrete channels. Each rack has bulbs stacked vertically and depending on the flow and channel configuration, can have multiple racks side by side. Modern horizontal systems will have controllers that are able to dim the bulbs to provide a consistent dose across a range of flows, thus enabling the power usage to be optimized. Modern systems also include an automatic cleaning system to remove the buildup of foulants that accumulate on the bulbs. Systems which require a manual chemical dip tank for bulb cleaning should be avoided. Maintenance or replacement of bulbs is accomplished by lifting a single rack of bulbs out of the channel (either by hand or with a small portable crane). Compared to other configurations discussed, the horizontal system has smaller bulbs and will require a larger quantity of bulbs.

Inclined Vertical

The inclined vertical UV configuration has bulbs inclined approximately 45 degrees to the flow path, with the orientation of bulbs still parallel to the flow. Instead of racks being set vertically, a single rack is set horizontally, perpendicular to the flow. The inclined vertical UV configuration utilizes larger bulbs with higher output and as such requires fewer bulbs than the horizontal system. Modern inclined systems include hydraulic or electric lifting mechanisms that allow a single rack of bulbs to be extended out of the channel for maintenance or bulb replacement. This configuration also includes automatic cleaning systems. Inclined vertical UV disinfection systems are often found in larger treatment plants where they are most cost effective.

Closed Vessel

Unlike the other two configurations, the closed vessel UV configuration does not utilize a concrete or steel open channel. Instead, bulbs are installed in a closed vessel, or pipe, through which water is passed. In order for the bulbs to provide adequate treatment, and to ensure the bulbs do not overheat, the entire vessel must be full of water and pressurized. Thus, this system is best suited in applications where the feed water is pumped into the UV process.

This type of UV disinfection system would most likely be used following membrane bio-reactor secondary treatment as the MBR filtrate is pressurized. Service and replacement of bulbs is accomplished by isolating the UV vessel, opening an access hatch and removing the bulbs as required. As such, multiple vessels are required to provide continuous treatment capacity. As with the other options, automatic cleaning is provided.

Inclined vertical UV disinfection is not likely to be cost effective at a smaller treatment plant. Both open channel horizontal and close vessel UV disinfection would provide sufficient disinfection and could both be cost effective for the expected size for the Mill City WPCF. Chapter 5 provides a comparison of capital costs associated with open channel horizontal and closed vessel UV disinfection systems, as well as a recommended alternative.

4.1.5. Tertiary Treatment (Denitrification)

Historical groundwater data recorded since 1982[2] show nitrate concentrations in the Mill City/Gates groundwater to be around 1 mg/L on average. Keller Associates has contracted with hydrology and geology subconsultants (GSI Water Solutions, GSI, and GeoSystems Analysis, Inc, GSA) to evaluate groundwater quality and infiltration rates for multiple rapid infiltration sites for disposal of treated wastewater. As the results of the full groundwater analysis may not be available prior to the submission of this report, Keller has assumed stringent nitrate effluent requirements, and this section provides preliminary evaluation of tertiary treatment for denitrification where very low nitrate limits may be required in the permit. Technical memorandums from GSI are provided in Appendix I which identify impacts to groundwater and the Santiam River for given effluent nitrate concentrations. It is important to note that the closest source of groundwater nitrate data to the current Mill City WPCF had the highest concentration of nitrate (Mill City Drinking Water Well, Linn County, Water System ID 00520) at approximately 1.4 mg/L average historical nitrate concentration, with the latest sampling in June of 2022 measuring 1.79 mg/L.

The current facility has no denitrification systems in place. A new WPCF would likely improve the local groundwater quality over that of the current system. One of the most common tertiary treatment processes for removal of nitrates in wastewater is biological denitrification utilizing a sand filtration system with an added carbon source for conversion of nitrates to nitrogen gas by denitrifying bacteria. If required, nitrate could be lowered to 1 mg/L using tertiary denitrification, bringing TIN to 2 mg/L in the treated effluent as opposed to 6 mg/L with secondary treatment alone. The cost for a denitrification process is included with the total project cost estimates in Chapter 6. However, should the permit limits not require a TIN of 2 mg/L, this process could be removed from the design, which would provide significant savings in capital and ongoing maintenance costs. Figure 4-8 shows a denitrification filter setup. A typical installation would consist of several filters for redundancy and to allow the system to be backwashed without interrupting treatment. A sand filter for denitrification would also be capable of achieving lower turbidity levels in treated effluent than secondary treatment alone.

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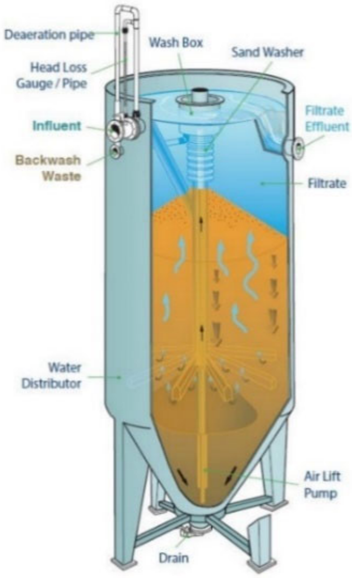
[2] Oregon Public Health. (2023). *Drinking Water Data Online*. Retrieved from yourwater.oregon.gov

FIGURE 4-8: DENITRIFICATION FILTER

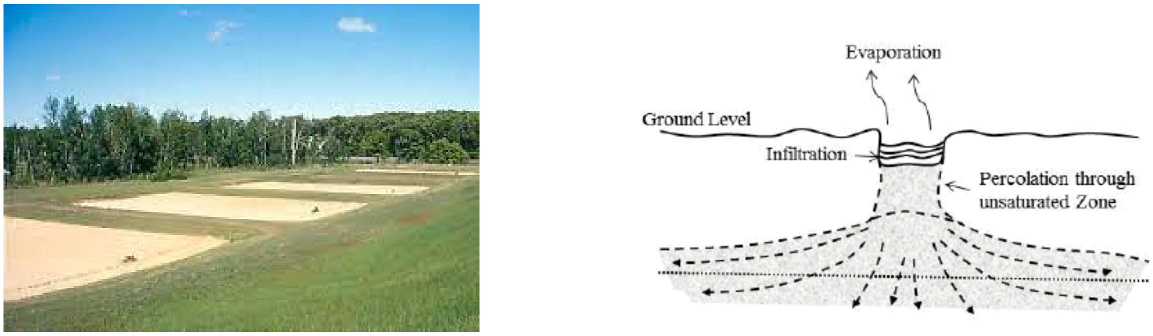


Other treatment options exist for removal of nitrates. Some of these technologies include ion exchange contactors, reverse osmosis (RO) membranes, and electrodialysis. These technologies are not commonly used in wastewater treatment systems, especially at smaller plants. The capital and operating costs of these systems, as well as production of concentrated waste streams or depleted filter media, make these options less feasible than biological denitrification with a sand filter, whose media can be backwashed and reused for many years. The use of pressure filtration technology, such as reverse osmosis, may also increase the operator classification required at the plant. Additionally, sand filters would remove more TSS in treated effluent compared to ion exchange or electrodialysis treatment trains.

4.1.6. Effluent Disposal

Treated effluent must be disposed of after treatment at the Mill City WPCF. Several options were considered by Keller Associates in the NSC WWMP including subsurface disposal through drainage fields, surface infiltration, land application (with winter storage), surface discharge to the North Santiam River, and injection wells. While discharge to surface waters would normally be advisable in many treatment scenarios, the Three Basin Rule precludes the discharge of wastewater effluent from the new treatment facility directly into the North Santiam River. Discharge to groundwater in the NSC is allowed as long as effluent does not affect the groundwater quality, and pollutant modeling and sampling is performed to ensure protection of groundwater. Surface infiltration using Rapid Infiltration Basins (RIBs) was recommended by Keller in the 2021 NSC master plan as the primary option for effluent disposal for the Mill City WPCF. RIBs consist of shallow excavations several feet deep where effluent is drained and can infiltrate into the groundwater table. The design of RIBs is limited primarily by the infiltration rates and groundwater depth specific to the area under consideration. Figure 4-9 shows a typical rapid infiltration basin system and an infiltration diagram.

FIGURE 4-9: RAPID INFILTRATION BASINS



Design, Size, and Redundancy

Infiltration basins will be designed based on EPA guidance on RIB effluent disposal using measured soil infiltration rates, final effluent quality parameters, available sites in the NSC basin, expected biological nutrient removal and mixing during infiltration, and depth to groundwater at the available sites.

Several sites have been identified for disposal of treated effluent for the future Mill City/Gates WPCF. To evaluate the feasibility of treated effluent infiltration, Keller has contracted with GSI and GSA to conduct soil and groundwater infiltration characterization studies and pollutant attenuation modeling during groundwater infiltration. The data referenced below is from the 2023 GSI Gates/Mill City Shallow Soil Characterization and Infiltration Testing Technical Memorandum.[3]

Subsurface investigation is necessary to determine the viability of different sites for rapid infiltration of treated effluent in compliance with groundwater discharge regulations and the Three Basin Rule. The first phase of the soils characterization study focused on shallow soils, and consisted of excavating test pits in four study areas to classify soil types, conduct infiltration tests, and collect soil samples. The objective of the shallow subsurface characterization was to collect data that can be used to select three of the four study areas for a second phase, which will be a deep soil characterization study.

The four study areas assessed for potential construction of rapid infiltration basins included the Baughman-Lucas Site (GM1), the Shepherd Site (GM2), the 4th Ave Right of Way (ROW) Site (GM4), and the Weyerhaeuser Site (GM5). Table 4-1 below provides initial infiltration rates as measured by GSI and GSA using single ring cylinder infiltrometer tests with lateral divergence correction as well as a modified test pit infiltration method with lateral divergence correction.

TABLE 4-1: RIB SITES MEASURED INFILTRATION RATES

Site ID	Effective Saturated Hydraulic Conductivity (Geometric Mean, ft/day)
GM1	5.97
GM2	0.12
GM4	0.78
GM5	0.18

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[3] GSI Water Solutions, Inc., and GeoSystems Analysis, Inc. (2023). Gates/Mill City Shallow Soil Characterizaiton and Inifltration Testing Results, Marion and Linn Counties, Oregon. Portland: GSI Water Solutions, Inc.

The US EPA recommends using a design infiltration rate of 10% of the measured infiltration rate to account for soil plugging typically associated with wastewater infiltration.[4] Preliminary design calculations suggest that the GM1 site may be best for disposal of effluent as it has a relatively high infiltration rate as compared to the other sites tested. The higher infiltration rate measured at the GM1 site would allow for infiltration basins with a much smaller footprint compared to the other sites included in the soils characterization study. The US EPA also recommends BOD_5 loading of less than 115 lb/acre/day for rapid infiltration basins. Preliminary calculations show BOD_5 loading of approximately 25 lbs/acre/day with the GM1 infiltration basins sized to handle average winter flow at 10% of the measured hydraulic conductivity. Estimates of site-specific design and effluent disposal redundancy criteria will be provided in Chapter 5 with discussion of alternative selections.

Fate and Transport Modeling

Additionally, sampling for specific contaminants including metals, VOCs, SOCs, and radionuclides in the current wastewater influent was conducted. Results were input into groundwater models simulating dilution, dispersion, sorption, and biodegradation from the proposed infiltration basins to the property boundary to aid in selection and design of future WPCF treatment processes for protection of NSC groundwater.[5] The WPCF influent testing revealed several contaminants of interest to groundwater quality, either because they are synthetic or volatile organic compounds, or they are naturally occurring compounds detected at a concentration above that of NSC groundwater concentrations. The compounds of interest and groundwater modeling summary info are included in Table 4-2. Total inorganic nitrogen (TIN) was modeled under two scenarios; SBR secondary treatment with denitrifying sand filters, and SBR treatment alone. The model inputs for these scenarios were 2 mg/L TIN (Scenario 1 - 1 mg/L ammonia and 1 mg/L nitrate) and 6 mg/L TIN (Scenario 2 - 1 mg/L ammonia and 5 mg/L nitrate), respectively.

TABLE 4-2: GROUNDWATER POLLUTANT MODELING SUMMARY

Compound	Model Input Concentration (mg/L)	Modeled Concentration in Groundwater at Property Boundary (mg/L)
TIN (Scenario 1)	2	1.26 - 1.61
TIN (Scenario 2)	6	3.36 - 4.44
Toluene[2]	0.0496	<0.0005
di(2-ethylhexyl)phthalate (DEHP)[2]	0.00901	<0.0001

Notes:
1. Modeling Includes dilution, dispersion, sorption, and biodegradation
2. Minimum detection limits for Toluene and DEHP are 0.0005 mg/L and 0.0001 mg/L, respectively

The groundwater modeling report concluded that both TIN scenario 1 and 2 result in very low TIN concentrations at the property boundary that would be further reduced as the constituents continued to travel along the horizontal hydraulic gradient in the aquifer. The estimated nitrate concentration at the property boundary likely represents a negligible increase over the background nitrate concentrations of 1.1 mg/L observed in upgradient groundwater.

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[4] U.S. Environmental Protection Agency. (1981, October). *Process Design Manual for Land Treatment of Municipal Wastewater.* Cincinnati: U.S. Environmental Protection Agency, Center for Environmental Research Information.

[5] GSI Water Solutions, Inc. (2023). *Evaluation of the Environmental Fate of Residual Pollutants from an Advance (Class A) Treated Wastewater Infiltration System, Mill City, Oregon.* Portland: GSI Water Solutions, Inc.

GSI also concluded that concentrations of DEHP and toluene would be below background concentrations by the time they reached the GM1 site property boundary, even without removal during treatment at the WPCF. However, some removal of both toluene and DEHP is expected during the secondary treatment process, prior to discharge through rapid infiltration. The pollutant fate and transport groundwater modeling and evaluation for site GM1 can be found in Appendix I.

4.1.7. Sludge Dewatering

Solids wasted from the secondary treatment process must be disposed of off-site. To minimize hauling and tipping fee costs, these solids can be mechanically dewatered onsite. Also note that some disposal sites will not accept sludge that does not pass the paint filter test, which can be difficult to achieve without mechanical dewatering. Mechanical dewatering also reduces the total volume and weight (and frequency of hauling) of solids that must be removed. Process equipment typically includes a feed pump, a mechanical dewatering press, a dewatered cake pump or conveyor, and a polymer injection system. Sludge drying beds may be considered as an alternate option for reducing landfill hauling costs for wastewater treatment plants. However, given the large area required for drying beds, possible odor issues, and the wet winter climate in the NSC, sludge drying beds were not considered a viable option for solids handling.

Size and Redundancy

While all three mechanical dewatering presses evaluated are able to function without an operator present, the size of the equipment will be based on dewatering all wasted solids on an 8-hr/day, 5-day/week operational schedule. A solids holding tank will also be provided to feed the press, but as this size is not dependent on the type of press, it is not included as part of this equipment evaluation. When the dewatering press is offline, wasted solids will need to be pumped to the solids holding tank where they are temporarily stored on site to await dewatering.

Performance Requirements

The new dewatering equipment must meet the following requirements:

- Thicken solids to 15%, or greater
- Include fully automated operation with limited operator observation required
- Be able to accommodate incoming solids ranging from 0.5% – 2%, or greater
- Efficient usage of energy, polymer, and wash water
- Solids capture rate of at least 95%

Alternatives Considered

Three dewatering technologies were considered, as shown in Figure 4-10. These include a screw press, volute press, and fan press. Each of these presses operate on a similar principle, in that sludge is passed over a screen (or surface with narrow openings) that allows water to leach out while retaining the solids. A compression zone at the back end of the unit further squeezes the solids to maximize the amount of water removed. With all of these technologies, polymer must be added in order to achieve optimal cake dryness and solids capture. This would be accomplished with a liquid polymer make-up unit that delivers blended polymer into the sludge upstream of the press. Prior to pressing, the polymer and sludge must be mixed and have time to react, either in-pipe or in a tank.

FIGURE 4-10: SLUDGE DEWATERING ALTERNATIVES


Screw Press

Volute Press

Fan Press

Screw Press

A screw press operates by introducing sludge into one end of a wedge wire drum with an internal screw shaft. As the sludge is moved along the length of the drum, a combination of smaller openings in the drum along with narrower spacing between flights of the screw, helps to compress the sludge and remove excess water. A compression cone is also provided at the back end of the unit to assist with compression of the solids. The excess water is drained back to the head of the WPCF and the cake solids are discharged into a hopper feeding either a cake pump or a conveyor, where the solids can then be discharged for disposal. An internal spray bar system cleans accumulated sludge off of the basket. There are a number of manufacturers that are able to provide a screw press with similar performance capabilities.

Volute Press

A volute press operates similar to a screw press. However, instead of using a wedge wire basket to remove excess water and retain solids, a volute press uses a series of concentric rings surrounding the screw shaft. A small gap is provided between each ring that serves as the pathway to removing water. Additionally, the rings alternate between a fixed ring and a “floating” ring. As the screw shaft rotates, the flights of the screw displace the floating ring. This provides a self-cleaning function to prevent solids from clogging the spacing between the rings. Similar to the screw press, the flights of the screw get more closely spaced and a compression cone at the end of the unit is provided to improve dewaterability.

A typical volute press skid includes a polymer injection, mixing and flocculation tank and can often include multiple drums. The benefit of multiple drums is that redundancy can be provided and a degree of dewatering can still be achieved with one drum offline (note that redundancy is only in the drums and not the flocculation tank). This can be a benefit over a screw press as a single screw press skid has no redundancy.

Fan Press

A fan press operates by introducing sludge into a circular channel that narrows along the flow path. Screens on either side of the channel allow water to drain away from the sludge channel. Depending on the manufacturer, a plate at the end of the channel can be utilized to create backpressure and improve dewaterability. Multiple channels can be installed on a single skid, providing redundancy in pressing. Equipment skids can also include the polymer dosing, injection and flocculation systems.

4.1.8. WPCF Sites

Several sites have been identified as possible locations for the future Mill City WPCF. In addition to the sites discussed in section 4.1.6, the FEMA trailer site, located just south of the existing WPCF, was identified as a potential location for the new treatment plant. However, it is unlikely that RIBs for disposal of treated effluent could be permitted at the existing drain field site. The WPCF itself could be located at this site, allowing for reuse of some of the current treatment plant infrastructure, but RIBs would need to be located elsewhere, requiring the installation of a costly effluent disposal line to the RIB site. Several other properties in Mill City were considered. However, due to the lack of space surrounding these properties for future WPCF expansion, further investigation of these sites was not undertaken. Keller recommends choosing a site that would allow both construction of the new WPCF as well as effluent disposal on the same site, precluding the need for long effluent transmission piping. At this time, the GM1 site under investigation by GSI and GSA is the most promising to allow both treatment and effluent disposal to be located at the same site. However, the ongoing subsurface investigations should be completed prior to making a final siting decision.

4.1.9. Backup Power

Backup power is required to allow the WPCF to continue to provide treatment during power outages. This is typically accomplished with a fuel-fired generator and an automatic transfer switch. To reduce the required size of the generator, capacity is determined based only on equipment required to meet discharge permits. Generators can be either natural gas fired or diesel. Natural gas generators are often significantly more expensive and require a significantly larger footprint. Based on this, it is recommended to utilize a diesel generator. As the cost for backup power generation will not vary significantly based on the treatment processes or siting chosen for the future Mill City WPCF, this equipment is included in the cost estimates for the proposed project in Chapter 6.

4.1.10. Design Criteria

This study utilizes historical Mill City DMR data, sewage flows recommended in Table 2 of OAR 340-071-0220, as well as PSU population projections to estimate future flows in a combined Mill City and Gates system. Actual future flows will depend on several factors and could potentially decrease through aggressive I/I reduction efforts. It is generally recommended that flows be reviewed periodically, and future capital projects phased where practical. Historical flow data for Mill city is provided in Table 4-3 below.

TABLE 4-3: MILL CITY HISTORICAL FLOW DATA

Mill City Historical Flows (MGD)									Planning Flow (MGD)		
Year	2016	2017	2018	2019	2020	2021	2022	Average			
ADWF	0.087	0.089	0.086	0.085	0.088	0.086	0.087	0.087	0.087		
MMDWF$_{10}$	0.100	0.097	0.089	0.089	0.092	0.092	0.101	0.094	0.101		
AADF	0.092	0.097	0.092	0.089	0.092	0.094	0.091	0.093	0.093		
AWWF	0.097	0.105	0.098	0.093	0.097	0.103	0.095	0.098	0.098		
MMWWF$_{5}$	0.110	0.114	0.105	0.102	0.104	0.116	0.109	0.109	0.116		
PWkF	0.116	0.130	0.110	0.136	0.124	0.151	0.156	0.132	0.156		
PDAF$_{5}$	0.141	0.176	0.125	0.169	0.202	0.194	0.221	0.175	0.221		
PIF$_{5}$	0.228	0.284	0.201	0.272	0.326	0.313	0.357	0.283	0.381		

Wastewater flows from existing Mill City connections (Table 4-3) were based on historical DMR data from Mill City. Keller Associates used the method recommended by DEQ in "Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon" for determining design flows associated with current connections in Mill City. A peak instantaneous flow of 0.381 MGD was extrapolated according to the above-mentioned guidelines. Flows associated with future connections to the sewer system, both in the form of new population growth in Mill City as well as connections from the City of Gates, were projected using PSU population projections, Table 2 from OAR 340-071-0220, as well as an average of 2.5 persons per EDU as suggested by Mill City municipal planning staff. The number of estimated additional EDUs associated with new population growth by year are shown in Table 4-4 below.

TABLE 4-4: ADDITIONAL EDU PROJECTIONS (GATES AND MILL CITY COMBINED)

Year	Additional EDUs
2025	314
2030	379
2035	434
2040	483
2045	532
2070	806

A breakdown of dwellings by number of bedrooms was obtained[6] and the percentages were applied to EDU projections to obtain future number of dwellings with 3 or more bedrooms. The suggested peak day sewage flows from OAR 640-071-0220 of 300 gal/EDU/day for dwellings with 2 or less bedrooms and additional 75 gpd for each additional bedroom above 2 was used to project flows based on EDUs. Additionally, from OAR 340-071-0220 Table 2, other existing establishments in Gates were tabulated and their suggested sewage flows added to the 2025 peak day flows. A list of these establishments is provided in Table 4-5 below. An average of historical peaking ratios from 2016-2022 were used to adjust peak day flows to other flow criteria.

TABLE 4-5: ESTABLISHMENTS IN GATES AND MINIMUM SUGGESTED SEWAGE FLOWS

Gates	
Establishment	GPD
Sierra Mexican	800
Canyon Espresso	300
Hwy 22 Canteen	800
Camp Bendaroo RV Park	750
Total	**2,650**

To account for an increase in industrial development following the construction of a municipal sewer system, AADF was increased by 1,500 gallons per acre per day starting in 2030. It was assumed industrial development will be a total of 3 acres in the sewer basin. Peaking factors were used to adjust the AADF to establish other design criteria flows. AAGRs from the combined PSU population projections of Mill City and Gates were used to project the additional industrial flows as well as flows from the tabulated establishments above (Table 4-5) through 2070. These projections, along with the base flows from Mill City historical DMR data (Table 4-3), and flows expected from future EDUs in Mill City and Gates were summed to produce the flow projections provided in Table 4-6 below.

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[6] Advameg, Inc. (2023). City Data. Retrieved from http://www.city-data.com/housing/houses-Mill-City-Oregon.html

TABLE 4-6: PROJECTED DESIGN FLOW CRITERIA (GATES AND MILL CITY COMBINED)

Flow Regime	Average Ratio to PDAF5 (2016-2022 Historical)	Projected Design Flow (MGD)					
Year	-	2025	2030	2035	2040	2045	2070
Total Population	-	*2,896*	*3,056*	*3,193*	*3,318*	*3,439*	*4,124*
ADWF	0.495	0.166	0.182	0.192	0.201	0.209	0.259
$MMDWF_{10}$	0.538	0.180	0.197	0.208	0.218	0.227	0.281
AADF	0.528	0.177	0.194	0.204	0.214	0.223	0.276
AWWF	0.561	0.188	0.206	0.217	0.227	0.237	0.293
$MMWWF_5$	0.619	0.207	0.227	0.240	0.251	0.262	0.324
$PDAF_5$	1.000	0.335	0.367	0.387	0.405	0.423	0.523
PIF_5	1.613	0.541	0.592	0.624	0.654	0.682	0.843

Based on the reported pumping capacity of the Spring Street and First Avenue lift stations in Mill City, the current PIF_5 is approximately 0.52 MGD if both stations are pumping simultaneously. Projected 2045 peak flows for Mill City and Gates combined are 0.682 MGD. With a projected flow of approximately 0.58 MGD for Mill City in 2045, the Spring Street and/or First Avenue lift stations will likely need to be upgraded within the 20-year planning horizon. Until then, the actual peak flows entering the WPCF from Mill City and Gates will not exceed 0.52 MGD.

The historical unit loadings (load divided by the population (pound per capita per day (ppcd)) were calculated from 2016-2022 DMR data. Existing Mill City average and max unit loadings are provided in Table 4-7 below.

TABLE 4-7: UNIT LOADING FOR MILL CITY EXISTING CONNECTIONS

Unit Loading Criteria (ppcd)		Existing loading (ppd)
BOD_5		
WWADL	0.059	119
WWMML	0.082	165
DWADL	0.061	123
DWMML	0.081	162
TSS		
WWADL	0.017	34
WWMML	0.023	46
DWADL	0.020	40
DWMML	0.028	57
TKN		
WWADL	0.025	50
WWMML	0.030	61
DWADL	0.029	59
DWMML	0.036	71
NH_3		
WWADL	0.022	44
WWMML	0.031	62
DWADL	0.024	48
DWMML	0.031	63
NO_3^-		
WADL	0.004	7
WWMML	0.005	10
DWADL	0.004	9
DWMML	0.006	11

For future connections, both in the form of new population growth in Mill City and the connections from the City of Gates, unit loading criteria[7] (Table 4-7) were applied to the population projections provided in Table 1-4. These future projected loadings along with the max loadings from the existing Mill City connections with STEP/STEG systems (Table 4-7) were summed. To account for loadings from future industrial and commercial sources, the residential loadings were assumed to account for 75% and commercial/industrial additions of 25% were added for total loading at the treatment plant for each constituent starting in 2030. The final loadings are provided in Table 4-8.

TABLE 4-8: UNIT LOADINGS APPLIED TO FUTURE CONNECTIONS

Per Capita Loadings Applied to Future Connections	
Parameter	PPCD
BOD_5	0.16
TSS	0.13
TKN	0.03
NH_3	0.026
NO_3^-	-
Total Phosphorus (as P)	0.007

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[7] Metcalf, & Eddy. (2013). *Wastewater Engineering Treatment and Reuse*. McGraw Hill.

TABLE 4-9: PROJECTED DESIGN LOADINGS (GATES AND MILL CITY COMBINED)

Year	2025	2030	2035	2040	2045
Population	2,896	3,056	3,193	3,318	3,439
Max Month Loading (ppd)					
BOD_5	280	408	437	464	490
TSS	137	210	234	256	277
TKN	100	140	145	150	155
NH_3	87	122	127	131	135
NO_3^-	13	18	18	18	18
TP	20	21	22	23	24

4.1.11. Map

Maps of the existing sewer shed are provided in Appendix A. Figure 4-11 and Figure 4-12 below show flow schematics of the current and future planned Mill City/Gates WPCF treatment processes.

FIGURE 4-11 CURRENT WPCF PROCESS FLOW DIAGRAM

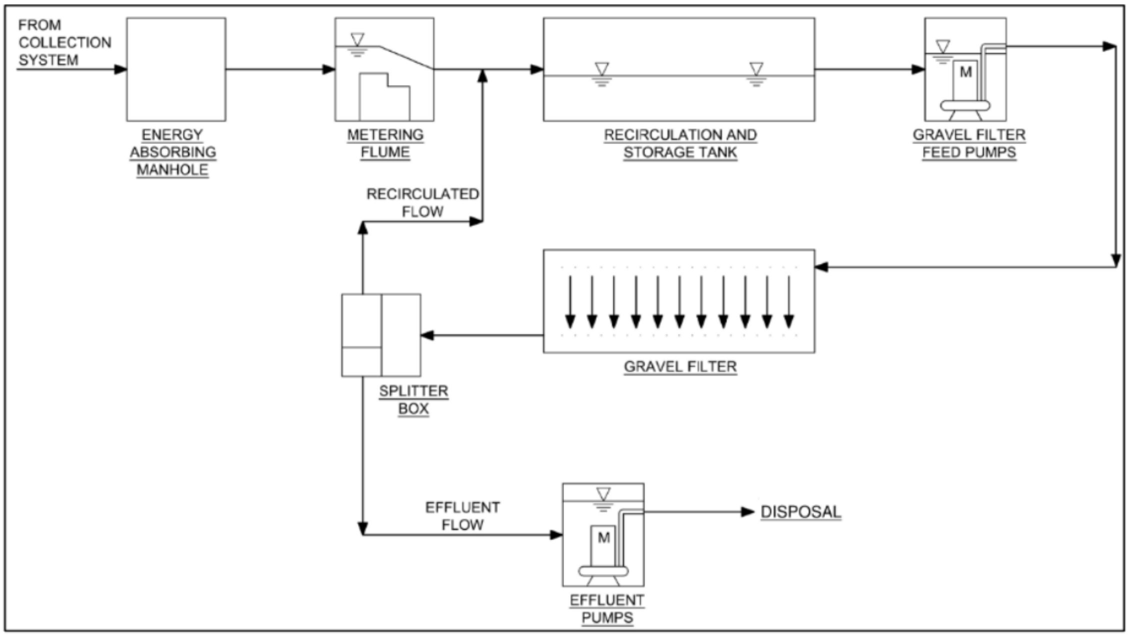
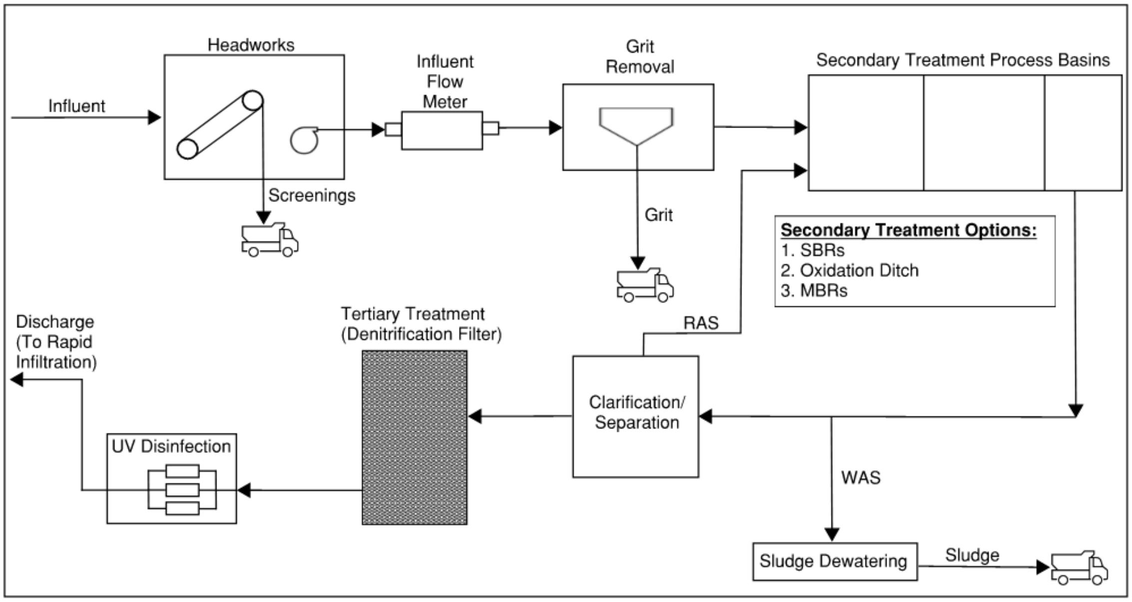


FIGURE 4-12 FUTURE WPCF PROCESS FLOW DIAGRAM



4.1.12. Environmental Impacts

A comparison of the potential environmental impacts of the alternatives is summarized in Table 4-10 at the end of this section.

4.1.13. Land Use

The four sites being considered for rapid infiltration of treated effluent are listed below with their current land-use designations. No proposed sites are located on land designated for exclusive farm use (prime farmland).

- Baughman-Lucas Study Area (GM1): Forest and Farm/Forest
- Shepherd Study Area (GM2): Farm/Forest
- 4th Ave Row Study Area (GM4): Rural Residential and Farm/Forest
- Weyerhauser Study Area (GM5): Forest

As discussed in section 4.1.6, preliminary calculations suggest that the GM1 site would be the most amenable site of the four included in the shallow soils characterization study for efficient disposal of treated effluent due to the relatively high measured infiltration rate. It is assumed that the new WPCF would be located at the same site as the effluent disposal basins to preclude the need for a long and expensive transmission line solely for conveyance of treated effluent to the disposal basins. Any site recommendations are contingent upon completion of subsurface investigations for treated effluent disposal in the NSC. If the concurrent subsurface hydrologic investigations determine the proposed site is unsuitable, or another site is more suitable, recommendations on siting will be revisited.

4.1.14. Floodplains

No potential sites are located inside the 100-year or 500-year floodplains. Figure 4-3 in Appendix A shows topography and floodplains in the Mill City/Gates study area.

4.1.15. Wetlands

The current WPCF is not located in or affecting any designated wetlands in the NSC. There are several sites under consideration for disposal of future effluent via RIBs. The Shepherd (GM2) infiltration study area is the only infiltration testing site under consideration that encompasses a small amount of freshwater emergent wetland.

4.1.16. Cultural Resources

None of the alternatives will interfere with the above-ground cultural resources identified by the State Historic Preservation Office.

4.1.17. Biological Resources

As described in section 1.2.5, species in the NSC listed as federally threatened or endangered include the Marbled Murrelet, Streaked Horned Lark, Northern Spotted Owl, Coho Salmon, Steelhead, Chinook Salmon, Pacific Eulachon, Bull Trout, Golden Paintbrush, Willamette Daisy, Water Howellia, Bradshaw’s Desert Parsley, Kincaid’s Lupine, Nelson’s Checkermallow, Taylor’s Checkerspot, Fender’s Blue Butterfly, and the Oregon Silverspot Butterfly. None of the fish species are likely to be affected by proposed projects as there is no discharge directly to the North Santiam River, and effluent will be treated to low nutrient levels before infiltration. If the other listed species are found, further investigation would be undertaken to determine the necessary mitigation measures.

4.1.18. Water Resources

The new Mill City/Gates WPCF will improve treatment reliability and effluent quality, leading to beneficial impacts on NSC water resources over the current facilities. Subsurface investigations are under way to prevent the intrusion of disposed effluent to the North Santiam River per the Three Basin Rule. Treated effluent will be disposed of via rapid infiltration basins, and processes at the new WPCF will be designed to provide high quality effluent to protect groundwater quality in the NSC.

4.1.19. Coastal Resources

No coastal resources are within the study area.

4.1.20. Socio-economic conditions

None of the alternatives would have a disproportionate effect on any segment of each community’s population. Equitable wastewater facilities would be provided to all people within the sewer authority limited only by physical geography and overall district budget - not by economic, social, or cultural status of any individual or neighborhood.

4.1.21. Miscellaneous issues

As described previously, the Three Basin Rule prohibits new discharge of treated wastewater effluent to the North Santiam River and outlines provisions for stringent protection of groundwater and surface waters in the NSC. Studies are underway to inform treatment and disposal decisions for the future Mill City/Gates WPCF to protect both groundwater and surface water resources in the study area.

TABLE 4-10: ENVIRONMENTAL IMPACTS SUMMARY

Environmental Criteria	Secondary Treatment			Tertiary Treatment	Other Treatment Processes			Effluent Disposal
	SBR	Oxidation Ditch	MBR	Denitrification Filter	Headworks	Disinfection	Solids Handling	Rapid Infiltration
Land Use/Prime Farmland	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	Sewer Authority must purchase disposal site
Floodplains	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Wetlands	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	Disposal site GM2 surrounds a small patch of freshwater emergent wetland
Cultural Resources	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Biological Resources	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Water Quality Issues	Improved effluent quality	Improved effluent quality	Improved effluent quality	Improved effluent quality	Improved effluent quality	Improved effluent quality	Improved effluent quality	No Impact
Coastal Resources	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Socio-Economic/Environmental Justice Issues	Increased development and economic opportunities	Increased development and economic opportunities	Increased development and economic opportunities	Increased development and economic opportunities	Increased development and economic opportunities	Increased development and economic opportunities	Increased development and economic opportunities	Increased development and economic opportunities
Miscellaneous Issues	Class II Operation	Class II Operation	Class III Operation	No Impact	No Impact	No Impact	No Impact	No Impact

4.1.22. Land Requirements

The sewer authority would purchase land necessary for the new treatment facilities as well as for rapid infiltration of the disposed effluent. It is recommended to locate these facilities at the same site to avoid the need for costly effluent transmission lines. The most important factors in deciding the new WPCF treatment and disposal site will likely include amenability to groundwater infiltration in compliance with the Three Basin Rule, as well as cost to the sewer authority for land acquisition.

4.1.23. Potential Construction Problems

The depth of the water table and subsurface rock may affect the construction of alternatives. Preliminary subsurface investigations for rapid infiltration basin design have revealed highly variable water table depths in the study area ranging from 12 to 50 feet below ground surface (bgs). Depending on the sites chosen for the new WPCF and RIBs, construction may require geotechnical stabilization and techniques that effectively manage dewatering and sloughing issues. Construction plans for any of the alternatives would also include provisions to control dust and runoff. Additionally, there must be sufficient acreage for construction of the new plant at the chosen site. To utilize most of the existing equipment at the Mill City WPCF (equalization basin, recirculation pumps, gravel filter) the new treatment system could be constructed at the current site, possibly utilizing the redundant drainage fields for construction until the new plant is fully functional. Under this scenario, treated effluent would need to be conveyed to the rapid infiltration basins located farther from the North Santiam River. Alternatively, the new WPCF could be located at the effluent disposal rapid infiltration sites. It is important to note that the subsurface investigations being conducted by GSI and GSA will not be completed until near the end of 2023, and while the phase I shallow soils report suggests site GM1 as the most ideal for infiltration of treated effluent, further investigations must be completed before a final decision is made on treatment and disposal siting.

4.1.24. Sustainability Considerations

To provide the Cities of Mill City and Gates with economically and environmentally sustainable wastewater treatment solutions, several treatment options have been considered, as described in the preceding sections. Groundwater infiltration models and levels of nutrient removal and dilution expected during rapid infiltration of treated effluent are being evaluated to inform necessary secondary and tertiary treatment processes for providing optimal effluent quality, while conserving the level of energy and chemicals needed at the WPCF.

4.1.25. Water and Energy Efficiency

Water and wastewater treatment facilities generally require clean water for use in filter backwashing, as well as washwater for solids handling and screening equipment. Several alternatives considered for the Mill City/Gates WPCF will require washwater for screening, as well as a tertiary treatment option that requires filter backwashing. The goal of the WPCF is to provide a high-quality effluent while maintaining a reasonable level of water and energy efficiency. Several add-ons are available for decreasing the water and energy footprint of the plant. Designing a water storage and reuse system for the plant would decrease the water footprint by allowing certain areas to be irrigated with reclaimed water. However, a chlorination system would be required to provide a disinfectant residual in any reclaimed water reuse and storage systems. These options generally incur capital costs while providing savings over the life of the plant. Life cycle costs analyses should be conducted to determine if certain options would provide a net benefit to the community in terms of energy, water, and cost savings.

4.1.26. Green Infrastructure

Variable frequency drive (VFD) process blowers are recommended in the process basins to optimize the level of aeration required for secondary treatment based on influent loading and wastewater temperatures. VFD blowers allow the operator to ramp up or down aeration in the process basins and offer significant energy and cost savings over the life of the plant when utilized in conjunction with online dissolved oxygen (DO) monitoring.

4.1.27. Other

The current Mill City WPCF operates as a Class I wastewater treatment system. The future WPCF will be classified as a Class II wastewater treatment system for the SBR, and oxidation ditch secondary treatment options, and likely a Class III wastewater treatment system for the MBR secondary treatment option due to operation and maintenance of the pressurized membrane filtration units. Operator classification is an important variable to consider as it can be more difficult and costly to hire qualified operations staff with higher levels of certification.

4.1.28. Cost Estimates

Relative cost estimates for the different treatment alternatives presented in section 4.1 are provided in Chapter 5. Capital operation and maintenance costs developed for the alternatives are Class 4 estimates as defined by the Association for the Advancement of Cost Engineering (AACE). AACE Class 4 estimates are used to provide sufficient accuracy for budgetary planning purposes. The cost estimates presented for the alternatives in Chapter 5 are relative costs and do not include costs that are shared between all alternatives for a given process. Chapter 6 will include total costs for the recommended alternatives in the total project cost estimate.

The cost estimates are based on the perception of current conditions at the project location and are based on cost estimating resources and experience with similar/recent wastewater projects. Estimates were developed based on 2023 dollars. The total estimated probable project costs include general conditions (10%), contingency (30%), contractor overhead and profit (OH&P, 15%), and professional services (25%) which are typical of a planning-level estimate. Overall project costs include total construction costs, costs for engineering design, construction management services, inspection, permits, as well as construction administrative costs.

Actual construction costs may differ from the estimates presented, depending on specific design requirements and the economic climate when a project is bid. As a result, the final project costs will vary from the estimations presented in this document. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Keller Associates cannot and does not warrant nor guarantee that proposals, bids, or actual construction costs will not vary from the cost estimates presented herein.

4.2. COLLECTION SYSTEM ALTERNATIVES

This section includes a description of the alternatives considered and compares the alternatives by reviewing various factors such as environmental impacts, land requirements, potential construction problems, sustainability, efficiency and costs.

The hydraulic model was exercised under 2070 flows to further identify needed improvements and potential alternatives to consider. The flows associated with new growth were assigned to the nearest junction (manhole or cleanout), however, there were areas where existing infrastructure did not exist. New collection system lines were added to convey flows to the system. It should be noted that the growth in the River Road Lift Station Basin requires upsizing of some existing pipelines upstream of the River Road Lift Station along NW 8th Place. These improvements have already been designed and the improvements were modeled as complete in the future model. Figure 11 in Appendix A illustrates the growth areas, their load placements, and added pipes to serve the 2070 growth areas. Specifically, the areas toward the eastern part of the City needed additional collection system components including a new lift station and gravity pipes. The results from the future model scenarios are included in Figure 12 and Figure 13 in Appendix A. The following deficiencies were identified:

- Flooding along NW Alder Street directly downstream of the River LS force main discharge
- Flooding along SW Kingwood Avenue west of SW 2nd Avenue in the Spring Street Basin

- Surcharging upstream of First Avenue Lift Station
- Peak inflow into Spring Street LS exceeds the firm capacity
- Peak inflow into First Ave LS exceeds the firm capacity

Of the deficiencies listed above, alternatives were only evaluated for the flooding along Kingwood Avenue in the Spring Street Basin. Improvements to address the other deficiencies are relatively straightforward and other feasible alternatives do not exist. Additionally, minor deficiencies such as replacement of aging infrastructure are not included in this alternatives analysis because they only consist of replacing with similar infrastructure and will not impact the operation of the system. The projects for which alternatives were evaluated include the following:

- Gates / Mill City Force Main Alignment
- Spring Street Basin Growth Alternatives (Flooding at Kingwood Avenue)

The City of Gates does not currently have a public wastewater system and residents currently rely on septic tanks and drainfields for wastewater management. Previous planning efforts recommended a new wastewater collection system to serve Gates and that the collected flows be conveyed to the new WPCF in Mill City once upgraded/replaced. The new Gates collection system will consist of gravity pipelines with lift stations to convey flows to the regional lift station pumping to Mill City. Alternatives for the Gates collection system (gravity vs STEP) were evaluated in previous planning efforts, and a gravity system was recommended. Therefore, this study only includes an evaluation of a gravity collection system in Gates.

4.2.1. DESCRIPTION – Gates/Mill City Force Main Alternatives

It is not feasible to convey the wastewater from Gates to Mill City via gravity flow, therefore a pressurized sewer line must be constructed between the two cities. Two main alternative alignments were considered in this study to convey the flows from Gates to Mill City.

- Alternative 1 consists of a new regional lift station in Gates located toward the southeast end of the city on the north side of the Santiam River. The force main will flow across the existing bridge to the south side of the Santiam River and then go west and south along Gates School Road. The force main will then go west along Kingwood Avenue to the new WPCF location.
- Alternative 2 also consists of a new regional lift station, but it will be located on the southwest end of the Gates. The force main will flow west along Central Street / Gates Mill City Road and within an inactive railroad right-of-way (ROW) to Mill City. This alternative requires upsizing the existing pumps at the First Ave LS, but the existing force main from First Avenue LS to the WPCF can be used. Once in Mill City, there are two alignments which were considered to get flows to the First Avenue LS.
- Alternative 2A discharges the pressure flow into a manhole along Alder Street and installing 8-inch gravity pipe along Alder Street to the First Avene LS
- Alternative 2B discharges the pressure flow into a manhole south of Alder Street and upsizing the existing 4-inch pipe within an existing walkway/bike pathway to the First Avenue LS.

The alignments for Alternative 1 (red), Alternative 2 (yellow), Alternative 2A (green), and Alternative 2B (blue) are illustrated in Figure 4-13.

4.2.2. DESIGN CRITERIA – Gates/Mill City Force Main Alternatives

The population projections, future systemwide flows and the new flow per capita for growth within Mill City are documented in previous chapters. Federal, state, and agency regulatory and design criteria used for the collection system are documented in Chapters 1, 3, and 4.

Future flows were input to the hydraulic model to size the force main and evaluate the capacity of the First Ave LS. The specific design criteria and model outputs are summarized below in Table .

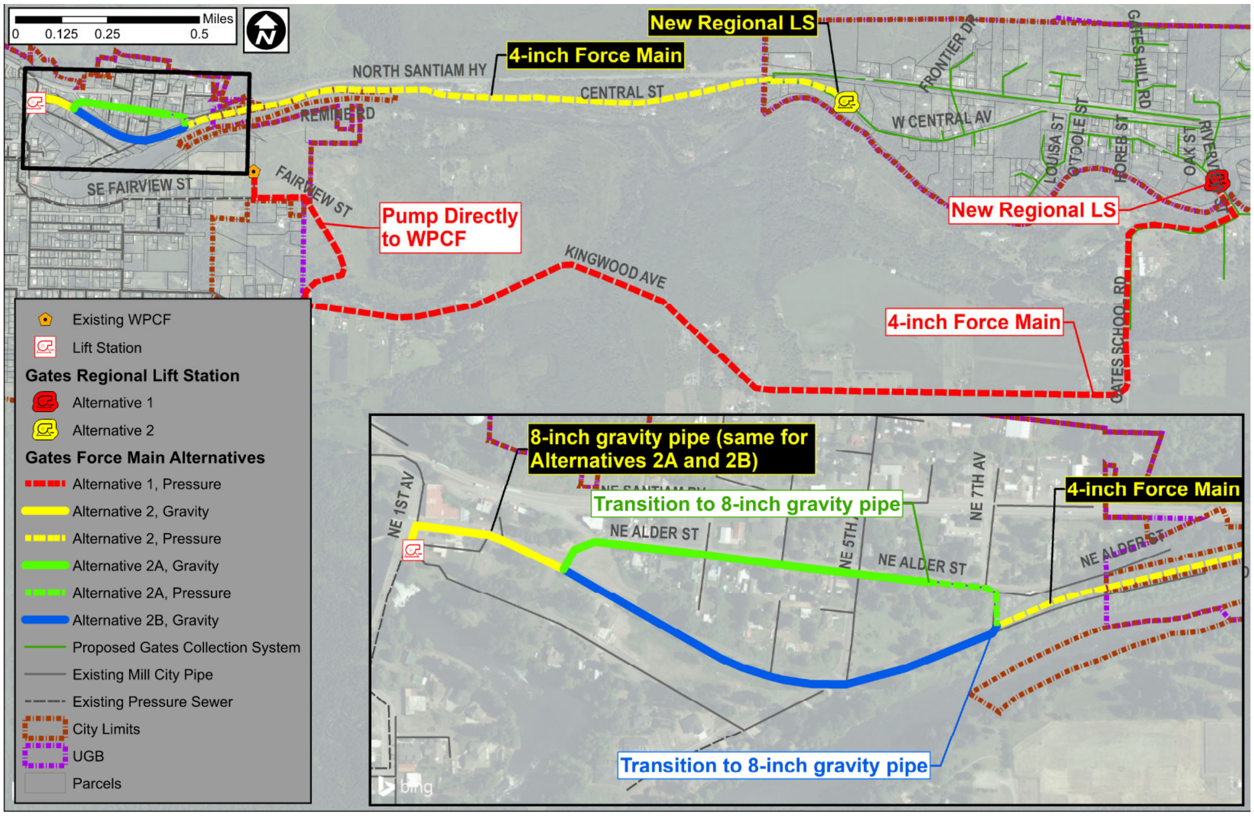
TABLE 4-11: GATES / MILL CITY DESIGN CRITERIA

Parameter	Value	Unit	Basis for Criteria
Gates Regional LS Design Flow	100	gpm	Equal to projected PIF for Gates in 2070.
Gates / Mill City Force Main Size	4	inches	Provides between 2 fps and 8 fps at design flow rate.
First Ave New Design Flow (Alt. 2 only)	300	gpm	Equal to PIF from the model during 2070 flows.

4.2.3. MAP – Gates/Mill City Force Main Alternatives

A figure illustrating the two alternative alignments considered is included in Figure 4-13.

FIGURE 4-13: GATES/MILL CITY FORCE MAIN ALTERNATIVES



4.2.4. ENVIRONMENTAL IMPACTS – Gates / Mill City Force Main Alternatives

A summary of the environmental impacts associated with the two alternatives are presented in Table . In summary, the route associated with Alternative 1 appears to pose a larger impact on environmental resources including floodplains, wetlands, and endangered species due to the crossing of the Santiam River, Triangle Creek, and Rock Creek. Alternative 2 crosses some smaller bodies of water but is not anticipated to be as significant of an impact as Alternative 1.

There is not expected to be any generation or management of residuals or wastes associated with this alternative because it only relates to the collection system and does address the treatment of the wastewater.

TABLE 4-12: GATES / MILL CITY ALTERNATIVES ENVIRONMENTAL IMPACTS

Environmental Impact	Alternative 1	Alternative 2
Floodplains	Crosses Rock Creek floodway & Santiam River floodway	No impact anticipated
Wetlands	Possible disturbance along Kingwood Road at Triangle Creek	No impact anticipated
Land Resources	No impact anticipated	No impact anticipated
Endangered Species	Several river and creek crossings which may impact aquatic species.	Several river and creek crossings which may impact aquatic species.
Historical/Acheological Properties	No impact anticipated	No impact anticipated

4.2.5. LAND REQUIREMENTS – Gates / Mill City Force Main Alternatives

The locations proposed for the regional lift stations for Alternative 1 and Alternative 2 would both require purchasing land to construct the infrastructure. The force main for Alternative 1 is anticipated to be installed within the county ROW along Gates School Road and Kingwood Ave for the majority of the length. Alternative 1 would be installed within the City/County ROW along Central Avenue and then within the old railroad ROW that is state ROW. Mill City currently owns a portion of the old railroad ROW within their city limits.

4.2.6. POTENTIAL CONSTRUCTION PROBLEMS – Gates/Mill City Force Main Alternatives

Potential construction problems associated with Alternative 1 may include the following:

- Crossing of Santiam River, Triangle Creek, and Rock Creek.
- Subsurface bedrock and boulders may be encountered, however, the force main bury depth can be relatively shallow compared to gravity sewer pipes.

Potential construction problems associated with both Alternatives 1 and 2 may include the following:

- Subsurface bedrock and boulders may be encountered, however, the force main bury depth can be relatively shallow compared to gravity sewer pipes.
- There is a potential landslide hazard area that may require mitigation measures to be accounted for in the design process.
- High water table is not expected for the majority of the length, however, may be encountered for stream crossings or adjacent to wetlands.

4.2.7. SUSTAINABILITY CONSIDERATIONS – Gates/Mill City Force Main Alternatives

Sustainability benefits for both Alternatives 1 and 2 are similar and could be implemented for either alternative. Both alternatives should consider installation of energy efficient pumps, VFDs or soft-starts, and trenchless installation methods such as directional drilling.

4.2.8. WATER AND ENERGY EFFICIENCY – Gates/Mill City Force Main Alternatives

Water and energy efficiency benefits for Alternatives 1 and 2 are similar and are applicable to either alternative. Both alternatives should consider installation of energy efficient pumps and VFDs or soft-starts. It was previously determined that gravity flow from Gates to Mill City is not feasible and therefore, both alternatives consist of energy use to pump wastewater.

4.2.9. GREEN INFRASTRUCTURE – Gates/Mill City Force Main Alternatives

Both alternatives should consider installing green infrastructure at the regional lift station site and reduce the amount of impervious surface. Additional opportunities for green infrastructure are not applicable to these alternatives.

4.2.10. OTHER – Gates/Mill City Force Main Alternatives

Other considerations are discussed in the non-monetary considerations in Chapter 5.

4.2.11. COST ESTIMATES – Gates/Mill City Force Main Alternatives

Cost estimates for these alternatives are provided in Chapter 5.

4.2.12. DESCRIPTION – Spring Street Growth Alternatives

As Mill City continues to grow, it is important to evaluate how the new developments will connect to the existing system and if there are any capacity issues due to the increased flows. Future flows were assigned to the hydraulic model and capacity issues were identified in the Spring Street Basin. These sections evaluate two alternatives for alleviating the capacity issues.

- Alternative 1 – Upsize the existing pipelines to the minimum diameter to pass flows without exceeding 0.85 d/D. This includes upsizing the existing 6-inch to 8-inches between SW 9th Avenue and Linn Boulevard and upsizing the existing 4-inch to 6-inches from Kingwood Avenue to Ivy Street.
- Alternative 2 – Replace the existing pipeline with a new 8-inch trunkline from Kingwood Avenue to Linn Boulevard.

4.2.13. DESIGN CRITERIA – Spring Street Growth Alternatives

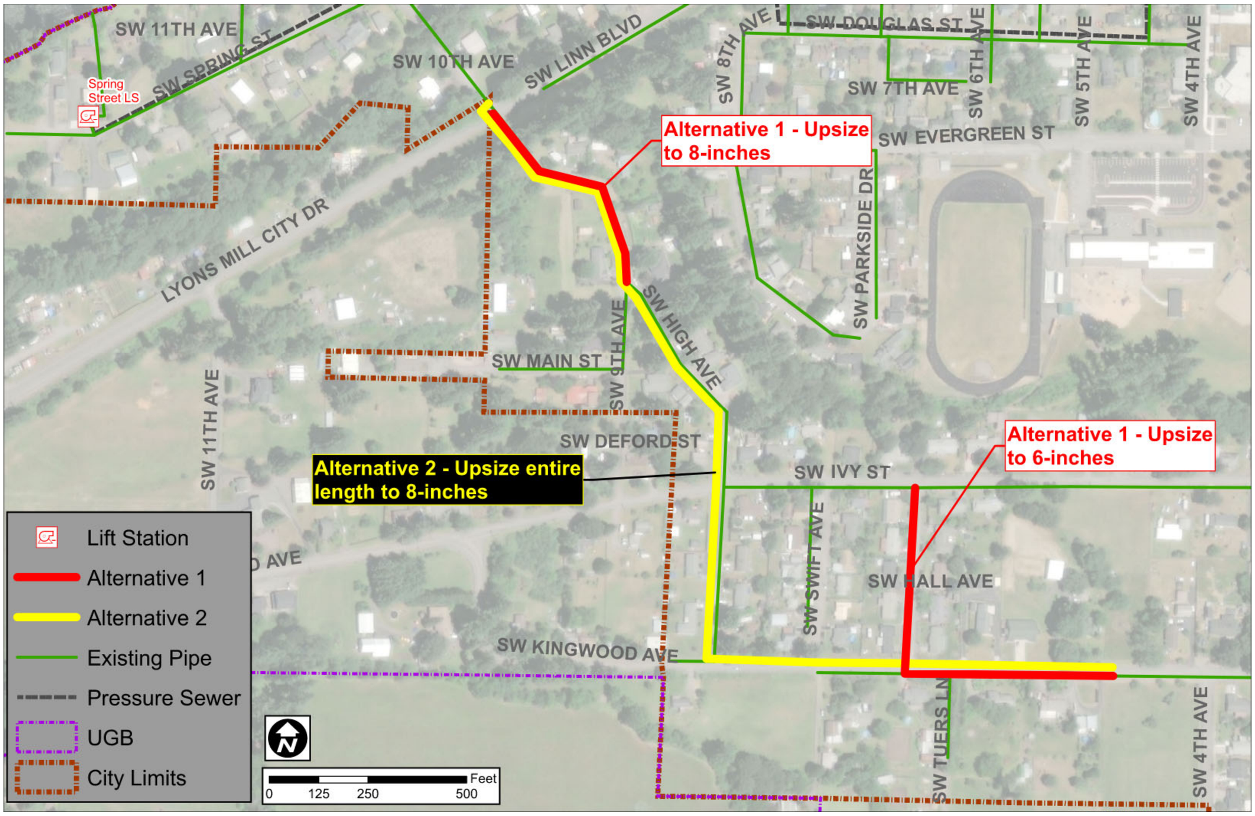
The projected populations and flows presented in previous chapters were used as the basis for this alternatives analysis. The growth areas shown in Chapter 3 were assigned to the existing collection system and the new trunkline to evaluate these alternatives. Note the results from the model are based on the selected Alternative 2 for the Gates/Mill City Force Main which will be routed to the First Ave lift station.

The upsized pipes associated with Alternative 1 were assumed to be constructed at the same slope as the existing pipes. The new 8-inch trunkline elevations were input at minimum recommended pipe slopes where feasible. Pipe slopes were greater than minimum slopes where topography resulted in excessively deep manholes (greater than 10-15 feet). In steeper areas, manhole inverts were assigned to maintain depths between 5 to 15 feet. It should be noted there were some areas where pipe slopes exceeded 20% slopes. These pipe segments should be anchored according to the governing agency's design standards.

4.2.14. MAP – Spring Street Growth Alternatives

Figure 4-14 summarizes the two alternatives considered for alleviating the surcharging and flooding in the Spring Street Basin.

FIGURE 4-14: SRING STREET ALTERNATIVES



4.2.15. ENVIRONMENTAL IMPACTS – Spring Street Growth Alternatives

Neither alternatives for this project are anticipated to have an impact on wetlands, water ways, endangered species, nor floodplains because the project locations are not near any of these features.

4.2.16. LAND REQUIREMENTS – Spring Street Growth Alternatives

Both alternatives consist of similar alignment and are both anticipated to be constructed within existing right-of-way within the City. No additional land requirements are necessary for either project.

4.2.17. POTENTIAL CONSTRUCTION PROBLEMS – Spring Street Growth Alternatives

Alternative 1 only consists of upsizing the existing pipes by one nominal pipe size. This may allow for the option to implement trenchless pipe construction methods such as pipe bursting. The upsized pipes can be installed at the existing elevations and slopes which decreases the likelihood of encountering subsurface rock.

Alternative 2 will be constructed deeper than the existing infrastructure, but not deeper than 10-15 feet deep. This alternative may consist of rock excavation due to the deeper bury depths. It is not anticipated that additional potential construction problems will be encountered.

4.2.18. SUSTAINABILITY CONSIDERATIONS – Spring Street Growth Alternatives

There are minimal improvements to the current sustainability and resiliency of the collection system associated with Alternative 1 because it is replacing the system with similar infrastructure.

Alternative 2 consists of a larger diameter pipe which is capable of passing solids and therefore eliminates the need for STEG tanks in existing and future connections that discharge to this line. Therefore, when existing STEG tanks along the corridor fail, the services can be reconnected with just a 4-inch service rather than replacing with a new STEG tank. Additionally, removing the STEG tanks from the system results in higher loading at the WPCF which actually improves the processes at the WPCF. The existing STEG tanks throughout the City remove solids before discharging to the collection system, and therefore the WPCF will need to add additional components to the treatment processes to improve removal rates. Additionally, development that can connect to the new trunkline will not be required to construct STEG tanks at new connections which reduces costs to the developer and continues to improve the loading at the WPCF. Lastly, removing STEG tanks from the system results in less operations and maintenance costs to the City. Currently, the City pumps the STEG tanks every couple years and discharges the solids to the WPCF. Removing the STEG tanks from the system will allow the City staff to focus on preventative maintenance to reduce I/I and maintain a more resilient system.

4.2.19. WATER AND ENERGY EFFICIENCY – Spring Street Growth Alternatives

Neither alternative consists of pumping or energy usage.

4.2.20. GREEN INFRASTRUCTURE – Spring Street Growth Alternatives

Green infrastructure to preserve or mimic natural processes for stormwater management are not applicable to this project. However, if deficiencies within the stormwater system are present within the corridor of this project, the stormwater improvements could be completed in conjunction with the collection system improvements.

4.2.21. OTHER – Spring Street Growth Alternatives

There were no other considerations in the selection of an alternative than those described above.

4.2.22. COST ESTIMATES – Spring Street Growth Alternatives

Cost estimates for these alternatives are provided in Chapter 5.

CHAPTER 5 - SELECTION OF AN ALTERNATIVE, TREATMENT

5.1. LIFE CYCLE COST ANALYSIS AND ALTERNATIVES SELECTION

This chapter will provide relative capital and life cycle cost estimates and recommendations for selection of the treatment alternatives described in Chapter 4. The alternatives recommended in this chapter have been evaluated based on advantages and disadvantages, expected effluent quality, treatment reliability, and capital and life cycle costs. Annual O&M costs are included in the cost estimates to arrive at a present value for comparison of alternatives. The cost estimates presented in this chapter are relative costs that do not include costs that are shared between all alternatives for a given process. The present value analysis was conducted using a real discount rate of 3% and a 20-year period. The treatment equipment (unless a short-lived asset) is assumed to have a 20-year useful life, so no salvage value is included for comparing the alternatives.

The estimated capital and operation and maintenance costs presented are considered only to be preliminary level cost estimates (Class 4 as defined by the American Association of Cost Engineers), which are used to provide sufficient accuracy for budgetary planning purposes. These estimates include costs associated with engineering services, contractor overhead and profit, and contingency to compensate for changes in the cost of construction and unexpected conditions. The cost estimates herein are based on the perception of current conditions at the project location. This estimate reflects an opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Keller Associates cannot and does not warrant nor guarantee that proposals, bids, or actual construction costs will not vary from the cost estimates presented herein.

5.1.1. Secondary Treatment

Secondary treatment options include sequencing batch reactors, oxidation ditches, and membrane bioreactors. The advantages and disadvantages for the secondary treatment options are provided in Table 5-1.

TABLE 5-1:SECONDARY TREATMENT OPTIONS ADVANTAGES AND DISADVANTAGES

Sequencing Batch Reactor	Oxidation Ditch	Membrane Bio-Reactor
Advantages		
- Simple operation - Smaller footprint than Oxidation Ditch - Lowest capital costs	- Simple operation - Less mechanical equipment than other options	- Smallest footprint, more concentrated biological process, so process basins may be much smaller - Capability to treat to very low TSS, N and P levels - Would set up system for multiple tertiary treatment options if needed, without extra add-ons
Disadvantages		
- Less operational flexibility to achieve lower nutrient limits - can only change the aeration intensity and cycle times, no internal recirculation - Post-Process equalization basin recommended	- Less operational flexibility to achieve lower nutrient limits - Larger footprint than SBR or MBR due to shallower process basins	- Generally highest capital and O&M Costs - More technical operation and maintenance compared to SBR and Oxidation Ditch (More equipment to be maintained) - Requires addition of fine screens in headworks - Would likely require a higher operator certification than SBR or Oxidation Ditch secondary treatment plant

A 20-year life cycle cost comparison for the three secondary treatment options, including capital costs, as well as operational and maintenance costs, is provided in Table 5-2.

TABLE 5-2: SECONDARY TREATMENT LIFE CYCLE COST ANALYSIS

Sequencing batch reactors incur the lowest capital costs as well as the lowest O&M costs over the 20-year period, although O&M for the SBR and Oxidation Ditch systems are effectively comparable.

Item	Sequencing Batch Reactor	Oxidation Ditch	Membrane Bio-Reactor
Capital Costs			
Excavation and Backfill	$140,000	$180,000	$110,000
Geotechnical Stabilization	$194,444	$250,000	$144,882
Concrete	$1,430,000	$1,820,000	$1,060,000
Buildings	$550,000	$385,000	$830,000
Mechanical Equipment	$1,800,145	$2,312,800	$3,405,640
Electrical and Controls	$604,000	$752,000	$840,000
Subtotal	***$4,718,589***	***$5,699,800***	***$6,390,522***
General Conditions (10%)	$472,000	$570,000	$640,000
Subtotal	***$5,190,589***	***$6,269,800***	***$7,030,522***
Contingency (30%)	$1,558,000	$1,881,000	$2,110,000
Subtotal	***$6,748,589***	***$8,150,800***	***$9,140,522***
Contractor OH&P (15%)	$1,013,000	$1,223,000	$1,372,000
Subtotal	***$7,761,589***	***$9,373,800***	***$10,512,522***
Professional Services (25%)	$1,941,000	$2,344,000	$2,629,000
Total Estimated Project Cost	**$9,702,589**	**$11,717,800**	**$13,141,522**
Annual O&M Costs			
Electricity	$18,800	$24,800	$81,500
Chemical	$32,303	$32,303	$36,023
Disposal	$7,300	$7,300	$7,300
Parts	$13,000	$9,000	$27,200
Personnel	$225,000	$225,000	$300,000
Estimated Annual O&M	$296,403	$298,403	$452,023
20-Year Life Cycle Cost	**$15,450,000**	**$17,510,000**	**$21,910,000**

SBR systems offer the least amount of operational flexibility in terms of recirculation, and process separation (aerobic, anaerobic, anoxic tanks), while MBRs provide the highest level of operational flexibility, biological process separation, and solids removal through membrane filtration. However, the MBR secondary treatment option incurs the highest capital and O&M costs and would likely result in a higher operator classification required than a plant based around SBR or Oxidation Ditch secondary treatment technology (Class II vs. Class III for MBR).

Current subsurface investigations are underway to determine the treated effluent requirements necessary to prevent negative impacts to surface waters and groundwaters in the NSC as described in the Three Basin Rule. Pending the results of the groundwater and soil investigations, WPCF planning and recommendations will assume a high level of effluent quality required for groundwater infiltration. The effluent quality requirements expected with permitting of the new Mill City WPCF are described in Table 1-6. Constituents of concern include TSS, BOD_5, ammonia, and nitrate. All secondary treatment processes discussed will provide sufficient removal of ammonia, as well as reduction of TSS and BOD_5 to meet the expected WPCF effluent requirements of 20 mg/L each. However, as the biological process oxidizes ammonia to nitrates during wastewater treatment, levels of nitrate may be higher in treated effluent than would be required to not exceed background groundwater concentrations. Where the secondary treatment process is unable to meet these effluent requirements, tertiary denitrification treatment will be required, regardless of the secondary treatment process chosen. Tertiary treatment is discussed in Chapter 4 and Chapter 6.

Keller recommends the implementation of sequencing batch reactors for secondary treatment. If permitted levels of nitrate are required to be below 5 mg/L, Keller recommends addition of tertiary denitrification filters for additional removal of nitrates, as well as extra solids removal, prior to disinfection and discharge to rapid infiltration basins. Under these treatment scenarios, the effluent would be of sufficiently high quality to protect NSC ground and surface waters and reduce clogging of RIBs during effluent disposal. The system would also be well situated for addition of further tertiary treatment if future discharge limitations are enforced for currently unregulated contaminants in wastewater effluents.

5.1.2. Headworks

Headworks processes are important to reduce wear and clogging of pumps and other mechanical equipment in downstream processes. Preliminary treatment that occurs in the headworks includes screening and grit removal. Options evaluated for screening at the Mill City WPCF include bar screens, drum screens, and band screens. Options evaluated for grit removal include mechanical vortex and induced vortex technologies. Table 5-3 provides advantages and disadvantages of the evaluated screening options and Table 5-4 provides 20-year life cycle cost estimates for screening options. Table 5-5 and Table 5-6 provide advantages and disadvantages and 20-year life cycle cost estimates for grit removal technologies.

TABLE 5-3: HEADWORKS SCREENING OPTIONS ADVANTAGES AND DISADVANTAGES

Bar Screens	Drum Screens	Band Screens
	Advantages	
- Small footprint - Low wash water requirement	- Lowest capital life cycle cost - Integrated washer/compactor	- Small footprint - Low wash water requirements
	Disadvantages	
- Separate washer/compactor - Same type of screen openings as backup screen	- Slightly larger footprint than other options	- Separate washer/compactor - Highest life cycle cost

TABLE 5-4: HEADWORKS SCREENING LIFE CYCLE COST ANALYSIS

Item	Multi-Rake Bar Screen	Drum Screen	Band Screen
Capital Costs			
Site Work	$10,000	$10,000	$10,000
Excavation and Backfill	$6,800	$8,000	$6,600
Concrete	$22,500	$26,500	$21,900
Building	$120,000	$150,000	$120,000
Screens	$200,200	$130,000	$222,700
Mechanical Equipment and Installation (30%)	$107,900	$97,400	$114,400
Electrical and Controls (25%)	$116,900	$105,500	$123,900
Subtotal	***$584,300***	***$527,400***	***$619,500***
General Conditions (10%)	$59,000	$53,000	$62,000
Subtotal	***$643,300***	***$580,400***	***$681,500***
Contingency (30%)	$193,000	$175,000	$205,000
Subtotal	***$836,300***	***$755,400***	***$886,500***
Contractor OH&P (15%)	$126,000	$114,000	$133,000
Subtotal	***$962,300***	***$869,400***	***$1,019,500***
Professional Services (25%)	$241,000	$218,000	$255,000
Total Estimated Project Cost	**$1,204,000**	**$1,088,000**	**$1,275,000**
Annual O&M Costs			
Electricity	$200	$200	$400
Disposal	$2,600	$2,600	$2,600
Parts	$3,000	$4,000	$3,000
Personnel	$5,200	$5,200	$5,200
Estimated Annual O&M	$11,000	$12,000	$11,200
20-Year Life Cycle Cost	**$1,420,000**	**$1,330,000**	**$1,500,000**

Band screens generally have lower capture rates than drum screens and bar screens of similar cost, and rotating drum screens generally require a larger footprint than bar screens. The excavation and concrete costs associated with the larger footprint of the drum screen option is included in the capital costs in Table 5-5. Based on the 20-year life cycle cost and the high screening capture rates, Keller recommends the rotating drum screen option with ¼” openings and an integrated washer/compactor system. For screening redundancy, Keller recommends installing a manually cleaned static screen as a downstream backup.

TABLE 5-5: HEADWORKS GRIT REMOVAL OPTIONS ADVANTAGES AND DISADVANTAGES

Induced Vortex	Mechanical Vortex
Advantages	
- Simple construction - Lower capital cost	- Controlled by programmable logic controller (more operational flexibility)
Disadvantages	
- Controlled by relay (less operational flexibility)	- Higher capital cost - More complex construction

TABLE 5-6: HEADWORKS GRIT REMOVAL LIFE CYCLE COST ANALYSIS

Item	Induced Vortex	Mechanical Vortex
WWTP Project		
Site Work	$10,000	$10,000
Excavation and Backfill	$5,000	$5,800
Concrete	$15,000	$28,900
Grit Trap, Pump and Classifier Equipment	$252,200	$393,900
Mechanical Equipment and Installation	$56,500	$131,600
Electrical and Controls (25%)	$84,700	$142,600
Subtotal	***$423,400***	***$712,800***
General Conditions (10%)	$43,000	$72,000
Subtotal	***$466,400***	***$784,800***
Contingency (30%)	$140,000	$236,000
Subtotal	***$606,400***	***$1,020,800***
Contractor OH&P (15%)	$91,000	$154,000
Subtotal	***$697,400***	***$1,174,800***
Professional Services (25%)	$175,000	$294,000
Total Estimated Project Cost	**$873,000**	**$1,469,000**
Annual O&M Costs		
Electricity	$200	$200
Disposal	$2,600	$2,600
Parts	$2,000	$4,000
Personnel	$2,600	$2,600
Estimated Annual O&M	$7,400	$9,400
20-Year Life Cycle Cost	**$1,020,000**	**$1,660,000**

As discussed in Chapter 4, aerated grit removal systems are generally not cost-effective at smaller treatment plants, and many manufacturers produce induced vortex and mechanical vortex technologies at competitive prices. Keller recommends an induced vortex grit removal system due to cheaper acquisition of mechanical components and simpler construction with availability for installation in a precast manhole.

5.1.3. Influent Lift Station

Two types of lift stations were evaluated for wastewater influent receiving and pumping at the future Mill City WPCF. These options include a wet well submersible pump lift station and a wet well/dry pit lift station configuration. Table 5-7 provides advantages and disadvantages of the influent lift station configurations, and Table 5-8 provides a life cycle cost comparison.

TABLE 5-7: INFLUENT LIFT STATION OPTIONS ADVANTAGES AND DISADVANTAGES

Wet Well	Wet Well/Dry Pit
Advantages	
- Lower capital costs - Requires less space - Does not require aboveground structures - Sealed pumps may require less maintenance	- Easier access and maintenance than submerged pumps
Disadvantages	
- When maintenance is required, pump access is more difficult	- Higher capital costs - Generally, only installed for large pump stations

TABLE 5-8: INFLUENT LIFT STATION LIFE CYCLE COST ANALYSIS

Item	Wet Well	Wet Well/Dry Pit
Capital Costs		
Site Work	$40,000	$100,000
Structures (Building and Manholes)	$25,000	$145,000
Pumping Equipment	$25,000	$25,000
Mechanical Equipment and Installation	$18,000	$81,000
Electrical and Controls (25%)	$27,000	$87,800
Subtotal	***$135,000***	***$438,800***
General Conditions (10%)	$14,000	$44,000
Subtotal	***$149,000***	***$482,800***
Contingency (30%)	$45,000	$145,000
Subtotal	***$194,000***	***$627,800***
Contractor OH&P (15%)	$30,000	$95,000
Subtotal	***$224,000***	***$722,800***
Professional Services (25%)	$56,000	$181,000
Total Estimated Project Cost	**$280,000**	**$904,000**
Annual O&M Costs		
Electricity	$4,800	$4,800
Parts	$2,000	$4,000
Personnel	$2,000	$3,000
Estimated Annual O&M	$8,800	$11,800
20-Year Life Cycle Cost	**$460,000**	**$1,140,000**

Based on low capital costs, simpler construction, and the expected size of the WPCF, Keller recommends a wet well with submerged pumps for the future WPCF influent lift station.

5.1.4. Disinfection

To achieve the expected E coli. discharge requirements, disinfection prior to discharge will be essential at the future Mill City WPCF. As a chemical disinfectant residual is generally not required for wastewater disinfection, and such disinfection systems require the use of costly and potentially hazardous chemical oxidants, Keller has proceeded with an evaluation of different technologies based on ultraviolet (UV) disinfection. The two technologies evaluated include open channel horizontal UV disinfection and enclosed chamber UV disinfection. Open channel inclined UV disinfection technology was not evaluated as it is not likely to be cost efficient for the expected treatment plant size. Table 5-9 provides advantages and disadvantages of both technologies. Table 5-10 provides life cycle cost analyses for the proposed disinfection technologies.

TABLE 5-9: DISINFECTION OPTIONS ADVANTAGES AND DISADVANTAGES

Open Channel	Enclosed
Advantages	
- Slightly lower capital cost for mechanical equipment	- No concrete channels required
Disadvantages	
- Requires concrete and excavation for construction of open channels	- Slightly higher capital costs for mechanical equipment - Higher electricity usage

TABLE 5-10: DISINFECTION LIFE CYCLE COST ANALYSIS

Item	Open Channel	Enclosed
WWTP Project		
Excavation and Concrete	$20,000	-
UV Equipment	$262,000	$287,000
Isolation Valves	-	$10,000
Mechanical Equipment and Installation (30%)	$85,000	$90,000
Electrical and Controls (25%)	$92,000	$97,000
Subtotal	***$459,000***	***$484,000***
General Conditions (10%)	$46,000	$49,000
Subtotal	***$505,000***	***$533,000***
Contingency (30%)	$152,000	$160,000
Subtotal	***$657,000***	***$693,000***
Contractor OH&P (15%)	$99,000	$104,000
Subtotal	***$756,000***	***$797,000***
Professional Services (25%)	$189,000	$200,000
Total Estimated Project Cost	**$945,000**	**$997,000**
Annual O&M Costs		
Electricity	$3,600	$7,900
Chemical	$200	$200
Parts	$4,100	$5,740
Personnel	$7,800	$7,800
Estimated Annual O&M	$15,700	$21,640
20-Year Life Cycle Cost	**$1,180,000**	**$1,320,000**

Based on lower capital costs and lower electricity requirements, Keller recommends the open channel UV disinfection configuration for effluent disinfection at the Mill City WPCF. Depending on effluent nitrate requirements, open channel UV disinfection would be compatible both after SBR secondary treatment as well as following tertiary denitrification filters (where required).

5.1.5. Solids Handling Equipment

During the wastewater treatment process, solids are separated from the liquid wastewater stream and must be disposed of. In order to consolidate and dispose of the separated sludge, it must be thickened and dewatered through solids handling processes. The main goal of solids handling is to reduce the total volume and weight of the solids to be disposed of by removing moisture from the separated sludge. The liquid stream separated from waste sludge is then generally sent back to the head of the treatment plant for processing. Following solids handling, the thickened and dewatered sludge can be disposed of at a solid waste disposal site more economically than would have been possible directly following clarification or filtration. Three solids handling technologies were evaluated in this study: screw press, volute press, and fan press. All three options are able to thicken and dewater waste sludge to levels required for economical disposal of solids, so the final recommendation is based on capital cost for installation, operating costs, and ease of maintenance. Table 5-11 provides advantages and disadvantages of the solids handling alternatives. Table 5-12 provides associated life cycle cost estimates.

TABLE 5-11: SOLIDS HANDLING OPTIONS ADVANTAGES AND DISADVANTAGES

Volute Press	Fan Press	Screw Press
Advantages		
- Lowest capital and life cycle cost - Ability to expand redundancy with a single skid including multiple drums - Lowest wash water usage - Can operate unattended	- Ability to expand redundancy with a single skid that includes multiple channels - Can operate unattended	- Capable of starting and stopping autonomously with linked sensors - Can operate unattended
Disadvantages		
- Fewer manufacturers and installations relative to screw press	- High wash water usage	- A single skid can only provide one press (for redundancy, multiple units would be necessary) - High wash water usage

TABLE 5-12: SOLIDS HANDLING LIFE CYCLE COST ANALYSIS

Item	Volute Press	Fan Press	Screw Press
Capital Costs			
Site Work, Excavation and Concrete	$23,700	$23,700	$23,700
Buildings	$188,000	$188,000	$188,000
Dewatering Press and Associated Equipment	$234,700	$361,800	$373,500
Mechanical Equipment and Installation (30%)	$134,000	$172,100	$175,600
Electrical and Controls (25%)	$145,100	$186,400	$190,200
Subtotal	***$725,500***	***$932,000***	***$951,000***
General Conditions (10%)	$73,000	$94,000	$96,000
Subtotal	***$798,500***	***$1,026,000***	***$1,047,000***
Contingency (30%)	$240,000	$308,000	$315,000
Subtotal	***$1,038,500***	***$1,334,000***	***$1,362,000***
Contractor OH&P (15%)	$156,000	$201,000	$205,000
Subtotal	***$1,194,500***	***$1,535,000***	***$1,567,000***
Professional Services (25%)	$299,000	$384,000	$392,000
Total Estimated Project Cost	**$1,493,500**	**$1,919,000**	**$1,959,000**
Annual O&M Costs			
Electricity	$1,100	$1,200	$1,000
Chemical	$1,000	$1,000	$1,000
Disposal	$19,500	$19,500	$19,500
Parts	$10,500	$10,500	$10,500
Personnel	$15,600	$15,600	$15,600
Estimated Annual O&M	$47,700	$47,800	$47,600
20-Year Life Cycle Cost	**$2,420,000**	**$2,850,000**	**$2,890,000**

Based on lower capital costs, Keller recommends the volute press for use in solids handling at the future Mill City WPCF. The volute press could also be expanded in the future to include multiple drums for redundancy in solids dewatering.

5.1.6. Effluent Disposal and Siting

Following disinfection, effluent must be disposed of in accordance with federal, state, and local regulations, and in compliance with the new WPCF permit. As the Three Basin Rule does not permit new discharge of treated effluent directly to the North Santiam River, discharge to groundwater through rapid infiltration basins will most likely be the permitted disposal option, pending the completion of subsurface investigations by GSI and GSA (Appendix I). As described in Chapter 4, several sites in the Mill City/Gates area are currently under investigations to determine the best candidate site for effluent disposal. Table 5-13 provides preliminary recommended basin sizes based on the measured groundwater infiltration rate of the four sites undergoing subsurface investigation. Preliminary design calculations are based on EPA guidance for design of rapid infiltration basins, as well as the expected 2045 $MMWWF_5$ wastewater flows and effluent quality at the future WPCF.

TABLE 5-13: RAPID INFILTRATION BASIN SIZES AT DIFFERENT DISPOSAL SITES

Site ID	Effective Saturated Hydraulic Conductivity (Geometric Mean, ft/day)	Recommended Basin Area (Acres)
GM1	5.97	1.72
GM2	0.12	85.78
GM4	0.78	13.2
GM5	0.18	57.18

Basin sizes were calculated using 10% of the measured infiltration rate to account for clogging of the soil that can occur during wastewater effluent infiltration.[1] It is also recommended to cycle effluent disposal to the infiltration basins utilizing short wet cycles (the effluent loading cycle) and longer dry cycles to allow for the infiltrations beds to dry and reaerate for improved biological treatment in the soil during infiltration. Allowing infiltration basins to dry or providing a “rest” period in between effluent loadings also helps to prevent clogging of basin soil over time. Per EPA recommended RIB loading and drying cycles (2 days loading and 7 days drying in the summer, and 2 days loading and 12 days drying in the winter), approximately 5-7 infiltration basins spread over the recommended basin site is proposed. Based on the Phase I Shallow Soil Report conducted by GSI and GSA, Keller recommends moving forward with general layouts at the GM1 site as it appears to be the most viable in terms of the basin area necessary for effluent disposal. It would likely be advantageous to locate the new WPCF at the same site as effluent disposal to avoid construction of costly pipelines for conveyance of treated effluent to the chosen infiltration disposal site. A preliminary examination of the GM1 site indicates that it would be sufficiently large for both the treatment facilities and infiltration basins needed for the 2045 expected planning flows and loadings, as well as several acres available for expansion of treatment and disposal facilities beyond 2045. Subsurface hydraulic investigations are still being conducted at the time of this report, and suitability of the proposed site for disposal of treated effluent are dependent on the final conclusions of the subsurface investigations and groundwater modeling. Where these investigations determine the proposed site to be unsuitable, the siting recommendation will be revisited.

5.2. NON-MONETARY FACTORS

Important non-monetary factors to be considered in treatment plant design include ease of operation, ease of obtaining equipment replacement parts, operator classification, future site planning, expansions, renovations, and straightforward and redundant operational framework to meet the requirements of the Three Basin Rule.

Keller recommends a treatment system based around SBR secondary treatment technology, likely followed by denitrification tertiary treatment. The secondary treatment process selection is based on monetary factors (capital and O&M costs), the ability of the process to meet the expected effluent requirements, and the non-monetary factors outlined above. A plant based around SBR for secondary treatment would likely require Class II operators, while the MBR option would likely require Class III operators due to pressurized membrane filtration. Class II operators would likely be easier to recruit than Class III in the area, and many communities in Western Oregon also operate SBR treatment plants.

A preliminary assessment of the GM1 disposal site suggests that the non-monetary siting criteria would be achievable in the coming decades. The non-monetary criteria for WPCF siting include room for site expansion and renovation, as well as ease of access for chemical and equipment deliveries. Odor control at the future WPCF site is also a concern for the municipal planning staff in Mill City.

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[1] U.S. Environmental Protection Agency. (1981, October). *Process Design Manual for Land Treatment of Municipal Wastewater.* Cincinnati: U.S. Environmental Protection Agency, Center for Environmental Research Information.

While residential developments are located near the GM1 site, treatment processes that are generally associated with odor, such as the headworks, could be located furthest from these developments and would be designed with odor control processes to further mitigate these issues.

SELECTION OF AN ALTERNATIVE, COLLECTION

This section provides a recommendation for a preferred alternative for the Gates / Mill City Force Main and the Spring Street Growth Alternatives discussed in Chapter 4. This section considers costs and non-monetary factors.

5.3. GATES / MILL CITY ALTERNATIVE SELECTED ALTERNATIVE

Based on the considerations documented in Chapter 4 and the following sections, it is recommended to pursue Alternative 2 for the Gates / Mill City Force Main project. Within Alternative 2, the alignment for 2B should be constructed.

5.3.1. Life Cycle Cost Analysis – Gates / Mill City Force Main

Construction costs were estimated for each of the two alternatives for the Gates/Mill City force main. Operations and maintenance and life-cycle costs were not compared because both alternatives have similar considerations. The detailed cost estimate is provided in Appendix E and a summary is included in Table 5-14. Note, the costs for Alternative 2 are based on the Alternative 2B alignment.

TABLE 5-14: MILL CITY/GATES ALTERNATIVE COST ESTIMATES

Item	Alternative 1	Alternative 2
Goods and Services	$6,008,000	$5,380,400
Construction Costs[1]	$3,904,000	$3,498,000
Engineering and Permitting[2]	$3,349,000	$3,124,000
Total Project Cost	**$13,270,000**	**$12,010,000**

1) Inclues mobilization, contractor overhead and profit, prevailing wages, American Iron and Steel / Build America, Buy America consideration, and contingency.

2) Includes engineering design, construction administration, and inspection, permitting, environmental, geotechnical, SCADA integration, surveying, and legal.

5.3.2. Non-Monetary Considerations – Gates / Mill City Force Main

Alternative 2 provides additional benefits including increased resiliency, use of existing infrastructure, and improved communities. This alternative consists of less water crossings which are more vulnerable to breaking and therefore improves the resiliency of the force main. This alternative avoids installation of a new wastewater pipeline across the Santiam River by utilizing the existing force main from the First Ave lift station. This reduces the risk of polluting a major water source by not adding another potential point of failure. The communities of Mill City and Gates can benefit from this alternative by constructing a walking/biking path above the force main located within the inactive railroad ROW. This would provide a path between the two communities that is off the existing highway. This pathway could be constructed with green infrastructure such as infiltration trenches to capture runoff. Alternative 2B is recommended over Alternative 2A. Alternative 2A is located lower in the sewer basin and will capture most of the new connections in this basin and allows for continued growth past the 2070 estimates with minimum pipe sizes. Alternative 2B also transitions from a pressure pipe to gravity pipe at a manhole location away from existing structures which is beneficial because there will be an increased odor at this transition manhole and will require some odor control measures.

5.4. SPRING STREET GROWTH SELECTED ALTERNATIVE

Based on the considerations documented in Chapter 4 and the following sections, it is recommended to pursue Alternative 1 for the Spring Street growth alternatives.

5.4.1. Life Cycle Cost Analysis – Spring Street Growth

Table 5-15 summarizes the capital, O&M, replacement, and salvage costs associated with both alternatives. The cost comparison for these alternatives considers each of these costs because the two alternatives result in different operation of the system and will have different costs over a 20-year life cycle. Alternative 1 will continue to use STEG tanks which have costs associated with it including pumping and disposal as well as replacement when they reach the end of their useful life. Additionally, there are pipeline O&M costs for CCTV and cleaning. Alternative 2 only has O&M costs for pipeline CCTV and cleaning. Replacement costs for pipeline were not considered since both alternatives would have similar costs. Additionally, the potential savings on chemicals at the WPCF associated with Alternative 2 due to the increased loading were not considered.

Although Alternative 1 has additional O&M costs associated with it, the capital costs for Alternative 2 significantly exceed those of Alternative 1. Therefore, unless there are other factors such as a desire to eliminate STEG tanks, Alternative 1 is recommended.

TABLE 5-15: SPRING BASIN ALTERNATIVE COSTS

Item	Alternative 1	Alternative 2
Capital Costs	$590,000	$1,790,000
O&M 20-Year Present Worth[1]	$90,900	$34,900
Replacement 20-Year Present Worth[2]	$102,000	$0
Salvage Value	$0	$0
20-Year Lifecycle cost	**$780,000**	**$1,824,900**

1) Equal to present worth of 20-years of O&M activities associated with each alternative.

2) Equal to present worth of 20-years of annual replacement savings for STEG tank replacement.

5.4.2. Non-Monetary Considerations – Spring Street Growth

Non-monetary considerations would be if the city had interest in phasing out the existing STEG tanks. If this were the case, Alternative 2 would allow for new connections along the alignment and new development to discharge directly to the trunkline. However, the city is not currently interested in removing STEG tanks from their system.

Alternative 1 consists of less disturbance to the existing system and will have a lesser impact on existing customers.

CHAPTER 6 - PROPOSED PROJECTS

This chapter includes a summary of the recommended alternatives and a description of the proposed project based on the information available at the time of this study. The chapter also includes description of the preliminary project schedule, anticipated permit requirements, sustainability considerations, cost estimates, and annual operating budgets.

6.1. PRELIMINARY PROJECT DESIGN

The project described below includes the recommended alternatives and are included in the capital improvement plan. The projects are prioritized according to the criteria outlined in Table 6-1.

TABLE 6-1: PRIORITIZATION CRITERIA

Priority	Implementation Timeline	Description
1	0-5 Years	► Construction of new WPCF ► Regionalization of Gates and Mill City systems ► Existing capacity related deficiency ► Conditions related replacement
2	5-20 Years	► Lower priority projects to complete within next 5-20 years
3	Development Driven	► Projects to serve new development.

Projects 1.1 through 1.3 – Water Pollution Control Facility

This project involves construction of a new WPCF and disposal site in Mill City, as well as decommissioning of the current WPCF. The new WPCF will be designed to receive and treat wastewater flows from both Mill City and Gates through 2045 as described in Chapter 4 and outlined in Table 6-2 below.

TABLE 6-2: WPCF DESIGN CRITERIA

WPCF Design Flows		WPCF Design Max Month Loadings	
Design Criteria	Flow (MGD)	Design Criteria	Loading (PPD)
ADF	0.223	BOD_5	490
MMF	0.262	TSS	277
PIF_5	0.682	TKN	155
		TP	24

Additionally, the site will include space for expanding the facility for treatment and disposal of future influent flows and loadings beyond 2045. Major WPCF processes and their recommended components are summarized below.

- Headworks – The headworks processes should be capable of removing branches, plastics, grit, and other deleterious materials that arrive in the WPCF influent to protect downstream pumps and mechanical equipment. Keller recommends a rotating drum screen option with ¼” openings and an integrated washer/compactor for headworks screening. For screening redundancy, a manually cleaned static screen is recommended as a downstream backup. Keller recommends an induced vortex grit removal system due to cheaper acquisition of mechanical components and simpler construction with installation in a precast manhole.

- Influent Lift Station – An influent lift station is required following the headworks to pump screened influent to secondary treatment and downstream processes. Keller recommends a wet well with submersible pumps alternating between duty and standby pumping. This configuration is less expensive and more cost effective for smaller treatment plants. Operating one pump at a time also results in less wear on each pump and allows maintenance to be performed on one pump without halting treatment of influent at the WPCF.

- Secondary Treatment – During secondary treatment, a large portion of the wastewater constituents will be removed. These include ammonia, TSS, BOD_5, as well as some nitrate. Secondary treatment will also likely encompass the bulk of the electrical and chemical operating costs associated with the facility treatment process. Keller recommends installation of a sequencing batch reactor (SBR) system for secondary treatment due to the low capital cost and relatively few pieces of mechanical equipment required. The SBR process will consist of two concrete process basins and a post-equalization basin where treated secondary effluent is stored until it is pumped to tertiary treatment, disinfection, and rapid infiltration. The SBR process would be sized to treat expected 2045 max month flows and loadings and blowers, diffusers, and mechanical mixers would be provided for aerobic treatment of the wastewater. A chemical injection system for addition of methanol and caustic soda to the process basins would be installed as well. The preliminary site layout includes room for expansion of treatment processes beyond 2045.

- Tertiary Treatment – If nitrate levels in treated effluent are required to be lower than 5 mg/L prior to rapid infiltration, Keller recommends tertiary treatment involving sand denitrification filters. A biological denitrification filter creates an environment free of oxygen with a high surface area. This encourages growth of denitrifying organisms that convert nitrate into nitrogen gas which is then released to the atmosphere. This process results in removal of the associated nitrogen from the liquid treatment train that originally entered as organic nitrogenous compounds or ammonia (together known as TKN). The filters would be located in metal tanks near the secondary treatment post-equalization tank and would be designed to bring monthly average nitrate levels down to 1 mg/L and daily average turbidity down to 2 NTU or less prior to disinfection and discharge.

- Disinfection – Keller recommends open channel horizontal UV disinfection for removal of coliform prior to discharge. This system would not require injection of chemicals directly into the water being treated but would require a small amount of chemical for cleaning of the UV bulbs when UV transmittance drops below setpoints.

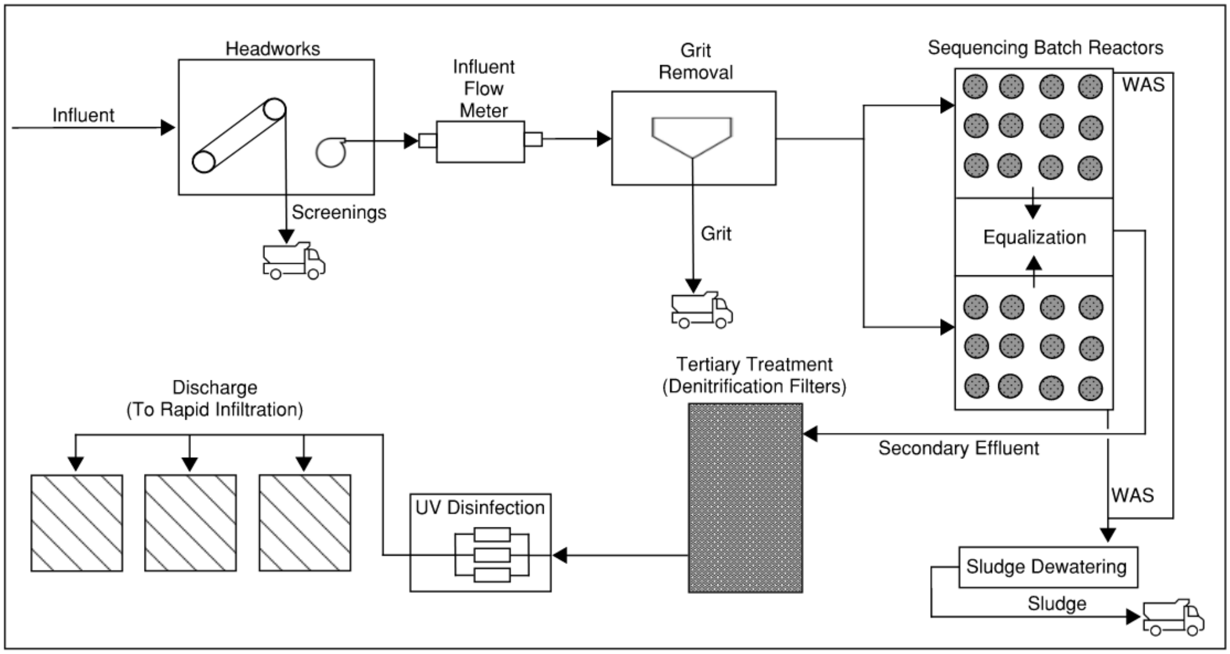
- Sludge Dewatering – During secondary treatment, microorganisms consume the wastewater constituents described above and eventually form a blanket of sludge on the bottom of the process basins. Some of this blanket is left to ensure a healthy microbial population, but older sludge would be pumped to a solids holding tank for storage before dewatering and hauling to a landfill. Due to lower capital cost and the ability to install multiple drums on a single skid, Keller recommends installation of a volute press for sludge thickening and dewatering. A polymer mixing and addition system would also be required to aid in sludge agglomeration and dewaterability. Following the dewatering process, solids would drop into a conveyer where they could be stored in a dumpster before they are hauled to a landfill.

- Effluent Pumping Station – Following disinfection, treated effluent would gravity flow to an effluent pumping station with a similar configuration to that of the influent lift station. A wet well with two submersible pumps would be utilized to send the final effluent to the rapid infiltration basins.

- Disposal – As surface water discharge is not an option per the Three Basin Rule, Keller recommends rapid infiltration basins (RIBs) for disposal of treated effluent. The basins would be designed based on EPA guidance and include redundant basins allowing operators to cycle effluent loading to minimize standing water in the RIBs. Data from subsurface investigations, as well as groundwater modeling and sampling will be utilized in design and operation recommendations to ensure groundwater and surface water are protected in the NSC.
- Backup Power – A backup diesel generator is recommended to run core processes, lights, and HVAC at the WPCF during power outages or other emergencies.
- Site Development – This portion of the project includes land development of the WPCF/RIB property. This includes access roads, utilities, access inside the property, and stormwater collection, treatment, and disposal. Also included in this project will be landscaping to comply with land use and design standards for the County and/or City.
- Current WPCF Decommissioning – Upon construction and startup of the future WPCF, the current facility will need to be decommissioned. Decommissioning of the current WPCF will include capping the influent line and capping or removing the effluent line. All sewage, sludge, and sediment will be removed from the pipes, basins, and gravel filter and disposed of. Tanks that are not being reused will be removed or backfilled with sand, earth, gravel, or other approved material. All aboveground piping, equipment, chemicals, spare parts will be removed. Cleaned piping and equipment may remain in place if buried or located below grade. Tanks and buildings may remain in place for other uses if they are properly cleaned and retro-fitted so that they are not a safety concern or environmental hazard. Unused monitoring wells will be abandoned in conformance with state requirements.

Figure 6-1 provides an updated flow diagram with the above recommended technologies for the future Mill City WPCF.

FIGURE 6-1: RECOMMENDED WPCF FLOW DIAGRAM



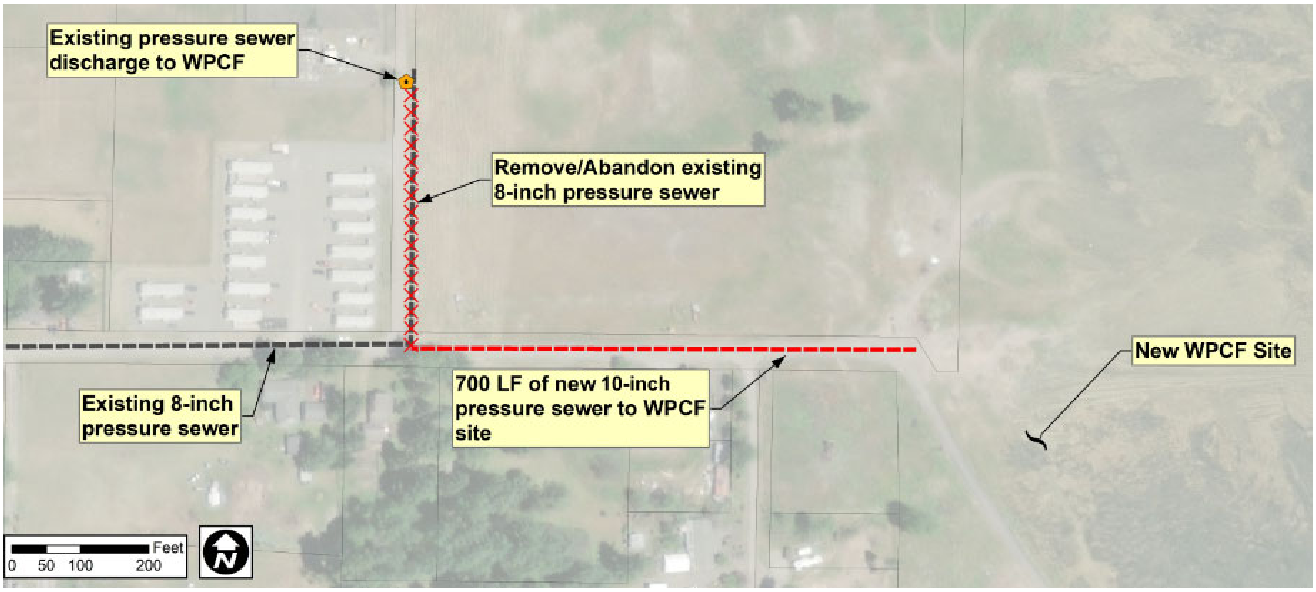
Project 1.4 – Mill City Lift Station Improvements

This project consists of upgrading the First Avenue Lift station including upsizing the pumps and electrical equipment. The First Avenue Lift Station pumps should upsize the existing 130 gpm pumps to 300 gpm and associated electrical/controls equipment. Install Variable Frequency Drives (VFDs) to allow for variable pumping rates depending on fluctuations in flows.

Project 1.5 – Mill City Piping Improvements

This project consists of abandoning a portion of the existing 8-inch pressure sewer pipeline going to the existing WPCF location and extending the pipeline along Fairview Avenue to the new WPCF site. It includes approximately 700 LF of new 10-inch pressure sewer pipeline installed within the Fairview Avenue right-of-way and running through the new WPCF site. The project extents are provided in Figure 6-2 The existing 8-inch force main should not be abandoned until the new 10-inch forcemain and WPCF are online.

FIGURE 6-2: FAIRVIEW AVE FORCE MAIN EXTENSION



Project 1.6 – Gates to Mill City Force Main and Gravity Main

This project consists of constructing 10,000 LF of 4-inch pressure sewer pipe and 2,000 LF of 8-inch gravity sewer pipe. The 4-inch pressure sewer pipe will start at the new Gates Regional Lift Station and head west toward Mill City. The preliminary layout of the force main is provided in Appendix G. It is anticipated that the pipe will be buried relatively shallow with three to four feet of ground cover. The pipe will be installed within Central Avenue for the first 1,000 LF and then will cross into the abandoned railroad right-of-way (currently owned by ODOT). Once in the right-of-way, the surface repair over the pipe will be a 10-foot-wide asphalt walking/biking path. The 4-inch force main will discharge into a lined manhole with odor control measures to the east of NE 5th Avenue and Santiam Pointe Loop. The existing 4-inch gravity pipe extending to the west will be replaced with an 8-inch gravity pipe at the same depths and slopes. At Wall Street the existing 4-inch gravity pipe will be abandoned and a new alignment within Wall Street to NE 1st Avenue will be constructed. The existing 4-inch in NE 1st Avenue to the First Avenue Lift Station will be replaced with an 8-inch pipe.

Some of the challenges which may be encountered during construction are described below.

- Several intermittent and perennial stream crossings along the proposed alignment that may be bored or open cut.
- Existing structures have been erected within the public right-of-way in between Mill City and Gates.
- Steep slopes and concern for landslides exist for a portion of the alignment.
- The existing Mill City collection system consists of some shallow 4-inch gravity pipes. Cover at a few locations may be less than three feet if installed at existing depths. Adjustments to the grade or mitigation for sub-standard depths will be provided during the design process.
- Shallow bedrock exists throughout the sections of the existing gravity pipe for the Mill City system. There is 300 LF of 8-inch gravity pipe with a new alignment. Rock excavation may be required.

Project 1.7 – Gates Lift Stations

This project consists of constructing three new lift stations in the City of Gates including the Gates Regional Lift Station which will pump flows to Mill City (Project 1.6). This project includes the pressure sewer pipelines within the City of Gates which is approximately 2,300 LF of 4-inch pressure pipeline. The Gates Regional Lift Station will consist of a new 6-foot diameter wetwell, duplex submersible pumps with a capacity of 100-150 gpm. Additional details regarding the lift stations are provided in Table 6-3. This lift station will collect flows from any connections connected to the new Gates collection system.

TABLE 6-3: GATES LIFT STATION DETAILS

Proposed Gates Lift Stations	Regional LS	Dogwood LS	Riverview LS
Type	Duplex; Submersible	Duplex; Submersible	Duplex; Submersible
Capacity (gpm)	100-150	<100	<100
Pump Manufacturer	Flygt / Xylem	Flygt / Xylem	Flygt / Xylem
Wetwell Diameter (ft)	6	6	6
Wetwell Depth (ft)^3	15	15	12
Level Indicator Type	Pressure Transducer & Floats	Pressure Transducer & Floats	Pressure Transducer & Floats
Variable Frequency Drive	Yes	Yes	Yes
Flow Meter (Y/N)	Yes	Yes	Yes
Pressure Gauge (Y/N)	Yes	Yes	Yes
Back-up Power	Yes	Yes	Yes
Transfer Switch	Automatic	Automatic	Automatic

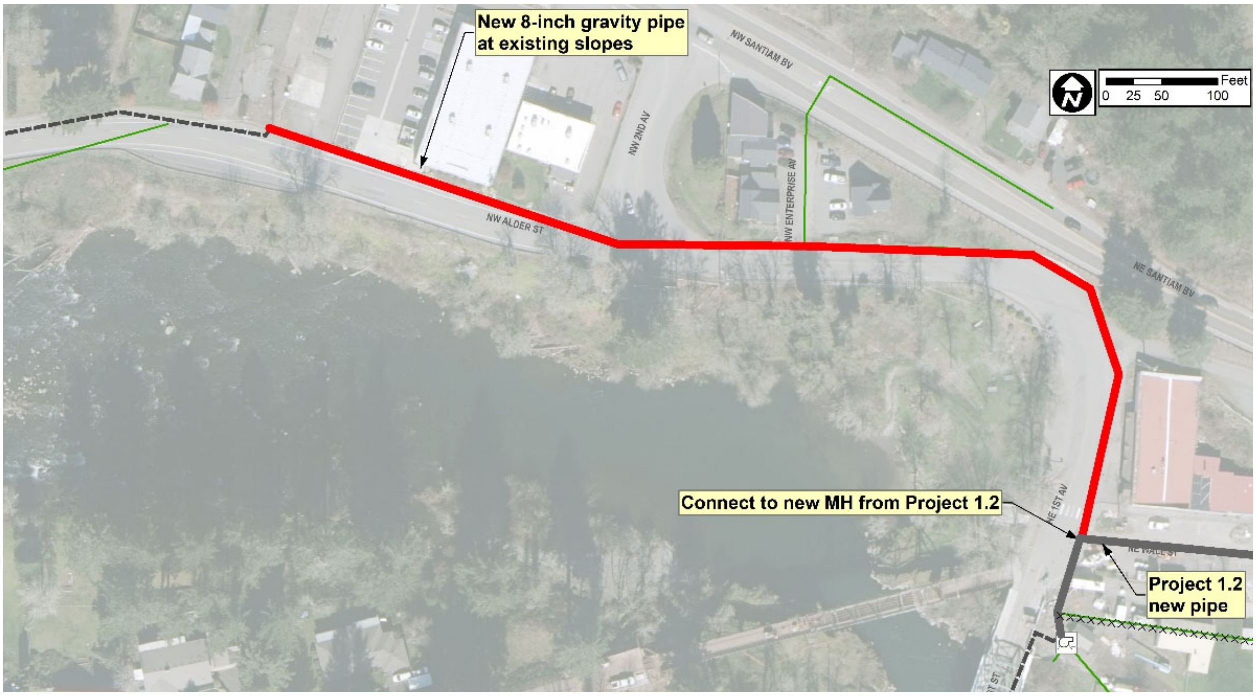
Project 1.8 and 1.9 – Gates Collection System and Services

This project consists of constructing a new gravity collection system within the City of Gates. It includes approximately 25,000 LF of new 8-inch gravity pipeline and three areas with pressurized systems and individual grinder pumps. The existing septic tanks should be either removed or abandoned-in-place per DEQ standards. The conceptual layout including approximate pipeline alignment, lift station locations, and pressure sewer systems is included in Appendix G. This project includes installation of new service connections to each customer.

Project 2.1– Alder Street Upsizing

This project consists of upsizing the existing 4-inch gravity pipeline from the manhole where the River Road pressure pipe discharges to gravity (along Alder Street west of NW 2nd Avenue) to the upsized 8-inch pipe installed as a part of Project 1.6. The project extents are provided in Figure 6-3. This project is not included in the Priority 1 improvements. The project may be funded by BizOregon, other grant funding, or system development charges (SDCs) and is anticipated to be constructed by 2026.

FIGURE 6-3: ALDER STREET UPSIZING



Project 3.1 – Spring Street Lift Station Upsizing

This project is not needed under existing conditions but as areas develop within the Spring Street Basin, the pumping capacity of the Spring Street Lift Station will need to be increased. Based on the peak hour flow criteria at the time of this study, the Spring Street Lift Station can accommodate approximately 200 additional people, or 80 EDU's before the peak inflow reaches the firm capacity. It is uncertain exactly when development in this basin will occur, and therefore the City should consider upsizing the pumps as development occurs in this basin. The City could consider upsizing the pumps to the projected 2070 peak inflow which is 380 gpm. Installation of VFDs should also be considered for energy efficiency.

Project 3.2 – Spring Street Basin Trunkline Upsize

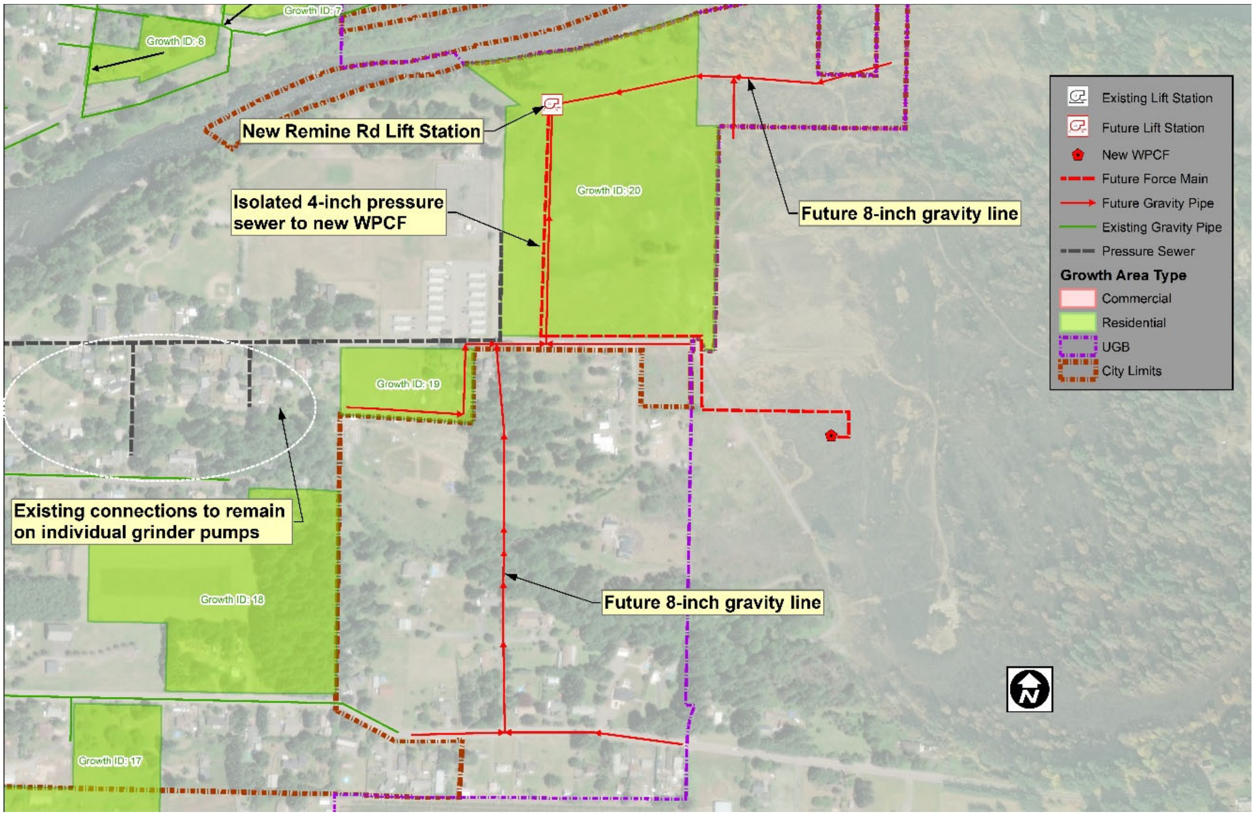
This project is not needed under existing conditions but as areas develop within the Spring Street Basin, the existing gravity lines will need to be upsized. This project consists of upsizing 1,000 LF of 4-inch pipe to 6-inch pipe along Kingwood Avenue and Hall Avenue and 600 LF of 6-inch pipe to 8-inch pipe along High Avenue. Consideration to alternative alignments should be given as development occurs in the vicinity of these projects. These developments may provide an alternate path to accomplish the conveyance requirements.

FIGURE 6-4: SPRING STREET BASIN TRUNKLINE UPSIZE

Project 3.3 – Remine Road Collection System

This project is not needed under existing conditions but as areas develop near the eastern edge of the City limits, additional collection system components will be needed to convey flows to the new WPCF. The proposed project will include a new lift station along Remine Road and a new gravity collection system to convey flows to the new lift station. The potential layout is shown in Figure 6-5. The lift station should pump to the new WPCF headworks through a dedicated 4-inch pressurized pipeline. It should be noted, future trunkline layouts outside of the identified growth areas are depicted in the figure. These are provided to depict a concept that could serve the remainder of the areas within this sewer basin for the UGB. The exact alignment of these trunklines will likely vary as the areas develop, however, the connectivity and drainage to the new Remine Road Lift Station should be similar. The City could consider constructing the Remine Road Lift Station at the existing WPCF site, however, it is slightly higher in elevation than the location shown in the figure below.

FIGURE 6-5: FUTURE SEWER BASIN NEAR REMINE ROAD



6.2. PROJECT SCHEDULE

The general project milestones are listed below. A preliminary project schedule is provided in Appendix G.

Project Milestones:

- December 2023: Finalize WWFPS
- January 2024 – July 2024: 30% Design
- August 2024 – January 2025: 60% Design
- February 2025 – May 2025: 90% Design
- March 2025 – June 2026: WPCF Construction
- September 2025 – January 2026: Gates Pump Station and Mill City Sewer Main Construction
- January 2026 – November 2026: Gates Sewer Main and pump stations
- July 2026 – August 2026: Substantial Completion and Commissioning and Startup
- September 2026 – December 2026: Connect new Gates connections
- September 2026 – October 2026: Decommissioning of old WPCF
- December 2026: Final Completion

Permit requirements

The new WPCF will require a new WPCF permit as administered by Oregon DEQ. Keller has based expected effluent requirements and the associated process design on guidelines from the Three Basin Rule and extensive meetings with the DEQ. Table 1-6 in Chapter 1 provides the expected discharge requirements of the new WPCF.

It is anticipated that several permits will be required by various local, state, and federal agencies. Appendix J contains a comprehensive list of possible permits, organized by agency and includes the name of the permit, regulations, permit trigger, application process, timing considerations, and which projects the permit may apply to. The following is a list of only the agencies: USACE, NOAA Fisheries, USFWS, ODFW, DSL, ODA, OWRD, DEQ, SHPO, ODOT, Marion County, Linn County, City of Gates, and the City of Mill City. The first design phase (Pre-design) of the project for Priority 1 projects will include permitting considerations and will begin the permitting efforts.

6.3. SUSTAINABILITY CONSIDERATIONS

6.3.1. Water And Energy Efficiency

The following were considered and recommended for implementing water and energy efficiency.

- Process blowers that utilize VFDs in tandem with DO monitoring can help optimize the level of aeration required under different influent loadings and temperatures.
- A water storage and reuse system that utilizes treated effluent for wash water, irrigation, and other utility uses could help reduce the water usage of the WPCF.
- VFDs at First Avenue Lift Station and Spring Street Lift Station

6.3.2. Green Infrastructure

The following were considered and recommended for implementing green infrastructure.

- Construct new lift station sites with pervious surface such as gravel, native plants, or pervious pavers.
- Construct the new WPCF with native vegetation and trees to avoid excessive use of irrigation water. Design WPCF landscape to be low maintenance.

6.3.3. Others

Additional sustainability considerations that are recommended to be implemented include the following:

- Utilizing electrically actuated valves to cycle RIBs with effluent discharge, and other mechanical equipment connected to a SCADA system would allow for better resiliency of the system and increased efficiency and simplicity of operation.

6.4. FUTURE REUSE CONSIDERATIONS

In order to produce Class A reuse water for irrigation and other municipal purposes as directed by OAR 340-055-0005 the future Mill city treatment plant would have to obtain a reuse permit from DEQ. In order to obtain a Class A reuse permit the Mill City treatment plant would need to add at a minimum chlorine disinfection, a treated effluent storage and pumping station, and purple pipe distribution infrastructure in order to distribute and utilize the Class A effluent. Prior to this, the additional treatment systems and reuse plan would also need to be approved by DEQ.

6.5. TOTAL PROJECT COST ESTIMATE

Total project cost estimates were prepared for each of the Priority 1 projects described in Section 6.1. A summary of the costs for priority 1 projects is provided in Table 6-4. The WPCF cost includes the cost for installation of tertiary denitrification filters. If these filters are not required in the final WPCF process design, significant savings could be achieved in mechanical equipment and construction costs.

TABLE 6-4: NSCSP PRIORITY 1 COSTS

Construction			
Area	**Description**	**Cost**	**Notes**
1	New WPCF	$ 20,386,888	
2	Existing Treatment Plant	$ 200,000	
3	Infiltration Basins	$ 574,615	
4	Mill City Lift Station Improvements	$ 274,838	
5	Mill City Piping Improvements	$ 250,000	
6	Gates to Mill City Force Main	$ 3,975,972	
7	Gates Lift Stations	$ 1,125,912	
8	Gates Collection Systems	$ 10,967,662	
9	Gates Service Connections	$ 3,382,586	
10	Site Support Services	$ 1,927,860	
11	General Conditions	$ 3,277,115	
Subtotal - Cost of Work		**$ 46,343,448**	
Other Costs			
	Escalation to GMP	$ 2,317,172	5.0%
	Design Contingency	$ 9,268,690	20.0%
	CM/GC Contingency	$ 2,317,172	5.0%
Subtotal - Other Costs		**$ 13,903,034**	
SUBTOTAL WITH OTHER COSTS		**$ 60,246,482**	
Markups			
	CM/GC Fee	$ 4,217,254	7.0%
	Bonds and Insurance	$ 1,445,916	2.4%
	OR CAT ax	$ 343,405	0.57%
Subtotal - Markups		**$ 6,006,574**	
TOTAL CONSTRUCTION COSTS		**$ 66,253,057**	
Other Contracts			
	Pre-Construction Contract	$ 375,218	
	EWA1 - Force Main Clearing & Test Pits	$ 103,259	Pending
Subtotal - Other Contracts		**$ 478,477**	
Owner Contingency			
	Owner Contingency in GMP	$ -	0.0%
Subtotal - Owner Contingency		**$ -**	
Total Contract Value		**$ 66,731,534**	
Other Project Costs			
10	Engineering Services	$ 9,000,000	~16%
11	Permits and Special Inspections	$ 220,000	
12	Utility Connection & Service Fees	$ 90,000	
13	Keller ESDCs	$ 4,500,000	~8%
14	Keller SCADA Integration	$ 250,000	
15	Marion County Costs	$ 850,000	
16	Land Acquisition	$ 1,200,000	
Subtotal - Other Project Costs		$ 16,110,000	
Total Project Cost		**$ 82,841,534**	
Total Construction OPCC Range Class 5: -30%/+50%			
	Estimate Class Ranges - Lower	$ 57,989,074	-30%
	Estimate Class Ranges - Upper	$ 124,262,301	+50%

Costs for Priority 2 and 3 projects were also estimated, and a summary is presented in Table 6-5. The projects are primarily development driven projects and a large portion of the project cost would be eligible to be paid for by SDCs. The detailed costs for each of these projects are provided in Appendix G.

TABLE 6-5: PRIORITY 2 AND 3 PROJECT COSTS

Project ID#	Project Name	Project Trigger	Total Estimated Cost (2023 Dollars)
2.1	**Alder Street Upsizing**	Existing system approaching capacity	$760,000
3.1	**Spring Street Lift Station Upsizing**	Development Driven	$250,000
3.2	**Spring Street Basin Trunkline**	Development Driven	$1,550,000
3.3	**Remine Road Collection System**	Development Driven	$5,480,000
TOTAL SYSTEM IMPROVEMENTS COSTS (rounded)			**$8,040,000**

6.6. ANNUAL OPERATING BUDGET

An itemized annual operating budget at the current Mill City WPCF for the fiscal year 2020-2021 is provided in Appendix C. Additional information on operating budget items can be found in the following sections.

6.6.1. Income

The existing City of Mill City sewer rate schedule consists of a flat rate of $44.10 per EDU per month, with businesses, public buildings, and schools added to the rate calculation based on EDU multipliers. Based on the 2021-2022 the annual sewer rate revenue was $448,400, thus, there were approximately 839 EDUs contributing to the rate revenue. During the 2021 NSC WWMP FCS Financial Group assessed the user rate impact of the new WPCF system O&M costs, expected annual debt service, and O&M costs for the new Mill City WPCF under 3 funding scenarios in a business case analysis. These funding scenarios included varying amounts of grant funding for the funding “Gap”.

The “Gap” refers to the remaining funding needed in addition to the direct legislative appropriation of $40 million that is allocated for Phase 1 of the North Santiam Canyon Sewer Project (NSCSP). The average monthly cost per EDU would be calculated by the annual debt service and the annual O&M cost of the system. FCS Financial Group has developed updated models for a year-to-year analysis. The model looks at the construction process and when existing users will be connected to the new treatment system as well as when the new users from the City of Gates would be connected and contributing to the rate revenue. This model includes assumptions relative to governance of the system and other policies related to new connections and when/if they will be required. The NSSA has begun engaging with legal representation to support the board in stepping through the process to create the policies needed to remove the assumptions and start discussing specifics on establishing the user rates. This means the new business case analysis will not be completed until after this planning study is submitted, and final user rate impacts will be determined separately from this WWFPS. Chapter 7 discusses collaboration and next steps for the project.

6.6.2. Annual Operations and Maintenance Costs

This section summarizes the anticipated O&M costs associated with the recommended Priority 1 projects. These O&M costs assume all Priority 1 projects have been completed. The costs were separated out by treatment and collection system.

Treatment System Annual O&M Costs

Table 6-6 provides annual operating and maintenance costs associated with the treatment system. These costs include electrical, chemical, staffing, and replacement part costs associate with each process in the treatment plant, as well as estimates for HVAC electrical costs, required analytical testing, and several miscellaneous items such as office supplies, phone bills, and training for operators. The O&M costs in Table 6-6 include chemical and replacement part costs for tertiary denitrification filters. If this treatment step is not required, O&M cost savings could also be achieved in both chemical usage and replacement parts.

TABLE 6-6: TREATMENT SYSTEM ANNUAL O&M COSTS SUMMARY

Item	2023 Dollars	2045 Dollars[1]
Electricity	$ 26,600	$ 52,000
Chemical	$ 34,500	$ 64,000
Disposal	$ 19,600	$ 47,000
Parts	$ 42,000	$ 65,000
Personnel	$ 335,800	$ 520,000
Other (Analytical Testing, Office Supplies, Utilities, Phones, Training, Fees, Insurance)	$ 121,500	$ 188,000
Total Annualized Costs	**$ 580,000**	**$ 936,000**

1) Includes additional costs associated with increased electricity and chemical usage as well as 2% inflation per year.

Collection System Annual O&M Costs

Completion of the recommended improvements will add an entirely new collection system in the City of Gates and therefore additional O&M costs are anticipated in addition to the existing Mill City system. Short-lived and long-lived asset replacement is included in Section 6.6.4. A summary of the annual costs for the collection system in 2023 and 2045 dollars is provided in Table 6-7. Additional details regarding the O&M and asset replacement costs are included in Appendix F.

6.6.3. Debt Repayments

The City of Mill City still holds a current debt of approximately $2 million for their current wastewater system. The City of Gates does not hold any current debt. What will happen to Mill City's current debt is not a part of this WWFPS, this will need further discussion and policy decisions by the City and the NSSA board.

6.6.4. Reserves

Debt Service Reserve

There is currently $40 million in grant funding for the priority 1 improvements. Depending on the type of funding pursued to cover the remainder of the capital costs for the proposed projects, a debt reserve may be required. Municipal bonds such as revenue bonds would require a debt service reserve, likely not exceeding 10% of the stated principal amount of the bond issue. A debt service reserve would likely not be required for a State loan. Several financing resources available to offset the costs associated with implementing the CIP include, but are not limited to: user rates, SDCs, DEQ State Revolving Fund Loan Program, Oregon Infrastructure Finance Authority grants and loans, USDA Rural Utilities Services loans and grants, direct state loans, revenue bonds, general obligation bonds, US Economic Development Administration grants, and Energy Trust of Oregon.

Short-Lived Asset Reserve

The short-lived assets for Mill City and Gates collection systems include STEP system replacements, lift station pump maintenance and replacement, and lift station electrical and instrumentation equipment. Long-lived assets include gravity and pressure pipelines, manholes and cleanouts, STEP and STEG tanks, and lift station valves, generators, wetwells, site, and buildings.

The O&M costs for the collection system include costs for annual CCTV inspections, STEG tank pumping and disposal, lift station power, and staffing. Quantities and annual costs were developed with input from the City on historical budgets and the system's targeted levels of service.

TABLE 6-7: COLLECTION SYSTEM SHORT-LIVED AND LONG-LIVED ASSETS

Item	2023 Dollars	2045 Dollars[1]
Short-Lived Asset Replacement	$110,000	$171,000
Long-Lived Asset Replacement[2]	$883,000	$1,366,000
Annual Operations Cost	$197,000	$305,000
Total Annual Costs	**$1,190,000**	**$1,842,000**

1) Assumes 2% annual inflation.

2) Long-lived asset replacement budget can be adjusted as needed.

Table 6-8 below provides a list of WPCF short-lived assets and their expected useful lives. This table includes replacement expenses for assets that are anticipated to wear out in the next 10 years. These costs were included in the total annual O&M costs provided in Table 6-6, but are broken out here by item. Costs for short-lived assets are in 2023 dollars.

TABLE 6-8: WPCF SHORT-LIVED ASSETS

Process Description	Item Description	Unit Cost	Replacement Frequency (Years)	Annualized Cost
Headworks and Influent Pumping	Screening and Grit Trap Wear Parts	$ 45,000	10	$ 4,500
	Pumps	$ 21,000	10	$ 2,100
Secondary Treatment	Diffuser Replacement and Pump Rebuilds	$ 95,000	10	$ 9,500
	Blower Replacement Parts	$ 20,000	5	$ 4,000
	Common Pump Parts	$ 2,000	1	$ 2,000
Disinfection	Replacement Parts and Bulbs	$ 4,100	1	$ 4,100
Solids Handling	Replacements Parts	$ 25,000	5	$ 5,000
Tertiary Treatment	Filter Airlift and Replacement Parts	$ 21,000	10	$ 2,100
Effluent Disposal	Pumps	$ 21,000	10	$ 2,100
			WPCF Total Short-Lived Assets (Rounded)	**$ 36,000**

CHAPTER 7 - CONCLUSIONS AND RECOMMENDATIONS

This chapter provides an overview and recommendations for the unique startup considerations, coordination efforts, and next steps for permitting and construction of the future Mill City mechanical WPCF.

7.1. TREATMENT PHASING AND STARTUP CONSIDERATIONS

The WPCF serving Mill City and Gates will require unique considerations for phasing and startup of the treatment and disposal processes. While all treatment equipment, processes, and disposal basins will be sized to hydraulically pass the expected 2045 flows from both Mill City and Gates with redundancy, design considerations should also be included for the lower flows and loadings that will be present upon initial startup of the treatment plant, particularly for the biological treatment processes and before the wastewater connections from Gates are added to the system.

Based on the analysis of current DMR data and flow and loading projections provided in Chapter 4, the initial average daily startup flows will be around 130,000 GPD with the connections from Mill City alone. The connections from Gates are expected to add approximately 40,000 GPD for a total initial flow of 170,000 GPD AADF. Mechanical equipment including headworks screens, influent flow meters, pumps, grit removal equipment, UV disinfection, solids handling, and the effluent pumping station will be sized to process these lower flows, as well as the 2045 projected design flows. Secondary and tertiary treatment processes (where required) as well as rapid infiltration of treated effluent will be capable of processing the full range of flows and loadings. Recommended treatment plant mechanical equipment is listed below along with design considerations for phasing from day 1 startup flows to 2045 projected flows. A discussion of phasing for secondary and possible tertiary treatment is provided in the following paragraph.

- Headworks Screening: Flow variations between startup and 2045 expected flows would not affect screening capability, screening equipment would be sized to handle both the minimum and maximum expected flows with redundancy.
- Influent Flow Meters: Flow metering equipment would be sized for the expected startup flow through the 2045 expected flows.
- Grit Removal: While the grit removal equipment relies on specific flow rates to produce velocities or flow patterns that allow grit to settle out and separate from the influent stream, the recommended grit removal system will be designed to operate under the full range of flows expected both at startup and in 2045.
- UV Disinfection: The recommended UV disinfection equipment would be designed with the capability to ramp down bulb power based on flows and turbidity. This would allow the equipment to operate over the full range of expected flows and loadings while also saving electricity used to power the UV bulbs.
- Influent and Effluent Pumping Stations: The influent and effluent pumping stations would function similar to collection system lift stations; an in-ground vault would be constructed with redundant pumps used to convey influent to downstream processes and final effluent to the rapid infiltration basins. The vault would fill with wastewater and pumps would function intermittently to empty the vault and convey wastewater downstream. Pump times would be shorter during startup phasing and the system would be designed to convey the full range of wastewater flows at the future WPCF.

- Effluent Disposal: The rapid infiltration disposal basins will be sized for 2045 expected flows and will also be able to process the startup flows without issue. During the first years of startup, effluent flow will be able to be pumped more slowly to the infiltration basins, likely resulting in lower groundwater mounding and higher removal of wastewater constituents in the upper soil horizons.

Loading ranges also must be considered both during design and especially during startup of the WPCF. Of particular importance in a treatment process with stringent denitrification requirements, whether through secondary treatment or tertiary treatment, is the influent BOD_5 loading, as conversion of nitrate to nitrogen gas requires a carbon energy source (typically measured in the industry as BOD_5). While the existing Mill City connections represent around 75% of the initial flow and connections from Gates represent about 25% of the flow, the BOD_5 loadings will be not be proportional to the expected influent flows, likely with the residential connections from Gates providing a higher per capita BOD_5 loading. This is because connections in Mill City will still be connected to the individual STEP/STEG systems, while the residential connections from Gates are expected to abandon the existing septic systems and operate as direct connections to the new community sewer system. According to EPA's Onsite Wastewater Treatment Systems Manual, approximately 40% of the BOD_5 present in wastewater is removed by a typical STEP system.[1] The secondary treatment process design will include provisions for addition of several important process chemicals including an additional carbon supplement required for denitrification. The anticipated dosing should be determined during the design phase, and continual monitoring during commissioning and startup will be necessary to ensure adequate treatment. These doses will likely be metered down when the residents from the City of Gates are connected.

7.2. CONSTRUCTION SEQUENCING

The future treatment facility will be built according to the schedule provided in Chapter 6 and Appendix G. Construction of the civil and structural components of the treatment facility are expected to occur throughout the majority of 2025, with installation of mechanical and electrical equipment planned to begin in early 2026. Included in the civil and structural components are the treatment basins, buildings, effluent pipeline to disposal, and disposal infiltration basins. Construction of the Gates pump station as well as the sewer main to Mill City is expected to occur during the later stages of the treatment facility civil and structural components. The final component of the construction project is the installation of the Gates collection sewer mains with residential connections added during commissioning and startup of the facility. Below is a summary of this sequence for the Priority 1 projects.

1. New treatment plant and rapid infiltration basins construction, startup, and commissioning.
2. Construction of new force main to the new treatment plant.
3. Abandonment of existing force main and demolition of existing WPCF.
4. 1st Avenue Lift Station upgrades
5. Construct Gates to Mill City force main
6. Construct Regional lift station in Gates on Central Avenue
7. Construct Gates main line collection system and two other local lift stations
8. Construct individual property connections basin by basin and make final connections to individual property plumbing

---

[1] U.S. Environmental Protection Agency. (2002). *Onsite Wastewater Treatment Systems Manual*. Office of Water, U.S. Environmental Protection Agency.

7.3. SUBCONSULTANT ROLES AND COORDINATION

The Mill City and Gates WWFPS has included collaboration with many parties including Marion and Linn Counties, the cities of Mill City and Gates, Oregon DEQ, the CM/GC contractor (Slayden) as well as multiple consultants. Continued collaboration between these parties will be required during the design and construction of the Mill City WPCF and Gates collection system. As this WWFPS has been conducted concurrently with groundwater and financial analyses, and reports on these topics may not be completed until after the WWFPS is finalized, subconsultant roles will continue into the early design stages of the treatment facility. Keller expects that close collaboration with GSI Water Solutions will continue for support with and updates to the groundwater modeling and subsurface investigations. The groundwater modeling and fate and transport investigations that have recently been completed by GSI are currently in draft format and will be reviewed by DEQ staff, and a site recommendation may be updated based on these continuing discussions.

Continued sampling at groundwater monitoring wells will also be conducted by GSI to comply with DEQ requirements and amend the current report being reviewed by the DEQ. GSI will also be conducting pilot testing of the rapid infiltration basin at site GM1 to further ground truth the current recommendation. Collaboration with FCS Financial Group will continue as additional funding resources are pursued for construction of the WPCF, as well as finalization of user rates and financial analyses. Much of the finalization of user rates will depend on policy decisions by the NSSA board and respective city councils, as well as finalizing the capital funding sources.

7.4. CONCLUSIONS AND NEXT STEPS

Keller has provided descriptions and recommendations for treatment processes and equipment in Chapters 4, 5, and 6. Selection criteria for treatment equipment was balanced between cost, operability, achievable treatment levels (limits of technology), and applicable federal and state environmental protections (i.e. Clean Water Act, Three basin Rule, and Oregon Administrative Rules).

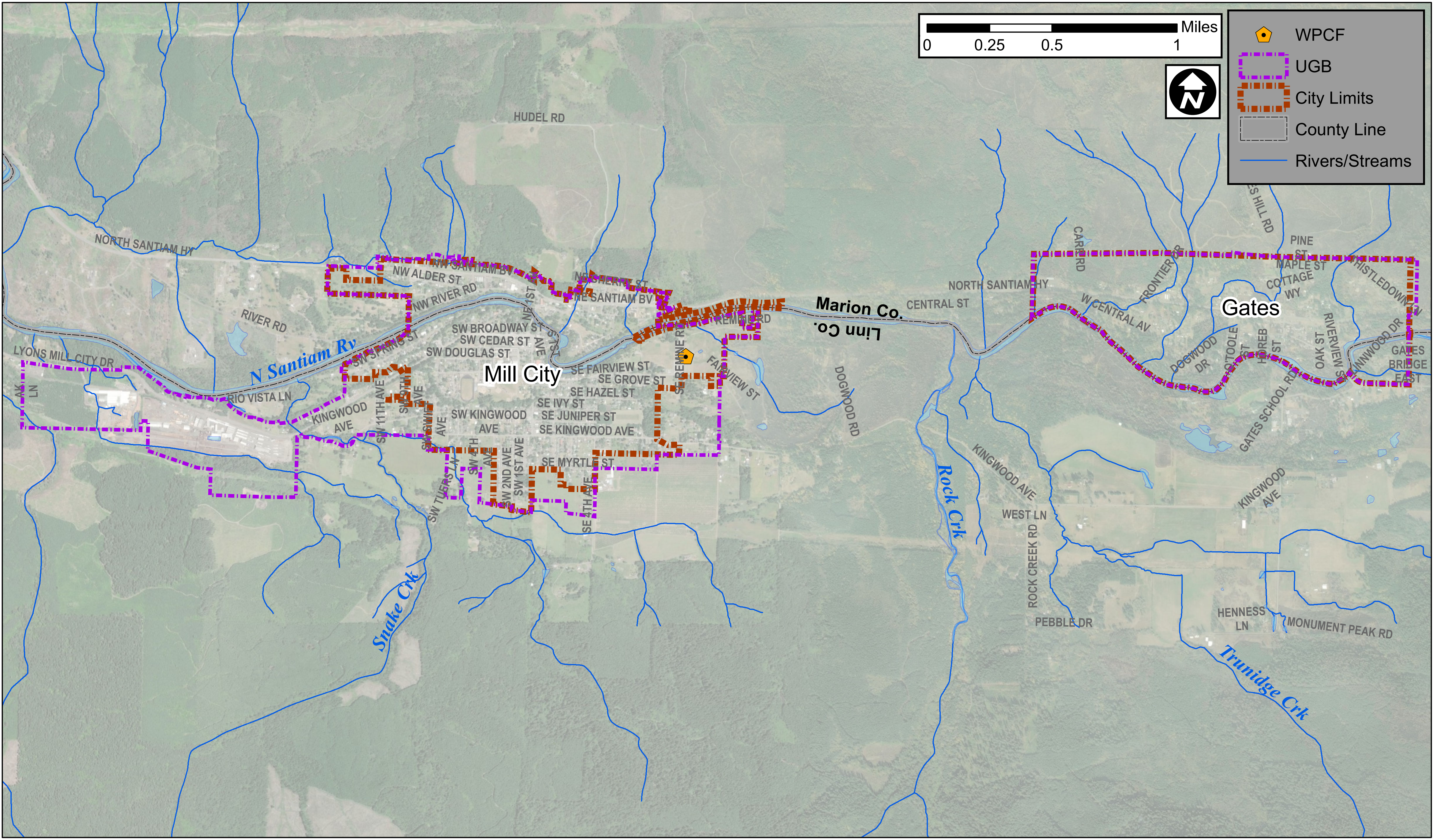
Additionally, preliminary site recommendations based on groundwater sampling, modeling, and analysis indicate the GM1 site would be the best for treatment and infiltration of WPCF effluent. However, as described previously, site selection is contingent upon completion of subsurface investigations, as well as negotiations with property owners. It is recommended to proceed with pilot testing of rapid infiltration at site GM1 based on the technical memorandums provided by GSI (See Appendix I).

Next steps for WPCF design and construction include completion of preliminary engineering reports (PERs) for more in-depth analyses of treatment processes, preliminary design, and construction drawings, finalizing guaranteed maximum price (GMP) for construction, and filing for groundwater discharge and required building permits for the WPCF.

APPENDIX A

Full Size Figures

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\Report MXDs\Figure 1 - Study Are



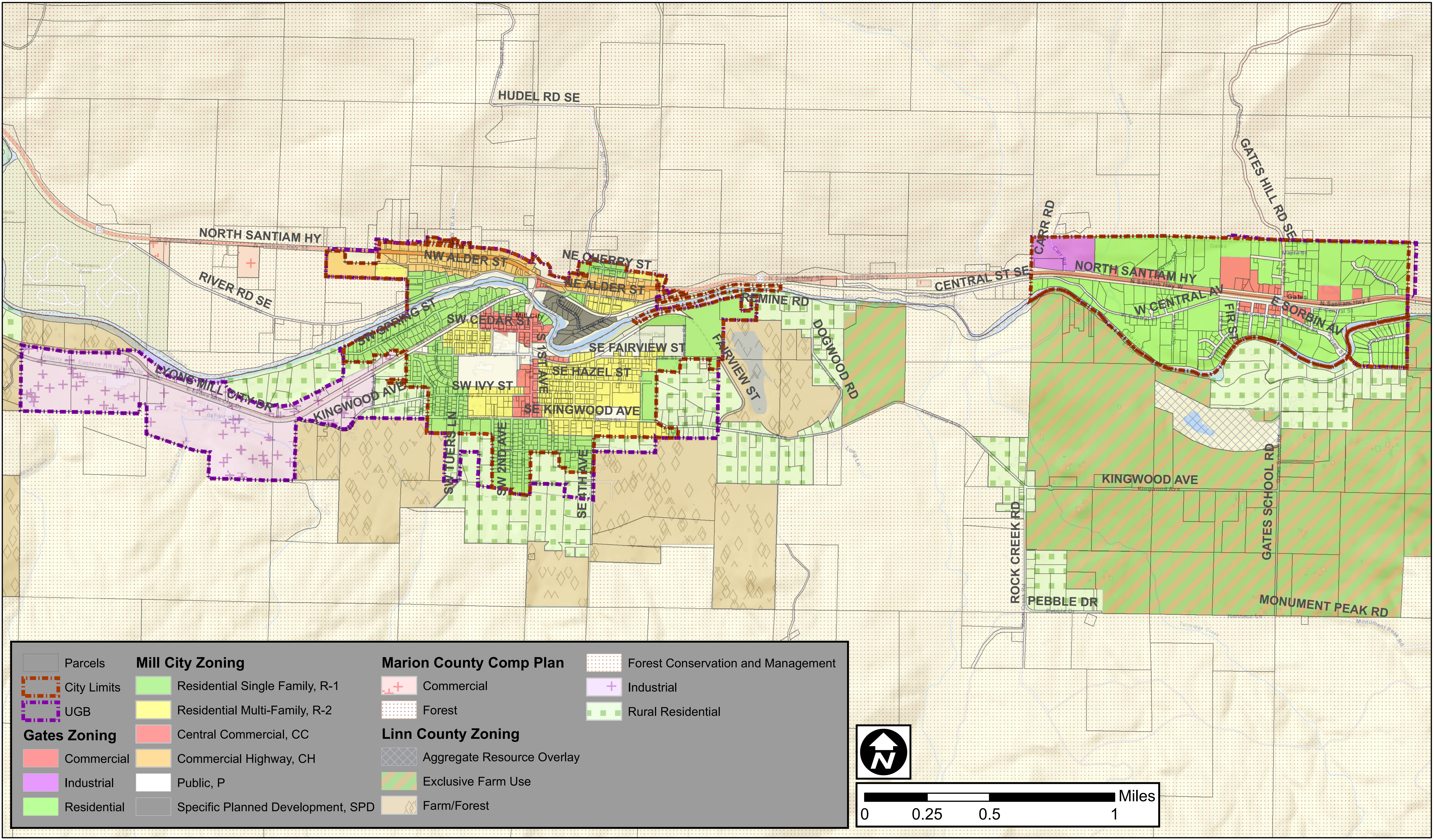
Study Area

Mill City / Gates WWFPS

KELLER ASSOCIATES

North Santiam Sewer Authority

Figure 1



KELLER ASSOCIATES

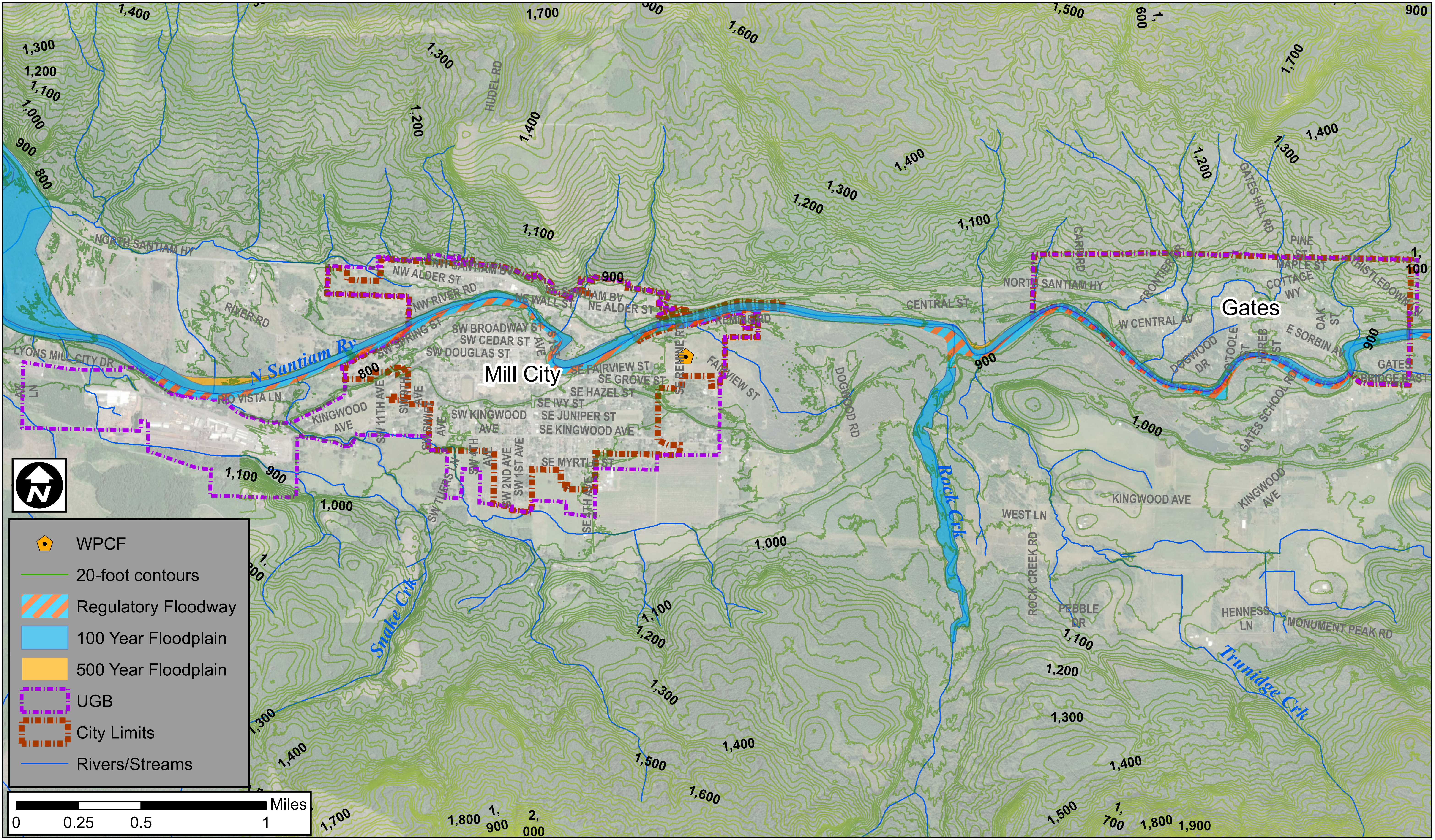
Existing and Future Land Use

Mill City / Gates WWFPS

North Santiam Sewer Authority

Figure 2

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\Report MXDs\Figure 2 - Land Us



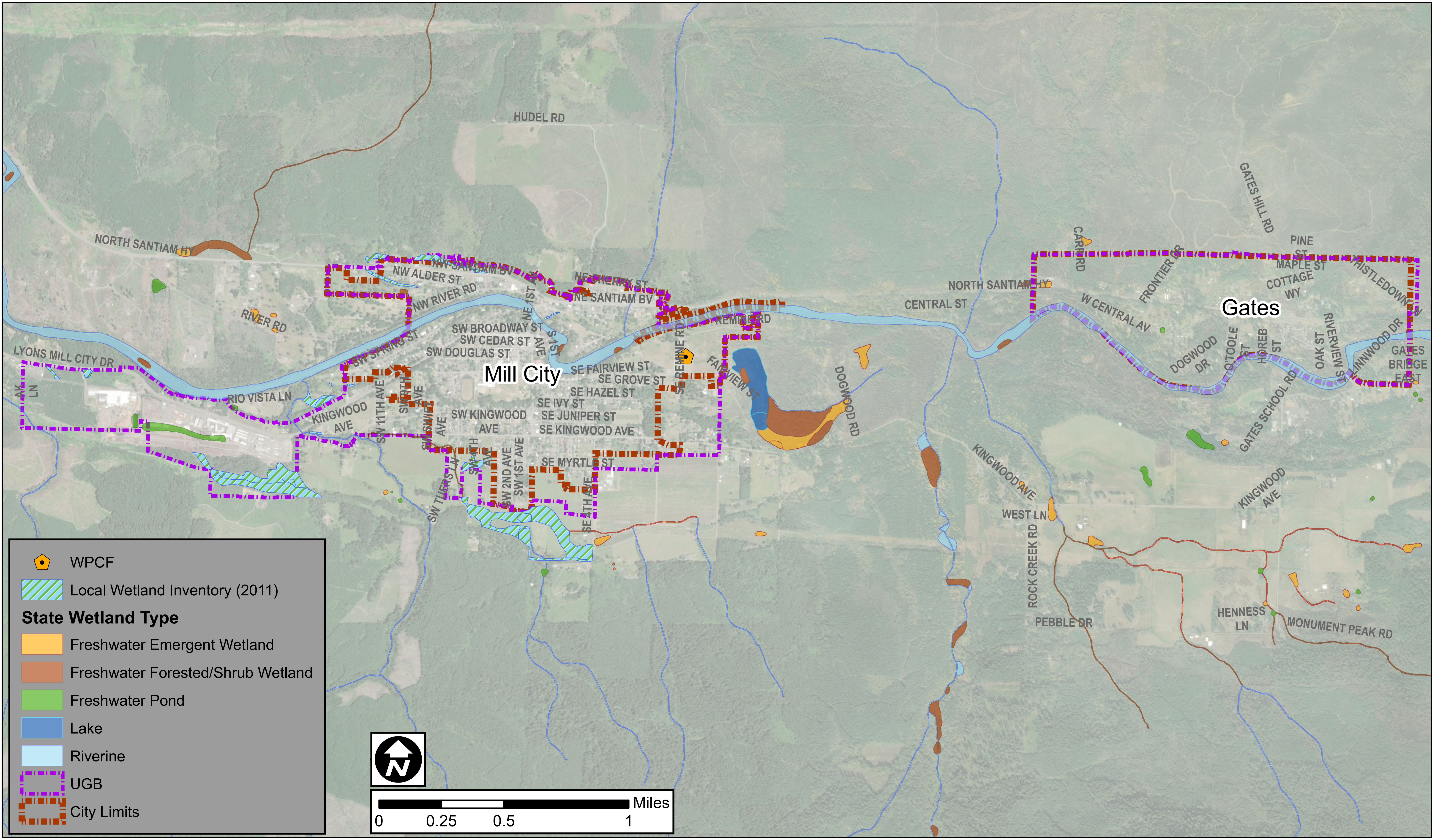
Topography & Floodplains

Mill City / Gates WWFPS

KELLER ASSOCIATES

North Santiam Sewer Authority

Figure 3



KELLER ASSOCIATES

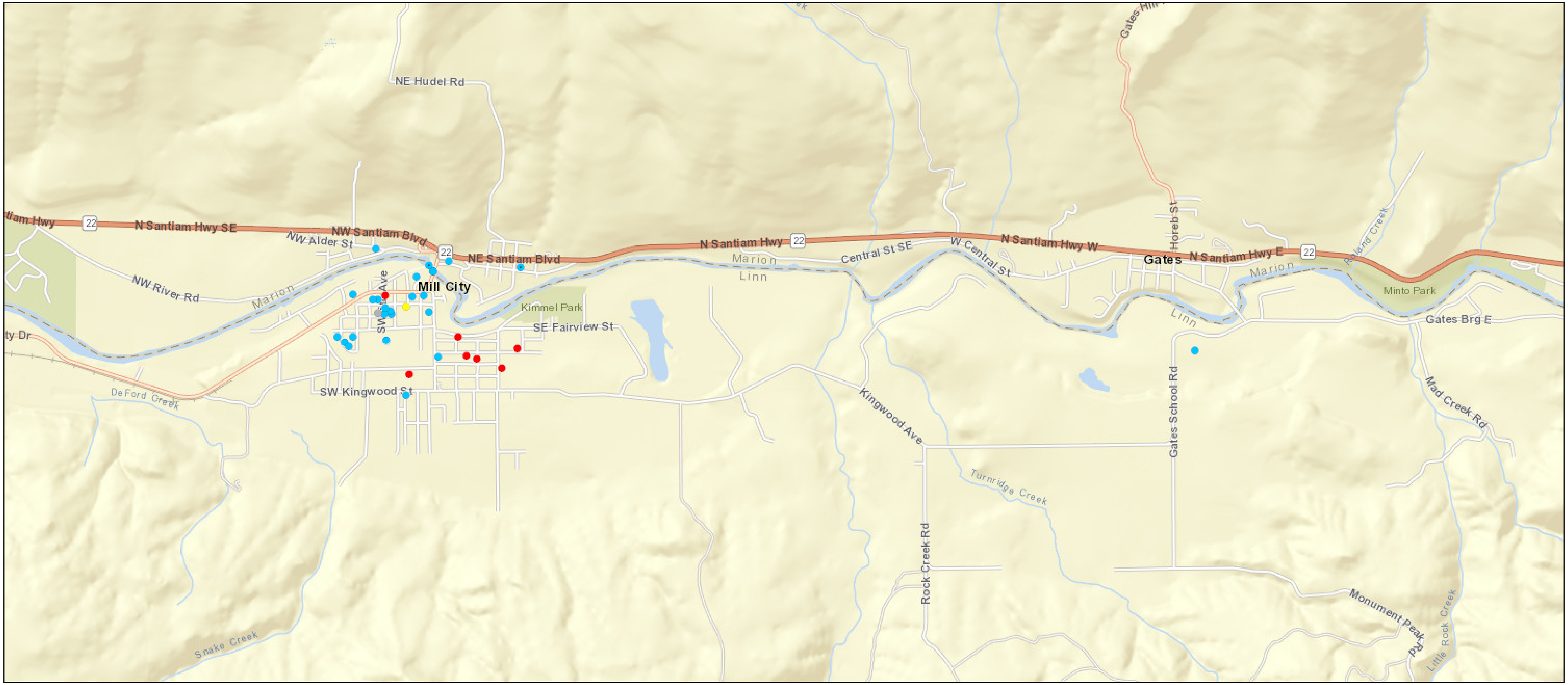
Wetlands

Mill City / Gates WWFPS

North Santiam Sewer Authority

Figure 4

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\Report MXDs\Figure 4 - Wetlands.



KELLER
ASSOCIATES

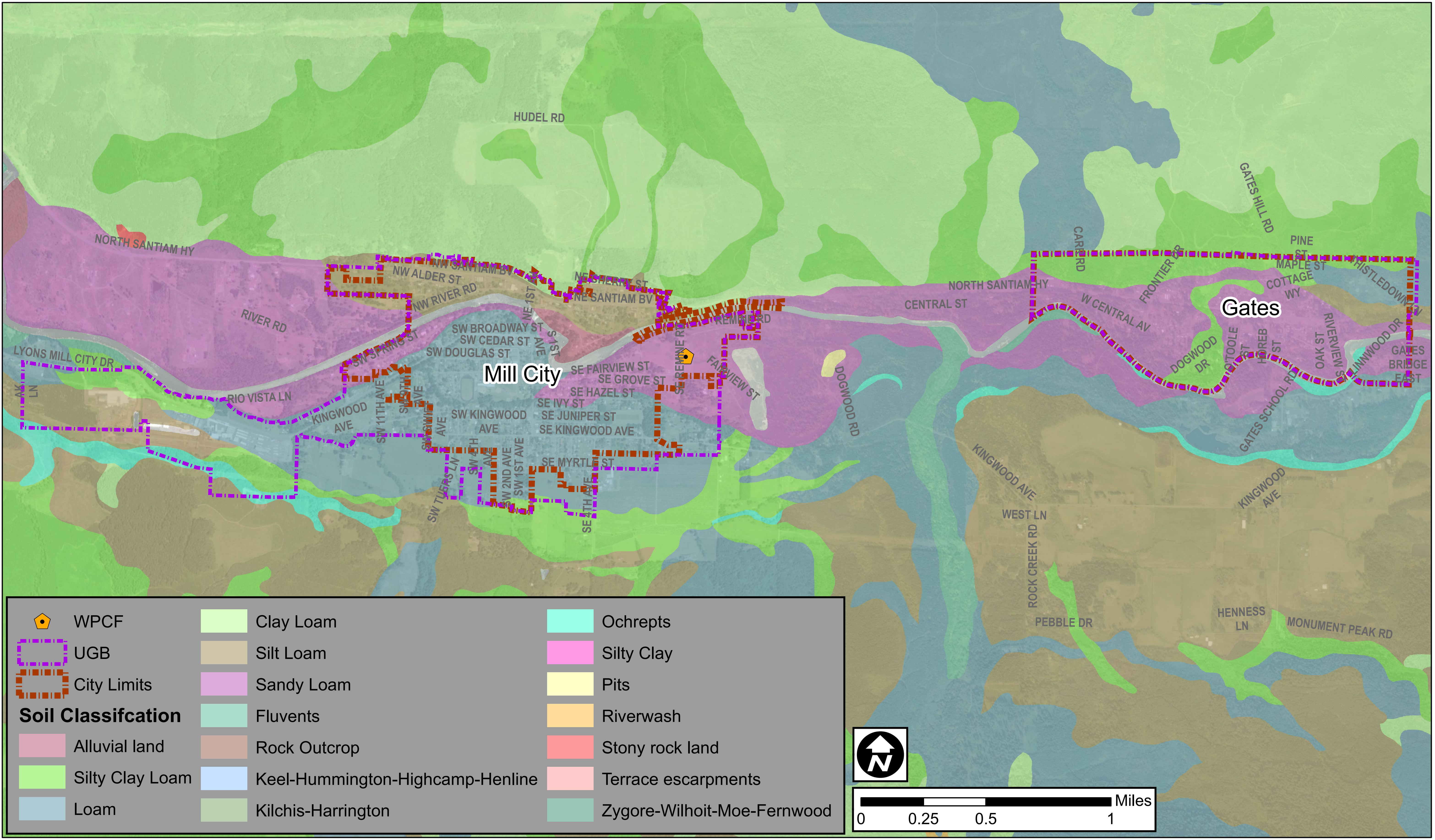
Historic Sites

Mill City / Gates WWFPS

North Santiam
Sewer Authority

Figure 5

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\Report MXDs\Figure 6 - Soil Types



KELLER ASSOCIATES

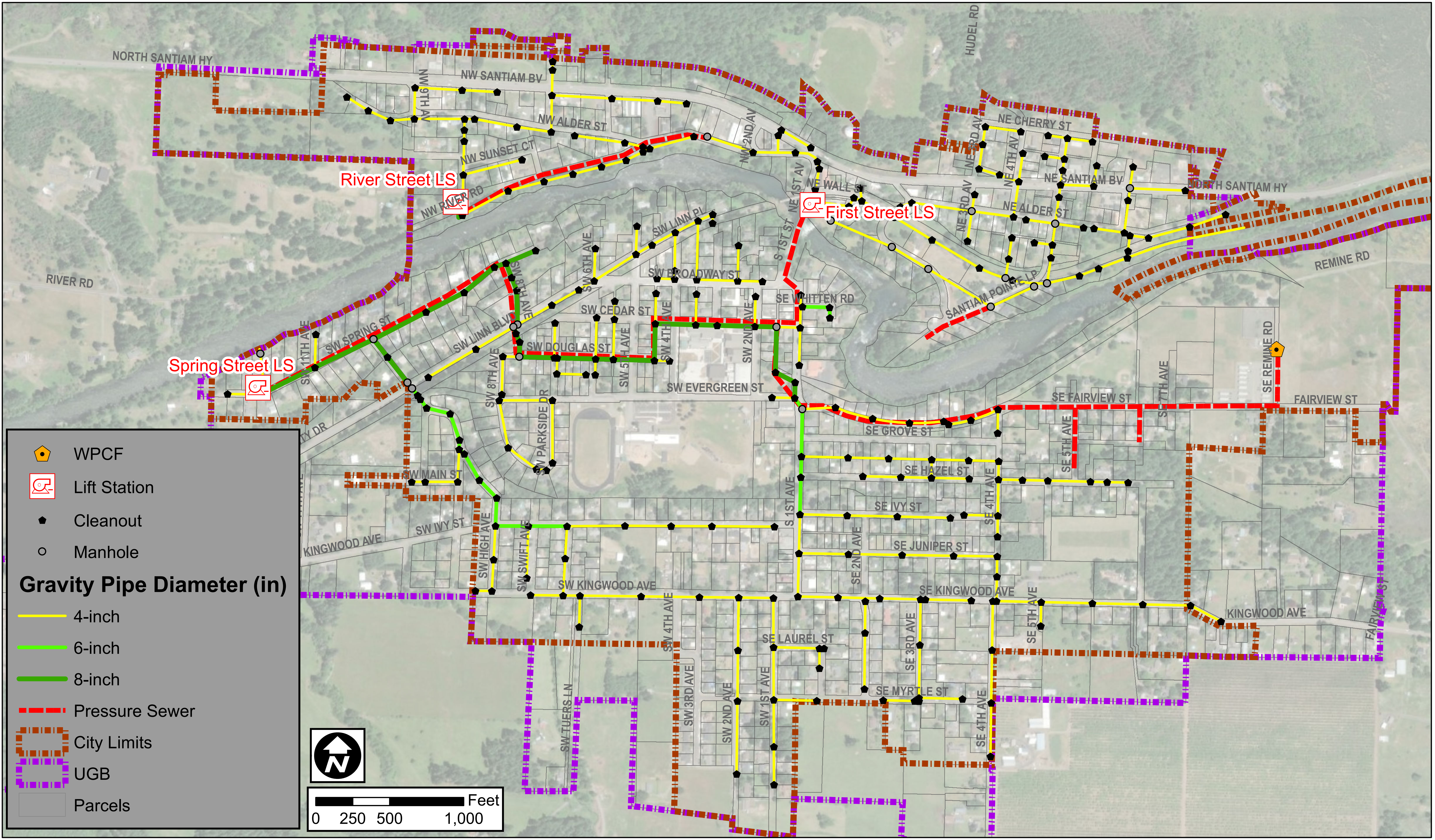
Soil Types

Mill City / Gates WWFPS

North Santiam Sewer Authority

Figure 6

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\Report MXDs\Figure X - Existing



KELLER ASSOCIATES

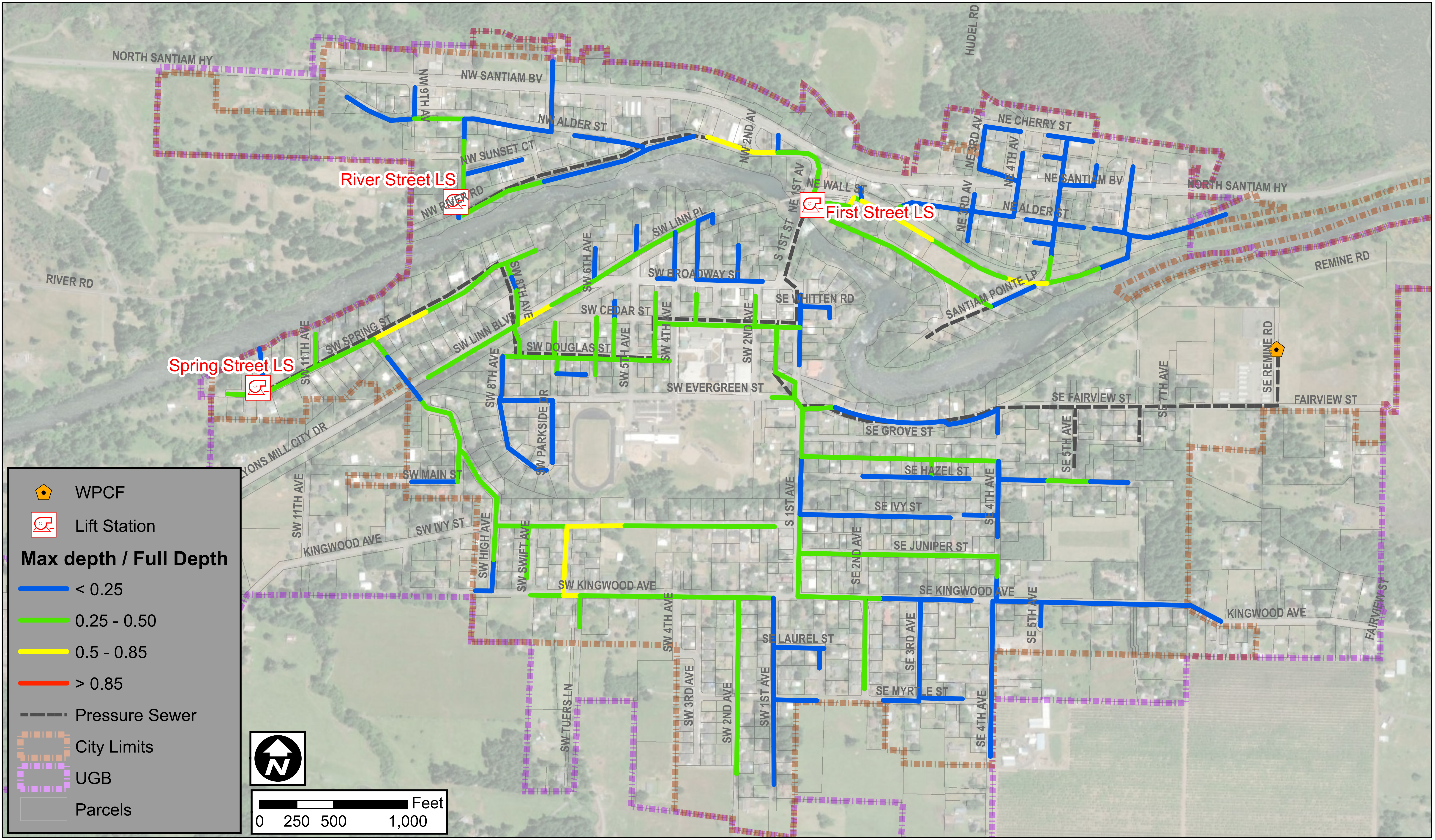
Existing Collection System

Mill City / Gates WWFPS

North Santiam Sewer Authority

Figure 7

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\Report MXDs\Figure X - Existing



KELLER ASSOCIATES

Existing PDF d/D

Mill City / Gates WWFPS

North Santiam Sewer Authority

Figure 8

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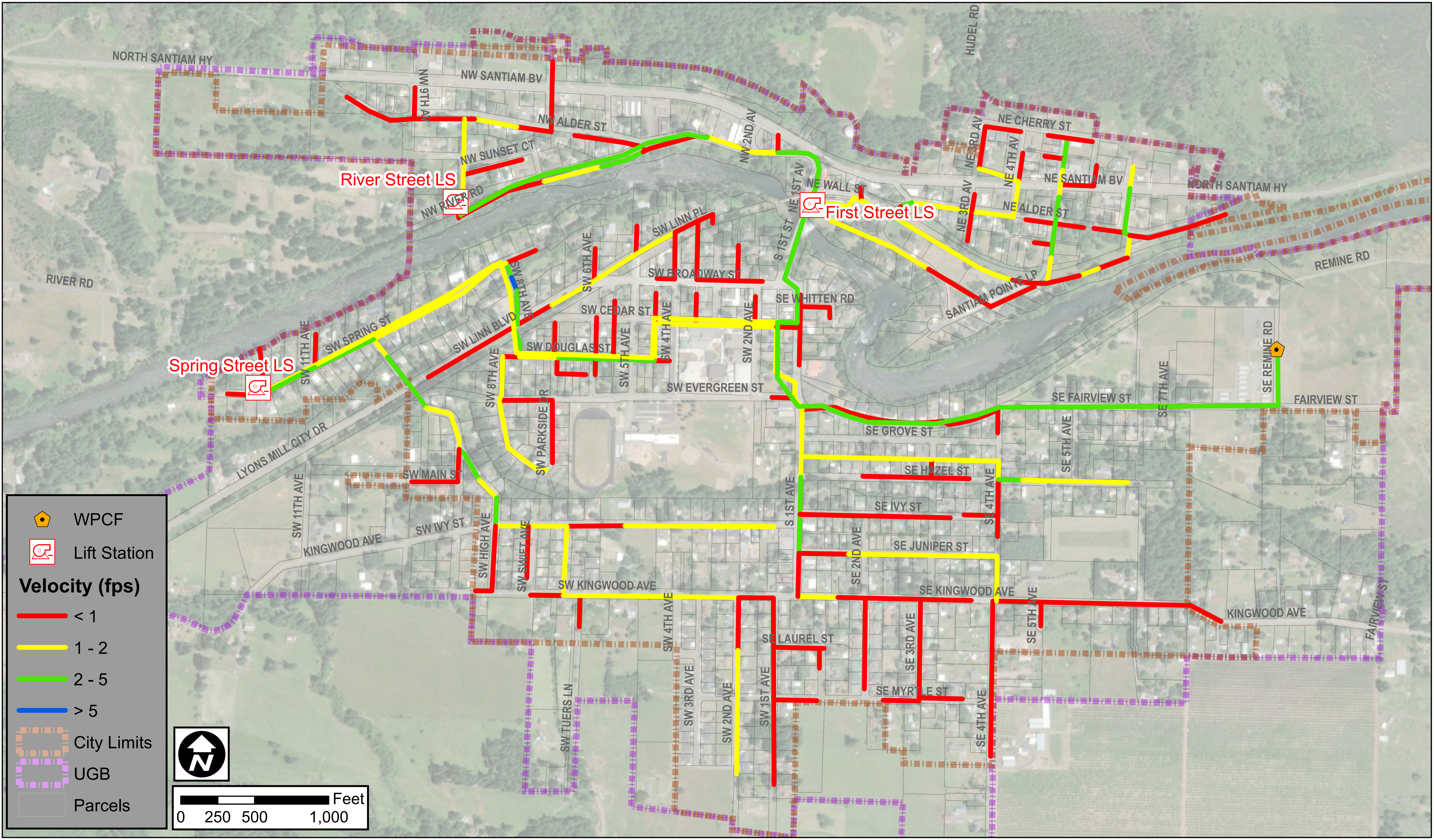


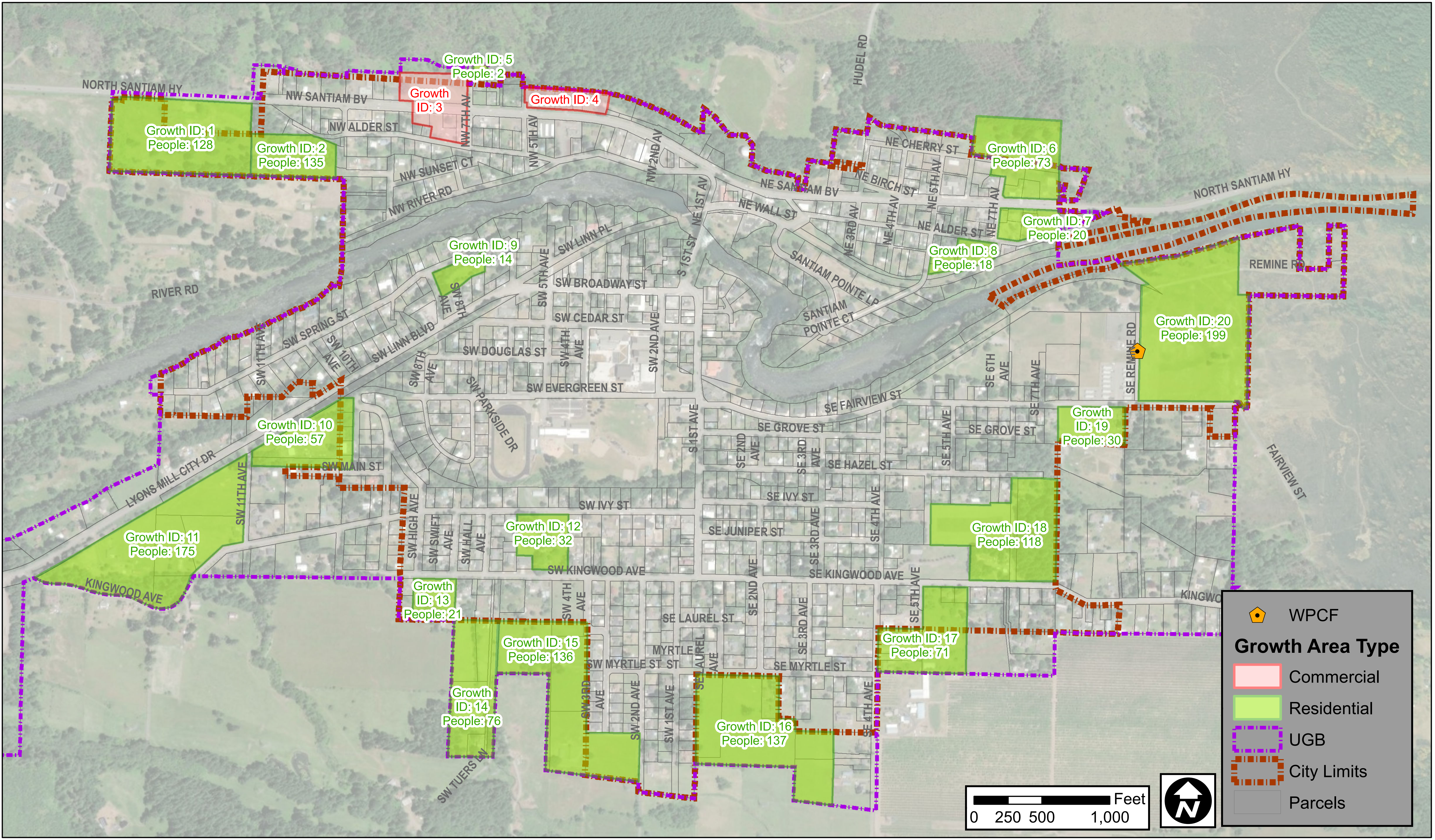
KELLER ASSOCIATES

Existing PDF Velocities

Mill City / Gates WWFPS

North Santiam Sewer Authority

Figure 9



Growth Areas

Mill City / Gates WWFPS

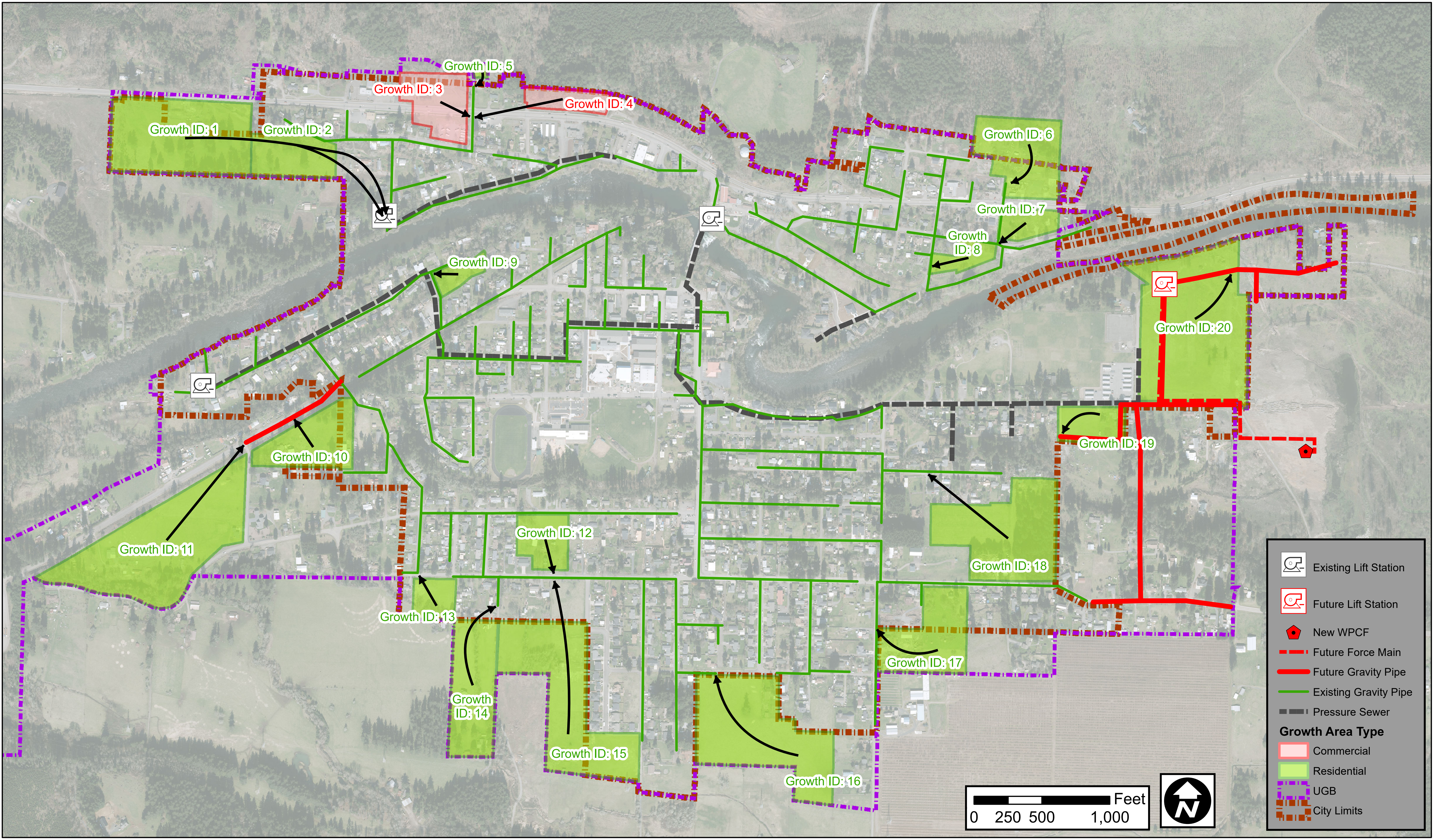
Figure 10

KELLER ASSOCIATES

North Santiam Sewer Authority

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\Report MXDs\Figure 10 - Growth A

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\Report MXDs\Figure 11 - Future C



KELLER
ASSOCIATES

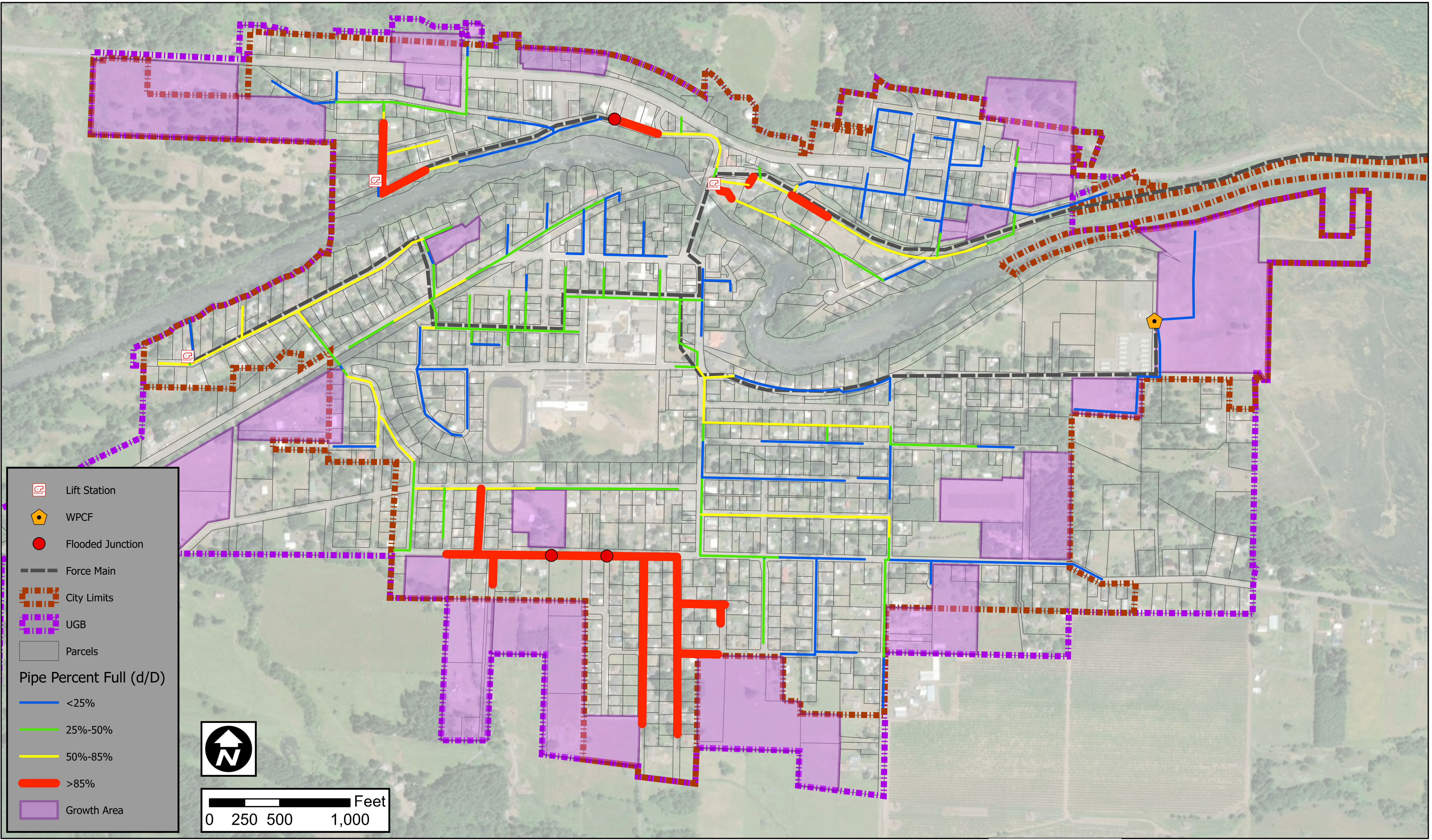
Future Collection System

Mill City / Gates WWFPS

North Santiam
Sewer Authority

Figure 11

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\ArcGIS Pro Maps\MCG Model R



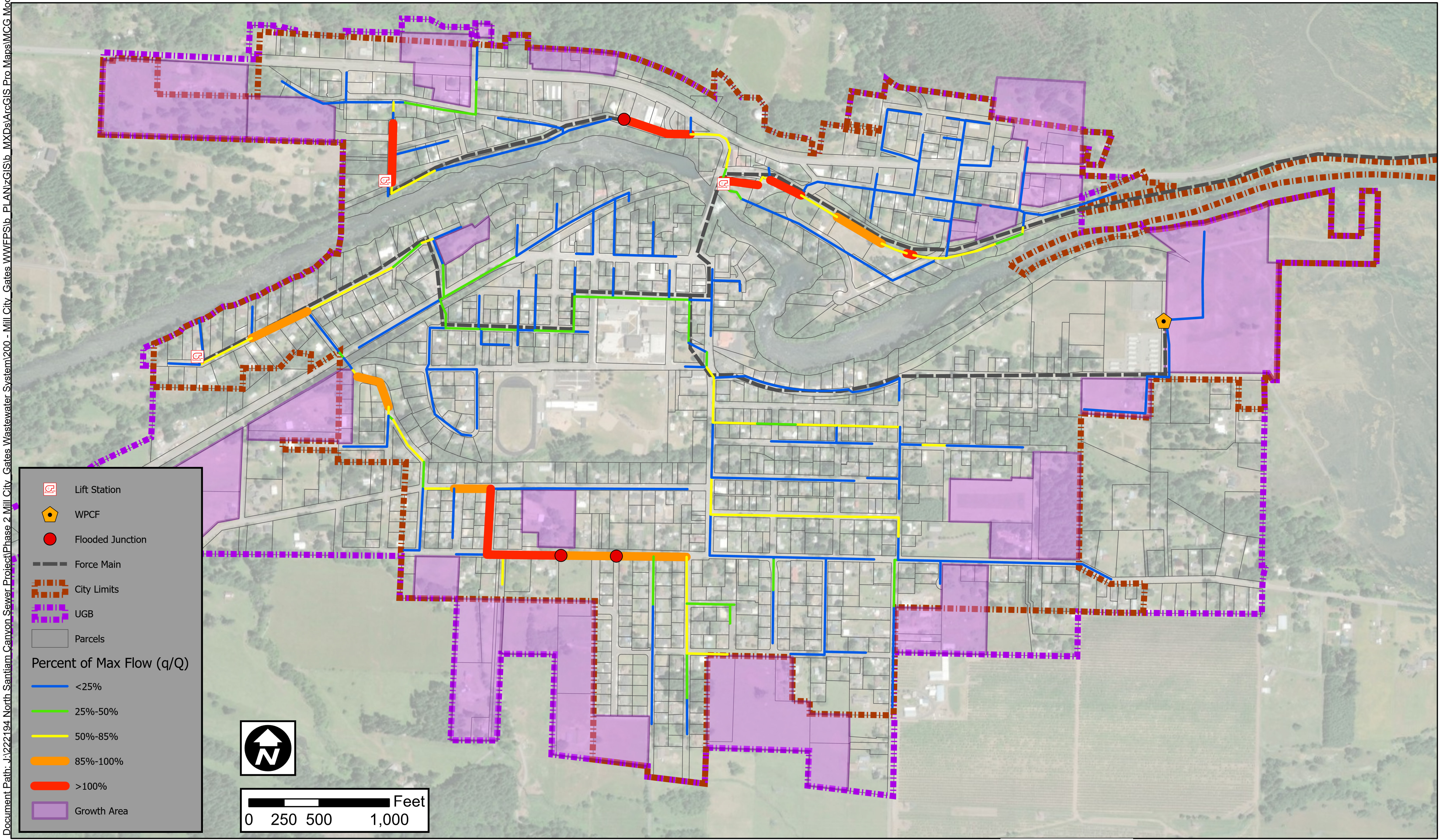
KELLER
ASSOCIATES

Future PDF d/D - Existing Pipes

Mill City / Gates WWFPS

North Santiam
Sewer Authority

Figure 12



Future PDF q/Q - Existing Pipes

Mill City / Gates WWFPS

Figure 13

KELLER ASSOCIATES

North Santiam Sewer Authority

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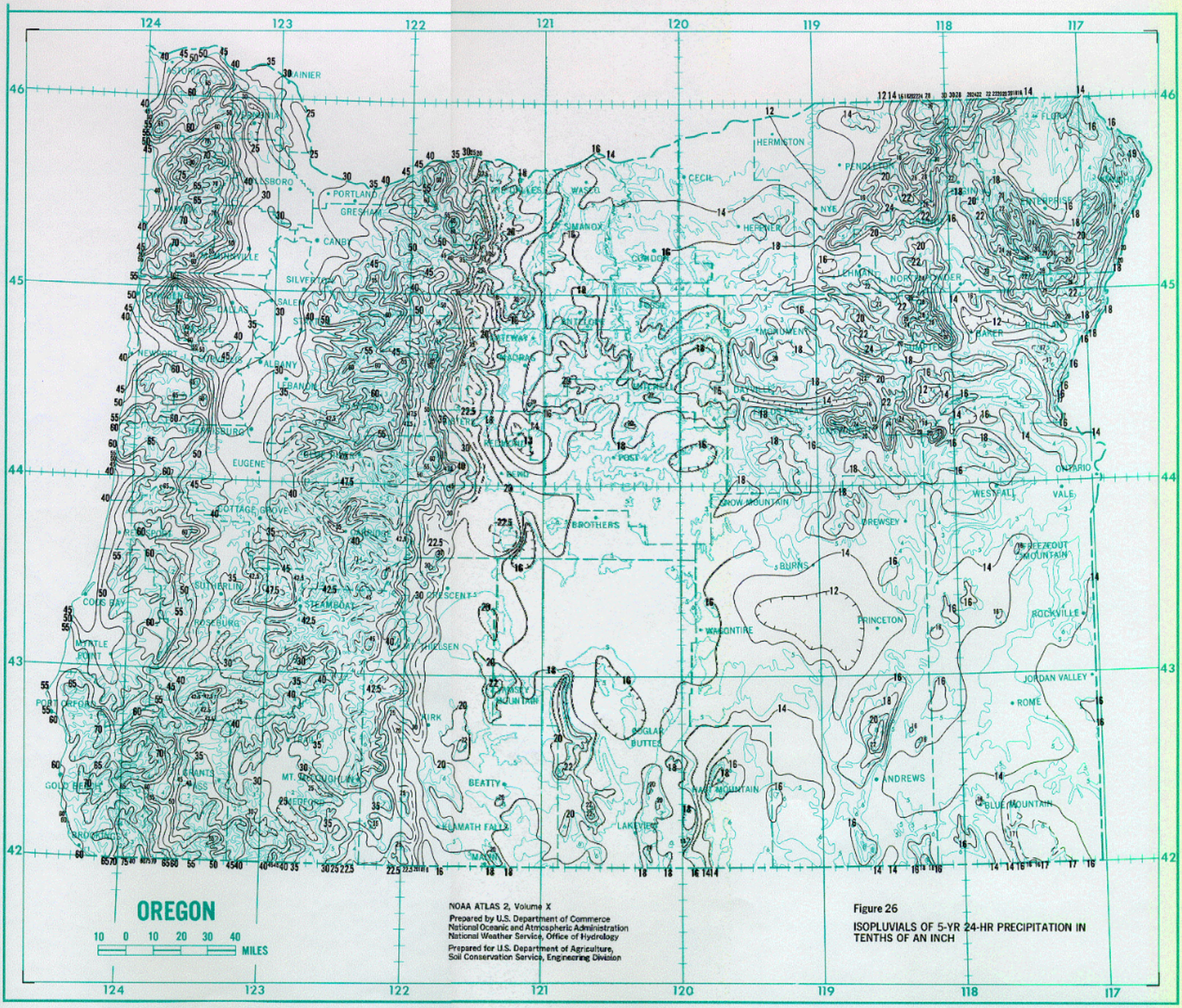
APPENDIX B

NOAA Atlas



NOAA ATLAS 2, Volume X
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 26
ISOPLUVIALS OF 5-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

APPENDIX C

Financial Statements

FORM
LB-11
This fund is authorized and established by resolution / or
____________ on (date) ____________ for the following
____

RESERVE FUND
RESOURCES AND REQUIREMENTS

Year this reserve fund will be reviewed to be continued or abolished.
Date can not be more than 10 years after establishment.
Review Year: ____________

SEWER RESERVE FUND 70 74
(Fund)

CITY OF MILL CITY
(Name of Municipal Corporation)

	Historical Data				**DESCRIPTION RESOURCES AND REQUIREMENTS**			Budget for Next Year 2020-2021			
	Actual		Adopted Budget 2019-2020					Proposed By Budget Officer	Approved By Budget Committee	Adopted By Governing Body	
	2017-2018	2018-2019									
1				1	RESOURCES						1
2	131,812	143,704	160,760	2	Cash on hand * (cash basis)			183,250	183,250	183,250	2
3	659	719	1,608	3	Interest			1,374	1,374	1,374	3
4	-	-	-	4	Previously levied taxes estimated to be receive			-	-	-	4
5	3,244	3,244	8,110	5	SDC SEWER			6,488	6,488	6,488	5
6		20,000	30,000	6	GRANTS			-	-	-	6
7	-	20,000	20,000	7	Transferred IN, from SEWER FUND			50,000	50,000	20,000	7
8				8				-	-	-	8
9				9					-	-	9
10	135,715	187,667	220,478	10	Total Resources, except taxes to be levied			241,112	241,112	211,112	10
11				11	Taxes estimated to be received						11
12				12	Taxes collected in year levied						12
13	**135,715**	**187,667**	**220,478**	13	**TOTAL RESOURCES**			**241,112**	**241,112**	**211,112**	13
14				14	REQUIREMENTS **						14
15				15	Org. Unit **or** Prog. & Activity	Object Classification	Detail				15
16				16	**Public Works - Wastewater**				-		16
17	1,681	2,011	3,602	17		M & S	Miscellaneous	3,504	3,504	3,504	17
18	-	5,000	5,000	18		M & S	Administration	2,500	2,500	2,500	18
19	10,000	35,000	50,000	19		M & S	Engineering	10,000	10,000	10,000	19
20	60,000	95,000	75,000	20		Cap Outlay	Wastewater Imp	50,000	50,000	50,000	20
21			20,000	21		C/O	Pump Station	20,000	20,000	20,000	21
22	64,034		-	22		Transfers		60,000	60,000	60,000	22
23				23					-		23
24				24							24
25				25							25
26				26	Ending balance (prior years)						26
27			66,876	27	**RESERVED FOR FUTURE EXPENDITURES**			95,108	95,108	95,108	27
28	**135,715**	**137,011**	**220,478**	28	**TOTAL REQUIREMENTS**			**241,112**	**241,112**	**241,112**	28

FORM
LB-30

REQUIREMENTS SUMMARY

ALLOCATED TO AN ORGANIZATIONAL UNIT OR PROGRAM & ACTIVITY

SEWER FUND 40

	Historical Data				**REQUIREMENTS FOR:**	Budget For Next Year 2020-2021			
	Actual		Adopted Budget This Year 2019-2020			Proposed By Budget Officer	Approved By Budget Committee	Adopted By Governing Body	
	Second Preceding Year 2017-2018	First Preceding Year 2018-2019							
1				1	PERSONNEL SERVICES				1
2	84,129	89,550	95,750	2	SALERIES	104,750	104,750	104,750	2
3	58,970	65,640	73,950	3	BENEFITS	80,750	80,750	80,750	3
4				4					4
5				5					5
6				6					6
7				7					7
8	**143,099**	**155,190**	**169,700**	8	**TOTAL PERSONNEL SERVICES**	**185,500**	**185,500**	**185,500**	8
9				9	**Total Full-Time Equivalent (FTE)**				9
10				10	MATERIALS AND SERVICES				10
11	5,425	5,700	5,400	11	OFFICE SUPPLIES/POSTAGE/PRINT	5,800	5,800	5,800	11
12	7,700	9,500	10,000	12	PLANNING/CONSULTANTS	3,750	3,750	3,750	12
13	1,600	2,600	2,100	13	MISCELLANEOUS	1,100	1,100	1,100	13
14	11,500	14,000	19,750	14	CONTRACTED SERVICES	19,275	19,275	19,275	14
15	16,700	16,000	17,250	15	UTILITIES/FACILITIES	22,300	22,300	22,300	15
16	8,365	4,500	3,500	16	INSURANCE	4,750	4,750	4,750	16
17	1,800	1,750	1,500	17	SCHOOL & TRAINING	3,250	3,250	3,250	17
18	12,750	22,950	14,000	18	MAINTENANCE	10,750	10,750	10,750	18
19	1,500	2,500	2,000	19	EQUIPMENT	4,000	4,000	4,000	19
20	23,000	27,000	28,000	20	SLUDGE MANAGEMENT	58,000	58,000	58,000	20
21				21					21
22				22					22
23				23					23
24				24					24
25				25					25
26				26					26
27	**90,340**	**106,500**	**103,500**	27	**TOTAL MATERIALS AND SERVICES**	**132,975**	**132,975**	**132,975**	27
28				28	CAPITAL OUTLAY				28
29	0	7,000	5,000	29	C/O SEWER PLANT	5,000	0	0	29
30	7,500	10,000	0	30	C/O PUMP STATION	0	0	0	30
31	0	0	0	31	C/O COLLECTION SYSTEM	0	0	0	31
32	7,050	0	0	32	C/O COMPUTERS	0	0	0	32
33	0	0	0	33	C/O MISCELLANEOUS SEWER	0	0	0	33
34				34					34
35	**14,550**	**17,000**	**5,000**	**35**	**TOTAL CAPITAL OUTLAY**	**5,000**	**5,000**	**5,000**	**35**
36	**247,989**	**278,690**	**278,200**	**36**	**ORGANIZATIONAL UNIT / ACTIVITY TOTAL**	**323,475**	**323,475**	**323,475**	**36**

REQUIREMENTS SUMMARY

FORM
LB-30

NOT ALLOCATED TO AN ORGANIZATIONAL UNIT OR PROGRAM

SEWER FUND 40
(name of fund)

	Historical Data					Budget For Next Year 2020-2021			
	Actual		Adopted Budget		**REQUIREMENTS DESCRIPTION PUBLIC WORKS**				
	Second Preceding Year 2017-2018	First Preceding Year2018-2019	This Year 2019-2020			Proposed By Budget Officer	Approved By Budget Committee	Adopted By Governing Body	
1				1	PERSONNEL SERVICES NOT ALLOCATED				1
2				2					2
3				3					3
4	**0**	**0**	**0**	**4**	**TOTAL PERSONNEL SERVICES**	**0**	**0**	**0**	**4**
5				**5**	**Total Full-Time Equivalent (FTE)**				**5**
6				6	MATERIALS AND SERVICES NOT ALLOCATED				6
7				7					7
8				8					8
9	**0**	**0**	**0**	**9**	**TOTAL MATERIALS AND SERVICES**	**0**	**0**	**0**	**9**
10				**10**	CAPITAL OUTLAY NOT ALLOCATED				**10**
11				11					11
12				12					12
13	**0**	**0**	**0**	**13**	**TOTAL CAPITAL OUTLAY**	**0**	**0**	**0**	**13**
14				14	DEBT SERVICE				14
15				15					15
16				16					16
17	**0**	**0**	**0**	**17**	**TOTAL DEBT SERVICE**	**0**	**0**	**0**	**17**
18				18	SPECIAL PAYMENTS				18
19				19					19
20				20					20
21	**0**	**0**	**0**	**21**	**TOTAL SPECIAL PAYMENTS**	**0**	**0**	**0**	**21**
22				22	INTERFUND TRANSFERS				22
23		20,000	20,000	23	STF XFER TO SEWER RESERVE	50,000	50,000	50,000	23
24	0	10,000	10,000	24	STF XFER TO EQUIPMENT RESERVE	10,000	10,000	10,000	24
25	128679	160,000	160,000	25	STF XFER TO BONDED DEBT	95,000	95,000	95,000	25
26	0	0		26	STF XFER TO GENERAL FACILITIES	0	0		26
27				27			0		27
28	**128,679**	**190,000**	**190,000**	28	**TOTAL INTERFUND TRANSFERS**	**155,000**	**155,000**	**155,000**	28
29			37,299	29	**OPERATING CONTINGENCY**	30,247	30,247	30,247	29
30	128,679	190,000	227,299	30	**Total Requirements NOT ALLOCATED**	185,247	185,247	185,247	30
31				31	Total Requirements for **ALL Org.Units/Progams within fund**				31
32				32	Reserved for future expenditure				32
33		101,346		33	Ending balance (prior years)				33
34			65,000	34	**UNAPPROPRIATED ENDING FUND BALANCE**	40,000	40,000	40,000	34
35	**128,679**	**291,346**	**292,299**	**35**	**TOTAL REQUIREMENTS**	**225,247**	**225,247**	**225,247**	**35**

FORM
LB-20

RESOURCES

SEWER FUND 40

CITY OF MILL CITY

	Historical Data				RESOURCE DESCRIPTION	Budget for Next Year 2020-2021			
	Actual		Adopted Budget This Year Year 2019-2020			Proposed By Budget Officer	Approved By Budget Committee	Adopted By Governing Body	
	Second Preceding Year 2017-2018	First Preceding Year 2018-2019							
1	72,776	152,000	125,346	1	Available cash on hand* (cash basis)	111,145	111,145	111,145	1
2	370,000	410,000	443,600	2	SEWER MONTHLY CHARGES	421,243	421,243	421,243	2
3	250	250	0	3	SEWER HOOK UPS	0	0	-	3
4	364	717	1,303	4	Interest/SEWER	834	834	834	4
5	500	250	250	5	MISCELLANEOUS	500	500	500	5
6				6	**OTHER RESOURCES**	0	0	-	6
7	-	0	0	7	SEWER DEPOSITS	3,000	3,000	3,000	7
8	10,500	9,000	0	8	LATE FEES/SEWER	12,000	12,000	12,000	8
9	-	0	0	9	TRANSFER FROM GENERAL FUND	0	0	-	9
10	-			10					10
11				11					11
12				12					12
13				13					13
14				14					14
15				15					15
16				16					16
17				17					17
18				18					18
19				19					19
20				20					20
21				21					21
22				22					22
23				23					23
24				24					24
25				25					25
26				26					26
27				27					27
28				28					28
29	454,390	572,217	570,499	29	Total resources, except taxes to be levied	548,722	548,722	548,722	29
30				30	Taxes estimated to be received				30
31				31	Taxes collected in year levied				31
32	**454,390**	**572,217**	**570,499**	**32**	**TOTAL RESOURCES**	**548,722**	**548,722**	**548,722**	**32**

*The balance of cash, cash equivalents and investments in the fund at the beginning of the budget year

150-504-020 (rev 10-16)

APPENDIX D

Pump Testing Results

1st Avenue Lift Station Analysis

Lift Station: 1st Avenue

Wet well is:	Circular
Formula:	Pi x R^2 x H
Diameter (ft):	8
Radius (ft):	4
Notes:	

Summary Table

	Flow Out (ft^3/s)	Flow Out (gpm)	TDH (ft of head)
Pump 1	0.30	133	Gauges not available
Pump 2	0.30	133	Gauges not available

Flow (in) = Flow (out) + Δ Storage

Flow In	Δ Time (sec)	Start Depth (ft)	End Depth (ft)	ΔH	Volume (ft^3)	Flow (ft^3/s)	Flow (gpm)
Pump 1 Fill 1	60	7.25	7.27	0.02	1.01	0.03	15.04
Pump 1 Fill 2	0			0	0.00	0.00	0.00
Pump 1 Fill Avg.	30						
Pump 2 Fill 1	60	7.25	7.27	0.02	1.01	0.03	15.04
Pump 2 Fill 2	0			0	0.00	0.00	0.00
Pump 2 Fill Avg.	30						

Δ Storage	Δ Time (sec)	Start Depth (ft)	Stop Depth (ft)	ΔH	Volume (ft^3)	Flow (ft^3/s)	Flow (gpm)
Pump 1 Test 1	60	7.58	7.25	0.33333	16.75	0.28	125.33
Pump 1 Test 2	60	7.58	7.25	0.33333	16.75	0.28	125.33
Pump 2 Test 1	60	7.75	7.4166666	0.3333334	16.76	0.28	125.33
Pump 2 Test 2	60	7.58	7.25	0.33333	16.75	0.28	125.33

Flow Out	Flow (ft^3/s)	Flow (gpm)
Pump 1	0.30	133
Pump 2	0.30	133

Pump Times

PUMP 1

Pump 1 Fill 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

Pump 1 Fill 2

Time one

Hour	Minute	Seconds	Time (min)
			0.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 0 seconds

Pump 1 Test 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

Pump 1 Test 2

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

PUMP 2

Pump 2 Fill 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	
			0

Delta T 60 seconds

Pump 2 Fill 2

Time one

Hour	Minute	Seconds	Time (min)
			0.0

Time two

Hour	Minute	Seconds	
			0

Delta T 0 seconds

Pump 2 Test 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0

Delta T 60 seconds

Pump 2 Test 2

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0

Delta T 60 seconds

River Lift Station Analysis

Lift Station: **River**

Wet well is: Circular
Formula: Pi x R^2 x H
Diameter (ft): 8
Radius (ft): 4
Notes:

Summary Table

	Flow Out (ft^3/s)	Flow Out (gpm)	TDH (ft of head)
Pump 1	0.29	129	Gauges not available
Pump 2	0.23	103	Gauges not available

Flow (in) = Flow (out) + Δ Storage

Flow In	Δ Time (sec)	Start Depth (ft)	End Depth (ft)	ΔH	Volume (ft^3)	Flow (ft^3/s)	Flow (gpm)
Pump 1 Fill 1	60	10	10.007	0.007	0.35	0.01	5.26
Pump 1 Fill 2	0	10	10.007	0.007	0.35	0.01	5.26
Pump 1 Fill Avg.	30						
Pump 2 Fill 1	60	10	10.007	0.007	0.35	0.01	5.26
Pump 2 Fill 2	0	10	10.007	0.007	0.35	0.01	5.26
Pump 2 Fill Avg.	30						

Δ Storage	Δ Time (sec)	Start Depth (ft)	Stop Depth (ft)	ΔH	Volume (ft^3)	Flow (ft^3/s)	Flow (gpm)
Pump 1 Test 1	60	10.265625	9.9375	0.328125	16.49	0.27	123.37
Pump 1 Test 2	60	10.265625	9.9375	0.328125	16.49	0.27	123.37
Pump 2 Test 1	60	10.5520833	10.2916666	0.2604167	13.09	0.22	97.91
Pump 2 Test 2	60	10.5520833	10.2916666	0.2604167	13.09	0.22	97.91

Flow Out	Flow (ft^3/s)	Flow (gpm)
Pump 1	0.29	129
Pump 2	0.23	103

Pump Times

PUMP 1

Pump 1 Fill 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

Pump 1 Fill 2

Time one

Hour	Minute	Seconds	Time (min)
			0.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 0 seconds

Pump 1 Test 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

Pump 1 Test 2

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

PUMP 2

Pump 2 Fill 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	
			0

Delta T 60 seconds

Pump 2 Fill 2

Time one

Hour	Minute	Seconds	Time (min)
			0.0

Time two

Hour	Minute	Seconds	
			0

Delta T 0 seconds

Pump 2 Test 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0

Delta T 60 seconds

Pump 2 Test 2

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0

Delta T 60 seconds

Spring Lift Station Analysis

Lift Station: Spring

Wet well is:	Circular
Formula:	Pi x R^2 x H
Diameter (ft):	10
Radius (ft):	5
Notes:	

Summary Table

	Flow Out (ft^3/s)	Flow Out (gpm)	TDH (ft of head)
Pump 1	0.66	294	Gauges not available
Pump 2	0.51	230	Gauges not available

Flow (in) = Flow (out) + Δ Storage

Flow In	Δ Time (sec)	Start Depth (ft)	End Depth (ft)	ΔH	Volume (ft^3)	Flow (ft^3/s)	Flow (gpm)
Pump 1 Fill 1	60	10	10.09	0.09	7.07	0.12	52.87
Pump 1 Fill 2	60	10	10.09	0.09	7.07	0.12	52.87
Pump 1 Fill Avg.	60						
Pump 2 Fill 1	60	10	10.09	0.09	7.07	0.12	52.87
Pump 2 Fill 2	60	10	10.09	0.09	7.07	0.12	52.87
Pump 2 Fill Avg.	60						

Δ Storage	Δ Time (sec)	Start Depth (ft)	Stop Depth (ft)	ΔH	Volume (ft^3)	Flow (ft^3/s)	Flow (gpm)
Pump 1 Test 1	60	11.307	10.895833	0.411167	32.29	0.54	241.55
Pump 1 Test 2	60	11.307	10.895833	0.411167	32.29	0.54	241.55
Pump 2 Test 1	60	11.5208333	11.21875	0.3020833	23.73	0.40	177.47
Pump 2 Test 2	60	11.5208333	11.21875	0.3020833	23.73	0.40	177.47

Flow Out	Flow (ft^3/s)	Flow (gpm)
Pump 1	0.66	294
Pump 2	0.51	230

Pump Times

PUMP 1

Pump 1 Fill 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

Pump 1 Fill 2

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

Pump 1 Test 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

Pump 1 Test 2

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0.0

Delta T 60 seconds

PUMP 2

Pump 2 Fill 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	
			0

Delta T 60 seconds

Pump 2 Fill 2

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	
			0

Delta T 60 seconds

Pump 2 Test 1

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0

Delta T 60 seconds

Pump 2 Test 2

Time one

Hour	Minute	Seconds	Time (min)
		60	1.0

Time two

Hour	Minute	Seconds	Time (min)
			0

Delta T 60 seconds

KELLER ASSOCIATES

LIFT STATION DATA SHEET

Project: NSCSP MCG WWFPS Date: April 4, 2023

Lift Station Name: First Avenue LS

Location: First Avenue & Wall Street

Number of Pumps: 2 Wet Well Dimensions: 8 feet ☒ Circular ☐ Rectangular

Pump Type(s): Submersible

Pumps are in: ☒ Wet Well ☐ Dry Well

Record Drawings: ☒ Yes ☐ No – gather elevations of inverts, pressure gauges, etc.

Pump Curves: ☐ Yes ☒ No

Level Set Points: ☐ Yes ☒ No – gather information.

Alarm Set Points: ☐ Yes ☒ No – gather information.

Discharge Manhole Lined: ☐ Yes ☒ No

Air Release on Discharge Line: ☐ Yes ☒ No ☐ N/A

Flow Meter: ☒ Yes ☐ No

Discharge Pressure Gauges: ☐ Yes ☒ No

Bypass Pump Provisions: ☐ Yes ☒ No

Odor/H_2S Control: ☐ Yes – type: ______ ☒ No

Level Indicator Type: Pressure Transducer

Inlet Pipe Size(s) (in): 4 Discharge Line Size (in): 3” transition to 4”

Pump and Motor Name Plate Data:

Voltage		Phase	
Drive Type		Hp	10
GPM		Curve No.	
Manufacturer	Flygt 3102.090	Serial No.	63-256-005206

Standby Power:

On-Site Generator: ☒ Yes – size (KW): ______ ☐ No

Transfer Switch: ☒ Automatic ☐ Manual ☐ None

Portable Generator Connection: ☐ Yes ☒ No

LIFT STATION
DATA SHEET

Safety / Security: ______

Fenced: ☐ Yes ☒ No

Access Locked: ☒ Yes ☐ No

Fall Protection: ☒ Yes ☐ No

SCADA / Controls / Alarms: ______

Year Constructed: 1990

Description of Upgrades: Upgraded in 2009.

NOTES: (Capacity related overflows? Power outages? Regular alarms and cause? History of problems/issues? Facility conditions? How often are pumps serviced? Wet well cleaned? Air release serviced?)

LIFT STATION
DATA SHEET

Lift Station Name: First Avenue LS

Date of Test: 4/4/2023

Pump Test Reminders:

1. **If VFD, operate at 60 Hz**
2. Be certain flow is not backing up into inlet pipes

Pump Test Data

Time (HH:MM:SS)	Wet Well Level/Depth (ft)	Pump Status (Pump # On/Off)	Condition (Filling / Emptying)	Discharge Pressure (psi)	Discharge Flow (gpm)	Notes
Example: *12:13:00*	*3.65'*	*Pump 1 – On*	*Emptying*	*10.8 psi*		
12:14:00	*1.50'*	*Pump 1 – Off*	*Filling*	*3.5 psi*		
60 seconds	87" to 91"	Pump 1	Emptying		112 gpm	
60 seconds	89" to 93"	Pump 2	Emptying		119 gpm	
60 seconds	88.1" to 93.1"	Pumps 1 & 2	Emptying		231 gpm	Inflow 18.2 gpm

ADDITIONAL NOTES / PUMP STATION SCHEMATICS:

- Inflow was equal to about 15 gpm.
- Lead pump on at 3.0 feet.
- Lead pump off at 1.5 feet.
- Lag pump on at 3.5 feet.
- Lag pump off at 1.75 feet.
- Overflow level at 5.0 feet.

KELLER ASSOCIATES

LIFT STATION DATA SHEET

Project: NSCSP MCG WWFPS Date: April 4, 2023

Lift Station Name: River Street LS

Location: River Street & 8th Place

Number of Pumps: 2 Wet Well Dimensions: 8 feet ☒ Circular ☐ Rectangular

Pump Type(s): Submersible

Pumps are in: ☒ Wet Well ☐ Dry Well

Record Drawings: ☒ Yes ☐ No – gather elevations of inverts, pressure gauges, etc.

Pump Curves: ☐ Yes ☒ No

Level Set Points: ☐ Yes ☒ No – gather information.

Alarm Set Points: ☐ Yes ☒ No – gather information.

Discharge Manhole Lined: ☐ Yes ☒ No

Air Release on Discharge Line: ☐ Yes ☒ No ☐ N/A

Flow Meter: ☒ Yes ☐ No

Discharge Pressure Gauges: ☐ Yes ☒ No

Bypass Pump Provisions: ☐ Yes ☒ No

Odor/H_2S Control: ☐ Yes – type: ________ ☒ No

Level Indicator Type: Pressure Transducer

Inlet Pipe Size(s) (in): 4 Discharge Line Size (in): 3” transition to 4”

Pump and Motor Name Plate Data:

Voltage		Phase	
Drive Type		Hp	7.5
GPM		Curve No.	
Manufacturer	FLYGT 3102.060	Serial No.	63-257-00-5206

Standby Power:

On-Site Generator: ☒ Yes – size (KW): ________ ☐ No

Transfer Switch: ☒ Automatic ☐ Manual ☐ None

Portable Generator Connection: ☐ Yes ☒ No

LIFT STATION DATA SHEET

Safety / Security:

Fenced: ☒ Yes ☐ No

Access Locked: ☒ Yes ☐ No

Fall Protection: ☒ Yes ☐ No

SCADA / Controls / Alarms:

Year Constructed: 1990

Description of Upgrades: Upgraded in 2009.

NOTES: (Capacity related overflows? Power outages? Regular alarms and cause? History of problems/issues? Facility conditions? How often are pumps serviced? Wet well cleaned? Air release serviced?)

LIFT STATION DATA SHEET

Lift Station Name: River Road LS

Date of Test: 4/4/2023

Pump Test Reminders:

1. **If VFD, operate at 60 Hz**
2. Be certain flow is not backing up into inlet pipes

Pump Test Data

Time (HH:MM:SS)	Wet Well Level/Depth (ft)	Pump Status (Pump # On/Off)	Condition (Filling / Emptying)	Discharge Pressure (psi)	Discharge Flow (gpm)	Notes
Example: *12:13:00*	*3.65'*	*Pump 1 – On*	*Emptying*	*10.8 psi*		
12:14:00	*1.50'*	*Pump 1 – Off*	*Filling*	*3.5 psi*		
60 seconds	119.3" to 123.2"	Pump 1	Emptying		132 gpm	
60 seconds	123.5" to 126.6"	Pump 2	Emptying		92 gpm	
60 seconds	125.3" to 129.5"	Pump 1 & 2	Emptying		224 gpm	

ADDITIONAL NOTES / PUMP STATION SCHEMATICS:

- Inflow around 5 gpm
- Lead pump on at 2.5 feet
- Lead pump off at 1.5 feet
- Lag pump on at 2.75 feet
- Lag pump off at 1.75 feet
- Overflow level at 5.95 feet

KELLER ASSOCIATES

LIFT STATION DATA SHEET

Project: NSCSP MCG WWFPS Date: April 4, 2023

Lift Station Name: Spring Street LS

Location: Spring Street & SW 11th Avenue

Number of Pumps: 2 Wet Well Dimensions: 10 feet ☒ Circular ☐ Rectangular

Pump Type(s): Submersible

Pumps are in: ☒ Wet Well ☐ Dry Well

Record Drawings: ☒ Yes ☐ No – gather elevations of inverts, pressure gauges, etc.

Pump Curves: ☐ Yes ☒ No

Level Set Points: ☐ Yes ☒ No – gather information.

Alarm Set Points: ☐ Yes ☒ No – gather information.

Discharge Manhole Lined: ☐ Yes ☒ No

Air Release on Discharge Line: ☐ Yes ☒ No ☐ N/A

Flow Meter: ☒ Yes ☐ No

Discharge Pressure Gauges: ☐ Yes ☒ No

Bypass Pump Provisions: ☐ Yes ☒ No

Odor/H_2S Control: ☐ Yes – type: ____________ ☒ No

Level Indicator Type: Pressure Transducer

Inlet Pipe Size(s) (in): 12 Discharge Line Size (in): 4” transition to 6”

Pump and Motor Name Plate Data:

Voltage		Phase	
Drive Type		Hp	20
GPM		Curve No.	
Manufacturer	Flygt 3153.091	Serial No.	63-462-00-6050

Standby Power:

On-Site Generator: ☒ Yes – size (KW): 60kW ☐ No

Transfer Switch: ☒ Automatic ☐ Manual ☐ None

Portable Generator Connection: ☐ Yes ☒ No

LIFT STATION DATA SHEET

Safety / Security:

Fenced: ☒ Yes ☐ No

Access Locked: ☒ Yes ☐ No

Fall Protection: ☒ Yes ☐ No

SCADA / Controls / Alarms:

Year Constructed: 1990

Description of Upgrades: Upgraded in 2009.

NOTES: (Capacity related overflows? Power outages? Regular alarms and cause? History of problems/issues? Facility conditions? How often are pumps serviced? Wet well cleaned? Air release serviced?)

LIFT STATION
DATA SHEET

Lift Station Name: Spring Street Lift Station

Date of Test: 4/4/2023

Pump Test Reminders:
1. **If VFD, operate at 60 Hz**
2. Be certain flow is not backing up into inlet pipes

Pump Test Data

Time (HH:MM:SS)	Wet Well Level/Depth (ft)	Pump Status (Pump # On/Off)	Condition (Filling / Emptying)	Discharge Pressure (psi)	Discharge Flow (gpm)	Notes
Example: *12:13:00*	*3.65'*	*Pump 1 – On*	*Emptying*	*10.8 psi*		
12:14:00	*1.50'*	*Pump 1 – Off*	*Filling*	*3.5 psi*		
60 seconds	130.8" to 135.7"	Pump 1	Emptying		270 gpm	
60 seconds	134.6" to 138.3"	Pump 2	Emptying		238 gpm	
60 seconds	135.6" to 140.5"	Pump 1 & 2	Emptying		508 gpm	

ADDITIONAL NOTES / PUMP STATION SCHEMATICS:

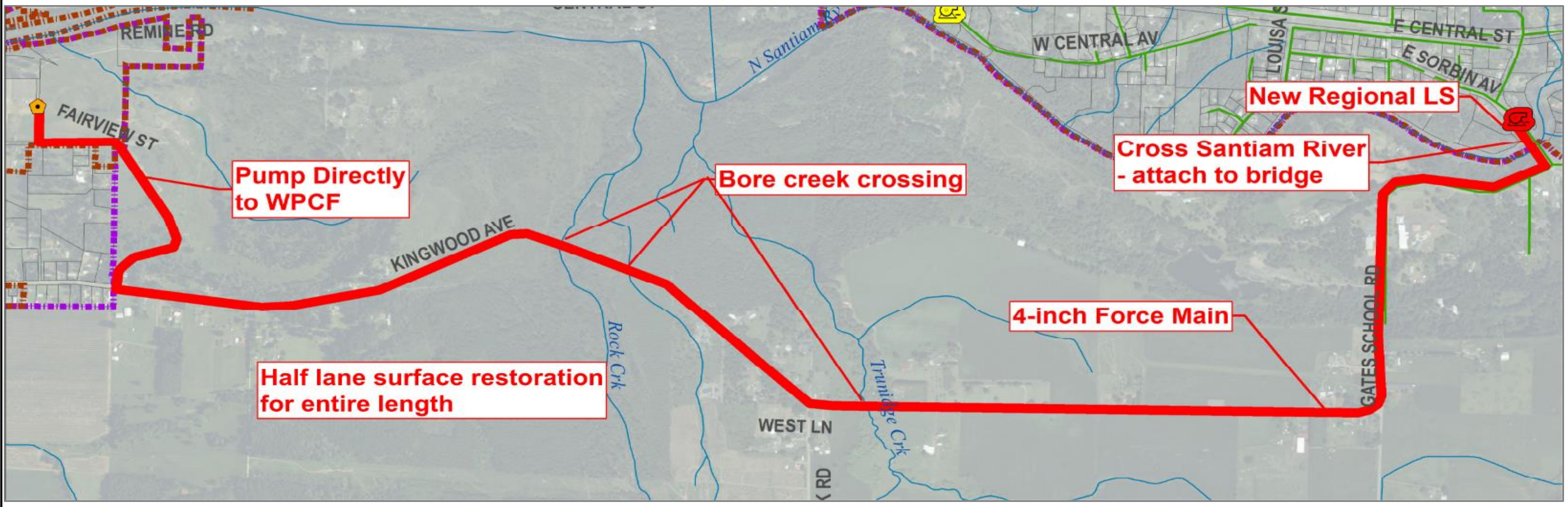
- Inflow of 55 gpm
- Lead on at 4.5 feet
- Lead off at 1.5 feet
- No lag settings provided.

APPENDIX E

Collection System Alternative Cost Estimates

Mill City / Gates
Wastewater Facility Plan

Alternative 1 - South Alignment	**Location:** Gates to Mill City WPCF



General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2022 Dollars)
Goods and Services					
4-inch HDPE Pipe - Excavation, Backfill, Cleanouts	20,000	LF	$140	$ 2,800,000	
Boring, Construction & Repairs (24 in and smaller casing)	600	LF	$1,000	$ 600,000	
Launching / Receiving Pit Excavation & Restoration	3	LS	$100,000	$ 300,000	
1/2 Lane (7') Pavement Repair	19,400	LF	$70	$ 1,358,000	
Gates Regional Lift Station (Site, Wetwell, Pumps, Electrical, Valves)	1	LS	$830,000	$ 830,000	
Traffic Control w/ Flaggers	1	LS	$120,000	$ 120,000	
				Construction Subtotal	***$ 6,008,000***
Additional Elements (estimated % of above)					
Mobilization and Administration			10%	$ 601,000	
Bonding			2.5%	$ 150,000	
Contractor Overhead and Profit			15%	$ 901,000	
Prevailing Wages			2.5%	$ 150,000	
AIS / BABA (if funded by IIJA/BIL or SRF)			5%	$ 300,000	
Contingency			30%	$ 1,802,000	
				Total Construction Subtotal	***$ 9,912,000***
Plans and Contract Documents					
Engineering Design and Bid Phase Services			15%	$ 1,487,000	
Engineering - Construction Contract Administration			5%	$ 496,000	
Engineering -- Inspection			8%	$ 793,000	
Environmental			LS	$ 75,000	
Permitting			LS	$ 50,000	
Geotechnical Investigation			LS	$ 100,000	
SCADA Integration			LS	$ 30,000	
Surveying			LS	$ 120,000	
Legal, Administrative, and Funding			2%	$ 198,000	
				Total Project Costs (rounded)	**$ 13,270,000**

EA = each, LF = linear foot, LS = lump sum
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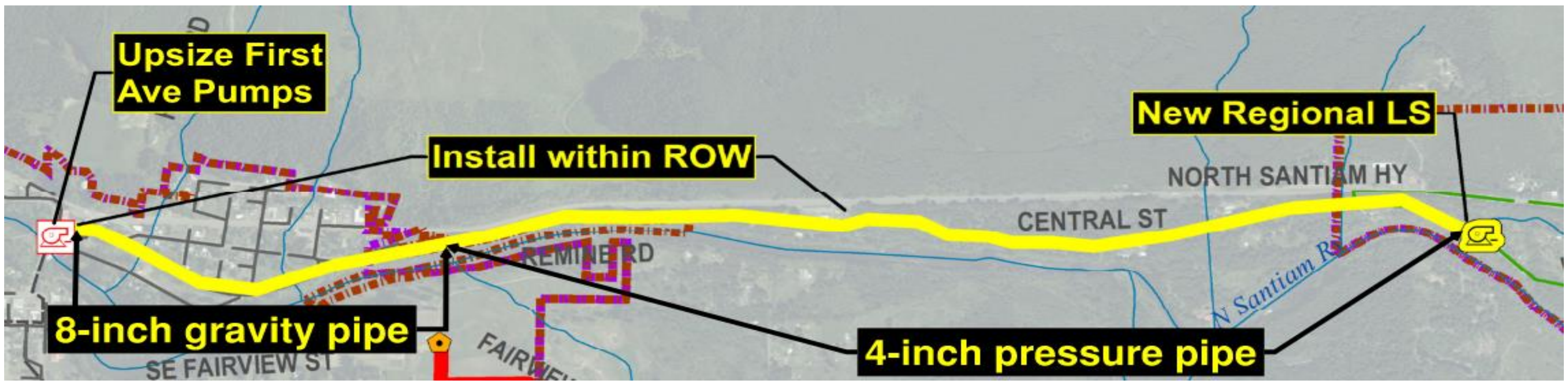
Plan and Contract document costs based on percent of Total Construction Subtotal.

Mill City / Gates
Wastewater Facility Plan

Alternative 2 - North Alignment

Location: Gates to Mill City WPCF



General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2022 Dollars)
Goods and Services					
4-inch HDPE Pipe - Excavation, Backfill, Cleanouts	9,660	LF	$140	$ 1,352,400	
8-inch PVC Pipe - Excavation, Backfill	2,420	LF	$150	$ 363,000	
48-Inch, Standard Manhole (<10 feet)	15	EA	$8,800	$ 132,000	
Manhole Odor Control System	1	LS	$15,000	$ 15,000	
Manhole Lining System (lining system only)	1	LS	$15,000	$ 15,000	
Boring, Construction & Repairs (24 in and smaller casing)	300	LF	$1,000	$ 300,000	
Launching / Receiving Pit Excavation & Restoration	4	LS	$100,000	$ 400,000	
1/2 Lane (7') Pavement Repair	1,800	LF	$70	$ 126,000	
Asphalt Walking/Biking Pathway Construction, 6' wide (Aggregate Base, Asphalt)	10,280	LF	$150	$ 1,542,000	
Gates Regional Lift Station (Site, Wetwell, Pumps, Electrical, Valves)	1	LS	$830,000	$ 830,000	
First Ave Lift Station Upgrades (Pumps, Electrical, SCADA)	1	LS	$175,000	$ 175,000	
Traffic Control w/ Flaggers	1	LS	$130,000	$ 130,000	
				Construction Subtotal	***$ 5,380,400***
Additional Elements (estimated % of above)					
Mobilization and Administration			10%	$ 538,000	
Bonding			2.5%	$ 135,000	
Contractor Overhead and Profit			15%	$ 807,000	
Prevailing Wages			3%	$ 135,000	
AIS / BABA (if funded by IIJA/BIL or SRF)			5%	$ 269,000	
Contingency			30%	$ 1,614,000	
				Total Construction Subtotal	***$ 8,879,000***
Plans and Contract Documents					
Engineering Design and Bid Phase Services			15%	$ 1,332,000	
Engineering - Construction Contract Administration			5%	$ 444,000	
Engineering -- Inspection			8%	$ 710,000	
Environmental			1%	$ 90,000	
Permitting			1%	$ 90,000	
Geotechnical Investigation			LS	$ 150,000	
SCADA Integration			LS	$ 30,000	
Surveying			LS	$ 100,000	
Legal, Administrative, and Funding			2%	$ 178,000	
				Total Project Costs (rounded)	**$ 12,010,000**

EA = each, LF = linear foot, LS = lump sum
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Plan and Contract document costs based on percent of Total Construction Subtotal.

Alternative 1 - Upsize Existing Infrastructure

Location: High Ave, 4th Ave & Kingwood Ave

General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2022 Dollars)
Goods and Services					
6-inch PVC Pipe - Excavation, Backfill	990	LF	$135	$ 133,700	
8-inch PVC Pipe - Excavation, Backfill	600	LF	$150	$ 90,000	
Sewer Cleanout	12	EA	$2,000	$ 24,000	
Reconnect Sewer Service (excavation, backfill, pipe, surface restoration)	21	EA	$1,000	$ 21,000	
1/2 Lane (7') Pavement Repair	1,590	LF	$70	$ 111,300	
Traffic Control w/o Flaggers	1	LS	$10,000	$ 10,000	
				Construction Subtotal	***$ 256,300***
Additional Elements (estimated % of above)					
Mobilization and Administration			10%	$ 26,000	
Bonding			2.5%	$ 6,000	
Contractor Overhead and Profit			15%	$ 38,000	
Prevailing Wages			2.5%	$ 6,000	
AIS / BABA (if funded by IIJA/BIL or SRF)			5%	$ 13,000	
Contingency			30%	$ 77,000	
				Total Construction Subtotal	***$ 423,000***
Plans and Contract Documents					
Engineering Design and Bid Phase Services			15%	$ 63,000	
Engineering - Construction Contract Administration			5%	$ 21,000	
Engineering -- Inspection			8%	$ 34,000	
Environmental			LS	$ 10,000	
Permitting			LS	$ 10,000	
Geotechnical Investigation			LS	$ -	
SCADA Integration			LS	$ -	
Surveying			LS	$ 20,000	
Legal, Administrative, and Funding			2%	$ 8,000	
				Total Project Costs (rounded)	**$ 590,000**

EA = each, LF = linear foot, LS = lump sum

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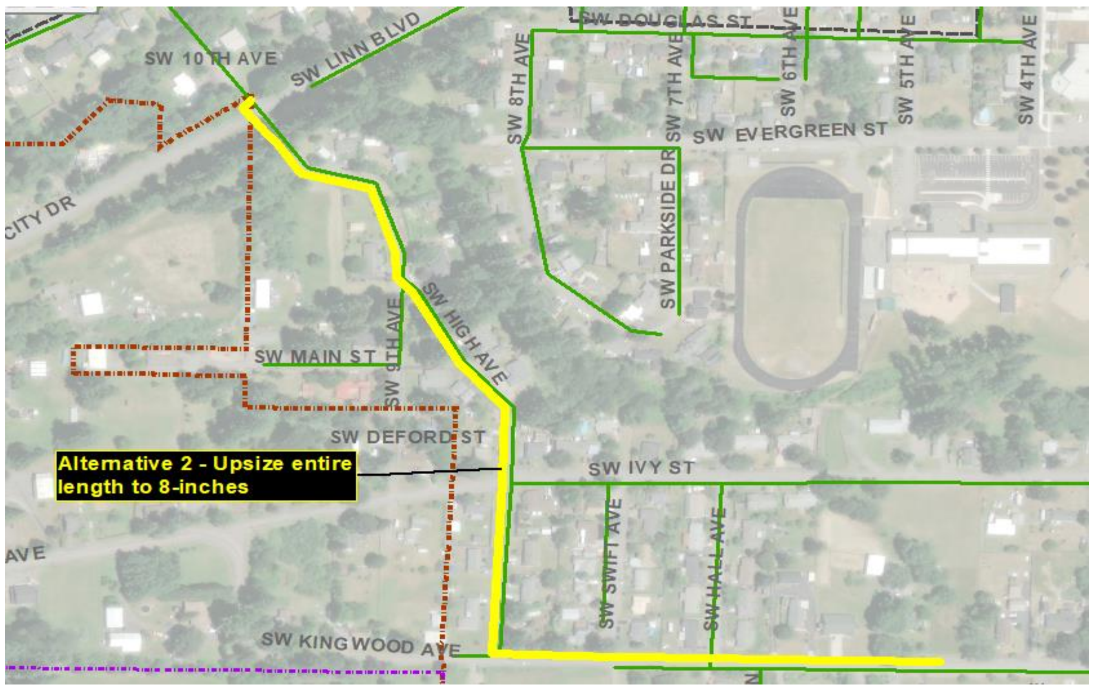
Plan and Contract document costs based on percent of Total Construction Subtotal.

Alternative 1 - Upsize Existing Infrastructure	**Location: E 4th Ave to Spring LS**



General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2022 Dollars)
Goods and Services					
8-inch PVC Pipe - Excavation, Backfill	2,700	LF	$150	$ 405,000	
48-Inch, Standard Manhole (<10 feet)	15	EA	$8,800	$ 132,000	
Connect to Existing Manhole	1	EA	$1,900	$ 1,900	
Reconnect Sewer Service (excavation, backfill, pipe, surface restoration)	30	EA	$1,000	$ 30,000	
1/2 Lane (7') Pavement Repair	2,700	LF	$70	$ 189,000	
Traffic Control w/o Flaggers	1	LS	$38,000	$ 38,000	
				Construction Subtotal	***$ 795,900***
Additional Elements (estimated % of above)					
Mobilization and Administration			10%	$ 80,000	
Bonding			2.5%	$ 20,000	
Contractor Overhead and Profit			15%	$ 119,000	
Prevailing Wages			2.5%	$ 20,000	
AIS / BABA (if funded by IIJA/BIL or SRF)			5%	$ 40,000	
Contingency			30%	$ 239,000	
				Total Construction Subtotal	***$ 1,314,000***
Plans and Contract Documents					
Engineering Design and Bid Phase Services			15%	$ 197,000	
Engineering - Construction Contract Administration			5%	$ 66,000	
Engineering -- Inspection			8%	$ 105,000	
Environmental			LS	$ 10,000	
Permitting			LS	$ 10,000	
Geotechnical Investigation			LS	$ 20,000	
SCADA Integration			LS	$ -	
Surveying			LS	$ 40,000	
Legal, Administrative, and Funding			2%	$ 26,000	
				Total Project Costs (rounded)	**$ 1,790,000**

EA = each, LF = linear foot, LS = lump sum
The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the cost presented herein.
Plan and Contract document costs based on percent of Total Construction Subtotal.

Client: Mill City/Gates
Project: WWFPS
Project No.: 222194-200

2% Discount Rate
3% Inflation Rate

Spring Basin Life Cycle Costs

Alternative 1 O&M Costs					
Line Item	Annual Cost	Unit Cost	Quantity	20-Year Present Worth Factor	20-Year Present Worth
Septic Tank Pumping	$2,600	$100	26	21.5	$56,020
Pipline CCTV & Cleaning	$1,620	$1	2,700	21.5	$34,905
				Total (Rounded)	**$90,900**

Alternative 2 O&M Costs					
Line Item	Annual Cost	Unit Cost	Quantity	20-Year Present Worth Factor	20-Year Present Worth
Pipline CCTV & Cleaning	$1,620	$1	2,700	21.5	$34,905
				Total (Rounded)	**$34,900**

Alternative 1 STEG Tank Replacement Costs					
Line Item	Annual Cost	Unit Cost	Quantity	Useful Life	20-Year Present Worth
STEG Tank Replacement	4752.2	5,000	26	40	**$102,392**

Alternative 2 STEG Tank Replacement Costs
Alternative 2 Removes STEG tanks along the project corridor and therefore have no replacement costs

Notes

1) Present worth factor uses 2% discount rate and 3% inflation rate.

2) Septic Tank pumping based on reported values from the NSCSP 2019 Master Plan.

3) Pipeline CCTV & Cleaning assumed to be same length for both alternatives.

4) Quantity of STEG tank replacements is equal to number of connections that would not need a STEG tank under Alternative 2.

APPENDIX F

Collection System Annual Costs

Client: Mill City / Gates
Project: WWFPS
Project No.: 222194

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Mill City Short Lived and Long Lived Asset Replacement

Short Lived Assets	Quantity	Unit	Unit Cost	Total Replacement Cost	Typical Useful Life / Frequency (years)	Annualized Replacement Cost
STEP Systems						
STEP Pump Replacement	68	EA	$400	$30,000	10	$3,000
Total STEP Systems				**$30,000**	**-**	**$3,000**
River Lift Station						
Submersible Pump & Motor (7.5 hp)	2	EA	$35,000	$70,000	20	$3,500
Routine Pump Inspection	1	LS	$3,000	$3,000	5	$600
Impeller Replacement	2	EA	$6,000	$12,000	10	$1,200
Instrumentation	1	LS	$10,000	$10,000	15	$700
Control Panel & Electrical	1	LS	$36,000	$40,000	15	$2,700
SCADA System	1	LS	$20,000	$20,000	15	$1,400
Total River Lift Station				**$155,000**	**-**	**$10,100**
First Avenue Lift Station						
Submersible Pump & Motor (10 hp)	2	EA	$40,000	$80,000	20	$4,000
Routine Pump Inspection	1	LS	$3,000	$3,000	5	$600
Impeller Replacement	2	EA	$6,000	$12,000	10	$1,200
Instrumentation	1	LS	$10,000	$10,000	15	$700
Control Panel & Electrical	1	LS	$36,000	$40,000	15	$2,700
SCADA System	1	LS	$20,000	$20,000	15	$1,400
Total First Avenue Lift Station				**$165,000**	**-**	**$10,600**
Spring Street Lift Station						
Submersible Pump & Motor (20 hp)	2	EA	$50,000	$100,000	20	$5,000
Routine Pump Inspection	1	LS	$3,000	$3,000	5	$600
Impeller Replacement	2	EA	$7,500	$15,000	10	$1,500
Instrumentation	1	LS	$10,000	$10,000	15	$700
Control Panel & Electrical	1	LS	$36,000	$40,000	15	$2,700
SCADA System	1	LS	$20,000	$20,000	15	$1,400
Total Spring Street Lift Station				**$188,000**	**-**	**$11,900**
Total Material Costs				**$508,000**	**-**	**$35,600**
Mobilization					10%	$3,560
Subtotal					-	**$39,160**
Contingency					20%	$7,800
Total Construction Cost					-	**$47,000**
Engineering					20%	$9,400
Total Short-Lived Asset Replacement (rounded)					**-**	**$56,000**

Client: Mill City / Gates
Project: WWFPS
Project No.: 222194

Mill City Short Lived and Long Lived Asset Replacement

Long Lived Assets	Quantity	Unit	Unit Cost	Total Replacement Cost	Typical Useful Life (years)	Annualized Replacement Cost
Pipelines / Cleanouts						
4-inch Pipe & Surface Repair (Gravity)	51,700	LF	$210	$10,860,000	75	$145,000
6-inch Pipe & Surface Repair (Gravity)	2,800	LF	$215	$600,000	75	$8,000
8-inch Pipe & Surface Repair (Gravity)	5,700	LF	$220	$1,250,000	75	$17,000
4-inch Pipe & Surface Repair (Pressure)	2,910	LF	$210	$610,000	75	$9,000
8-inch pipe & Surface Repair (Pressure)	8,840	LF	$220	$1,940,000	75	$26,000
Cleanout	268	EA	$3,000	$800,000	50	$16,000
Manhole	29	EA	$9,800	$280,000	50	$6,000
STEG Tank & Service Line	706	EA	$10,000	$7,060,000	50	$142,000
STEP System & Service Line	34	EA	$10,000	$340,000	50	$7,000
Total Pipelines / Cleanouts				**$23,740,000**	**-**	**$376,000**
River Lift Station						
Valves / Meters	1	LS	$48,000	$48,000	30	$1,600
Onsite Diesel Generator (40kW)	1	EA	$50,000	$50,000	30	$1,700
Wetwell (rehab)	1	EA	$42,000	$42,000	25	$1,700
Site paving, fencing, landscaping, etc.	1	LS	$10,000	$10,000	30	$400
Building	1	LS	$35,000	$40,000	40	$1,000
Total River Lift Station				**$190,000**	**-**	**$6,400**
First Avenue Lift Station						
Valves / Meters	1	LS	$48,000	$50,000	30	$1,700
Onsite Diesel Generator (40kW)	1	EA	$50,000	$50,000	30	$1,700
Wetwell (rehab)	1	EA	$42,000	$40,000	25	$1,600
Site paving, fencing, landscaping, etc.	1	LS	$10,000	$10,000	30	$400
Building	1	LS	$35,000	$40,000	40	$1,000
Total First Avenue Lift Station				**$190,000**	**-**	**$6,400**
Spring Street Lift Station						
Valves / Meters	1	LS	$48,000	$50,000	30	$1,700
Onsite Diesel Generator (60kW)	1	EA	$50,000	$50,000	30	$1,700
Wetwell (rehab)	1	EA	$42,000	$40,000	25	$1,600
Site paving, fencing, landscaping, etc.	1	LS	$10,000	$10,000	30	$400
Building	1	LS	$35,000	$40,000	40	$1,000
Total Spring Street Lift Station				**$190,000**	**-**	**$6,400**
Total Collection System Replacement Costs				**$24,310,000**		**$395,200**
Mobilization					10%	$39,520
Subtotal					-	**$434,720**
Contingency					20%	$86,900
Total Construction Cost					-	**$521,600**
Engineering					20%	$104,300
Total Long-Lived Asset Replacement (rounded)					-	$626,000

Client: Mill City / Gates
Project: WWFPS
Project No.: 222194

Gates Short Lived and Long Lived Asset Replacement

Short Lived Assets	Quantity	Unit	Unit Cost	Total Replacement Cost	Typical Useful Life (years)	Annualized Replacement Cost
STEP Systems						
STEP Pump Replacement	60	EA	$400	$20,000	10	$2,000
Total STEP Systems				**$20,000**	**-**	**$2,000**
Riverview Lift Station						
Submersible Pump & Motor (hp TBD)	2	EA	$40,000	$80,000	20	$4,000
Routine Pump Inspection	1	LS	$3,000	$3,000	5	$600
Impeller Replacement	2	EA	$6,000	$12,000	10	$1,200
Instrumentation	1	LS	$10,000	$10,000	15	$700
Control Panel & Electrical	1	LS	$36,000	$40,000	15	$2,700
SCADA System	1	LS	$20,000	$20,000	15	$1,400
Total River Lift Station				**$165,000**	**-**	**$10,600**
Dogwood Lift Station						
Submersible Pump & Motor (hp TBD)	2	EA	$40,000	$80,000	20	$4,000
Routine Pump Inspection	1	LS	$3,000	$3,000	5	$600
Impeller Replacement	2	EA	$6,000	$12,000	10	$1,200
Instrumentation	1	LS	$10,000	$10,000	15	$700
Control Panel & Electrical	1	LS	$36,000	$40,000	15	$2,700
SCADA System	1	LS	$20,000	$20,000	15	$1,400
Total First Avenue Lift Station				**$165,000**	**-**	**$10,600**
Gates Regional Lift Station						
Submersible Pump & Motor (hp TBD)	2	EA	$40,000	$80,000	20	$4,000
Routine Pump Inspection	1	LS	$3,000	$3,000	5	$600
Impeller Replacement	2	EA	$7,500	$15,000	10	$1,500
Instrumentation	1	LS	$10,000	$10,000	15	$700
Control Panel & Electrical	1	LS	$36,000	$40,000	15	$2,700
SCADA System	1	LS	$20,000	$20,000	15	$1,400
Total Spring Street Lift Station				**$168,000**	**-**	**$10,900**
Total Material Costs				**$498,000**	**-**	**$34,100**
Mobilization					10%	$3,410
Subtotal					-	**$37,510**
Contingency					20%	$7,500
Total Construction Cost					-	**$45,000**
Engineering					20%	$9,000
Total Short-Lived Asset Replacement (rounded)					**-**	**$54,000**

Client: Mill City / Gates
Project: WWFPS
Project No.: 222194

Gates Short Lived and Long Lived Asset Replacement

Long Lived Assets	Quantity	Unit	Unit Cost	Total Replacement Cost	Typical Useful Life (years)	Annualized Replacement Cost
Pipelines / Cleanouts						
8-inch Pipe & Surface Repair (Gravity)	24,640	LF	$220	$5,420,000	75	$73,000
4-inch Pipe & Surface Repair (Pressure)	12,322	LF	$210	$2,590,000	75	$35,000
Cleanout	30	EA	$3,000	$90,000	50	$2,000
Manhole	130	EA	$9,800	$1,270,000	50	$26,000
STEP System & Service Line	30	EA	$10,000	$300,000	50	$6,000
Total Pipelines / Cleanouts				**$9,670,000**	**-**	**$142,000**
Riverview Lift Station						
Valves / Meters	1	LS	$48,000	$48,000	30	$1,600
Onsite Diesel Generator	1	EA	$50,000	$50,000	30	$1,700
Wetwell (rehab)	1	EA	$42,000	$42,000	20	$2,100
Site paving, fencing, landscaping, etc.	1	LS	$10,000	$10,000	30	$400
Building	1	LS	$35,000	$40,000	40	$1,000
Total River Lift Station				**$190,000**	**-**	**$6,800**
Dogwood Lift Station						
Valves / Meters	1	LS	$48,000	$50,000	30	$1,700
Onsite Diesel Generator	1	EA	$50,000	$50,000	30	$1,700
Wetwell (rehab)	1	EA	$42,000	$40,000	20	$2,000
Site paving, fencing, landscaping, etc.	1	LS	$10,000	$10,000	30	$400
Building	1	LS	$35,000	$40,000	40	$1,000
Total First Avenue Lift Station				**$190,000**	**-**	**$6,800**
Gates Regional Lift Station						
Valves / Meters	1	LS	$48,000	$50,000	30	$1,700
Onsite Diesel Generator	1	EA	$50,000	$50,000	30	$1,700
Wetwell (rehab)	1	EA	$42,000	$40,000	20	$2,000
Site paving, fencing, landscaping, etc.	1	LS	$10,000	$10,000	30	$400
Building	1	LS	$35,000	$40,000	40	$1,000
Total Spring Street Lift Station				**$190,000**	**-**	**$6,800**
Total Collection System Replacement Costs				**$10,240,000**		**$162,400**
Mobilization					10%	$16,240
Subtotal					-	**$178,640**
Contingency					20%	$35,700
Total Construction Cost					-	**$214,300**
Engineering					20%	$42,900
Total Long-Lived Asset Replacement (rounded)					**-**	**$257,000**

Client: Mill City / Gates
Project: WWFPS
Project No.: 222194

Annual Collection System O&M Costs

Mill City	
Activity	**Annual Cost**
Pipeline CCTV	$37,000
STEG Tank Pumping	$35,000
Lift Station Power Costs	$1,600
Staffing	$50,000
Total O&M	$124,000

Pipeline CCTV		
Target	10%	
Target Linear Feet	7,000	
Cost per LF	$5.3	
Annual CCTV Cost	$37,000	

STEG Tank Pumping		
Target	15%	annually
Target Number of Tanks	103	
Cost per Tank Pump	$340	
Annual Pumping Cost (rounded)	$35,000	

Lift Station Power Costs	Annual (kWh per year)
River Road LS	3,700
First Avenue LS	3,000
Spring Street LS	8,600
Power Unit Cost (per kWh)	$0.10
Annual Power Cost	$1,600

Wastewater Staffing	% of Total Spent	Collection vs. Treatment Split		
Collection	15%	60%		
Treatment	10%	40%		
	Supervisor	Operator 1	Operator 2	Total
Total WW hours/week	10	5	2.5	17.5
Collection Hrs/Week[1]	6	3	1.5	10.5
Current FTE	0.15	0.08	0.04	0.26
Recommended FTE[2]	0.10	0.00	0.00	0.10
Rate	$150,000	$115,000	$100,000	$365,000
Annual Staffing Cost for WW Collection	$37,500	$8,625	$3,750	$49,875

1) Based on % of total time and collection vs. treatment split in table above

2) Additional 4 hours per week for lift station preventative maintenance and site maintenance.

Client: Mill City / Gates
Project: WWFPS
Project No.: 222194

Annual Collection System O&M Costs

Gates	
Activity	**Annual Cost**
Pipeline CCTV	$21,000
Lift Station Power Costs	$1,600
Staffing	$50,000
Total O&M	$73,000

Pipeline CCTV		
Target	10%	annually
Target Linear Feet	4,000	
Cost per LF	$5.3	
Annual CCTV Cost	$21,000	

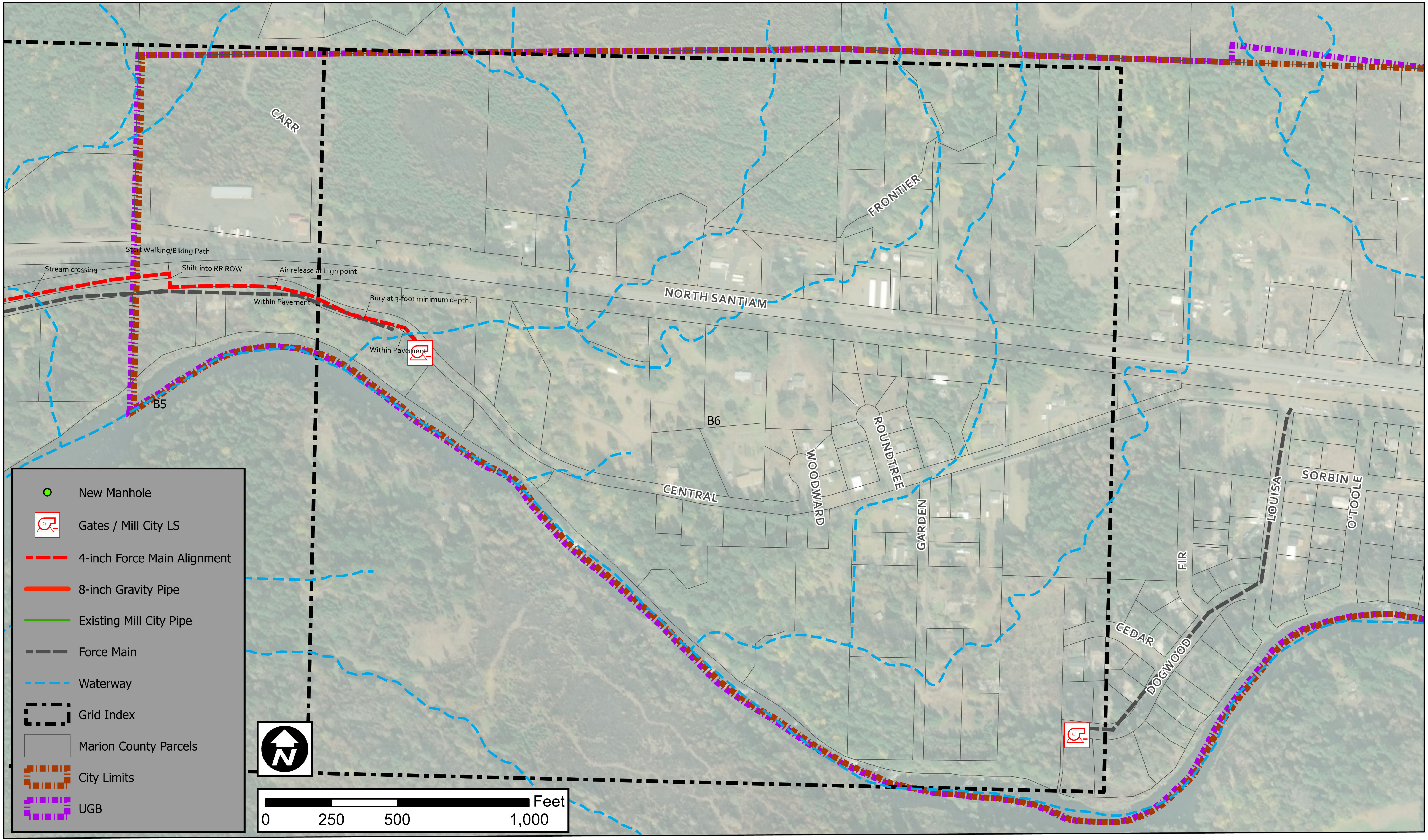
Lift Station Power Costs	Annual (kWh per year)	
Riverview LS	5,100	*Equal to average power consumption from Mill City lift stations*
Dogwood LS	5,100	
Gates Regional LS	5,100	
Power Unit Cost (per kWh)	$0.10	
Annual Power Cost	$1,600	

Wastewater Staffing	
Annual Staffing Cost	$49,875

Assumes equivalent FTE and staffing as Mill City since Gates system will also consists of three lift stations

APPENDIX G

Conceptual Project Design



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Gates to Mill City Force Main Alignment

Mill City / Gates WWFPS

North Santiam
Sewer Authority

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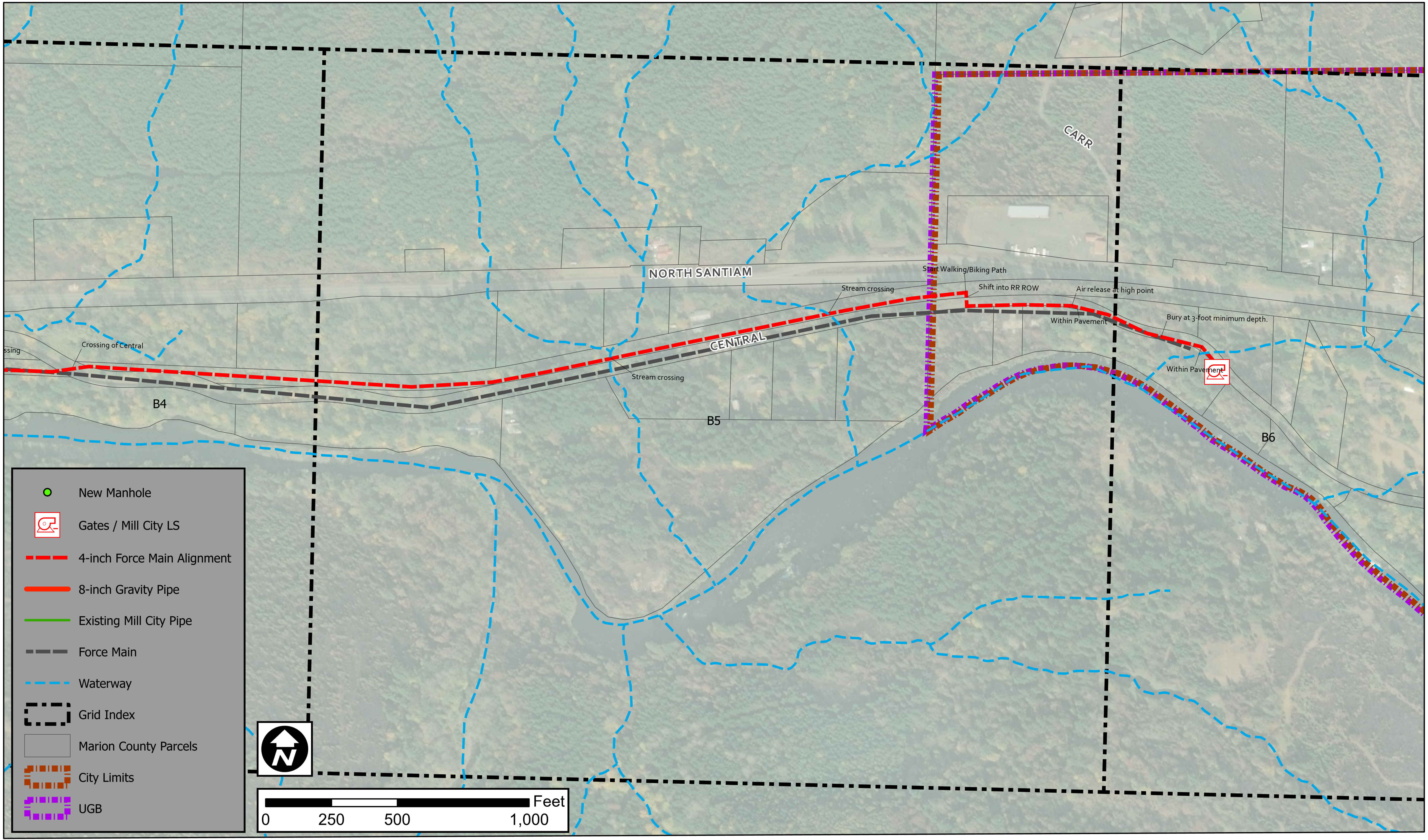

Gates to Mill City Force Main Alignment

Mill City / Gates WWFPS

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North Santiam Sewer Authority

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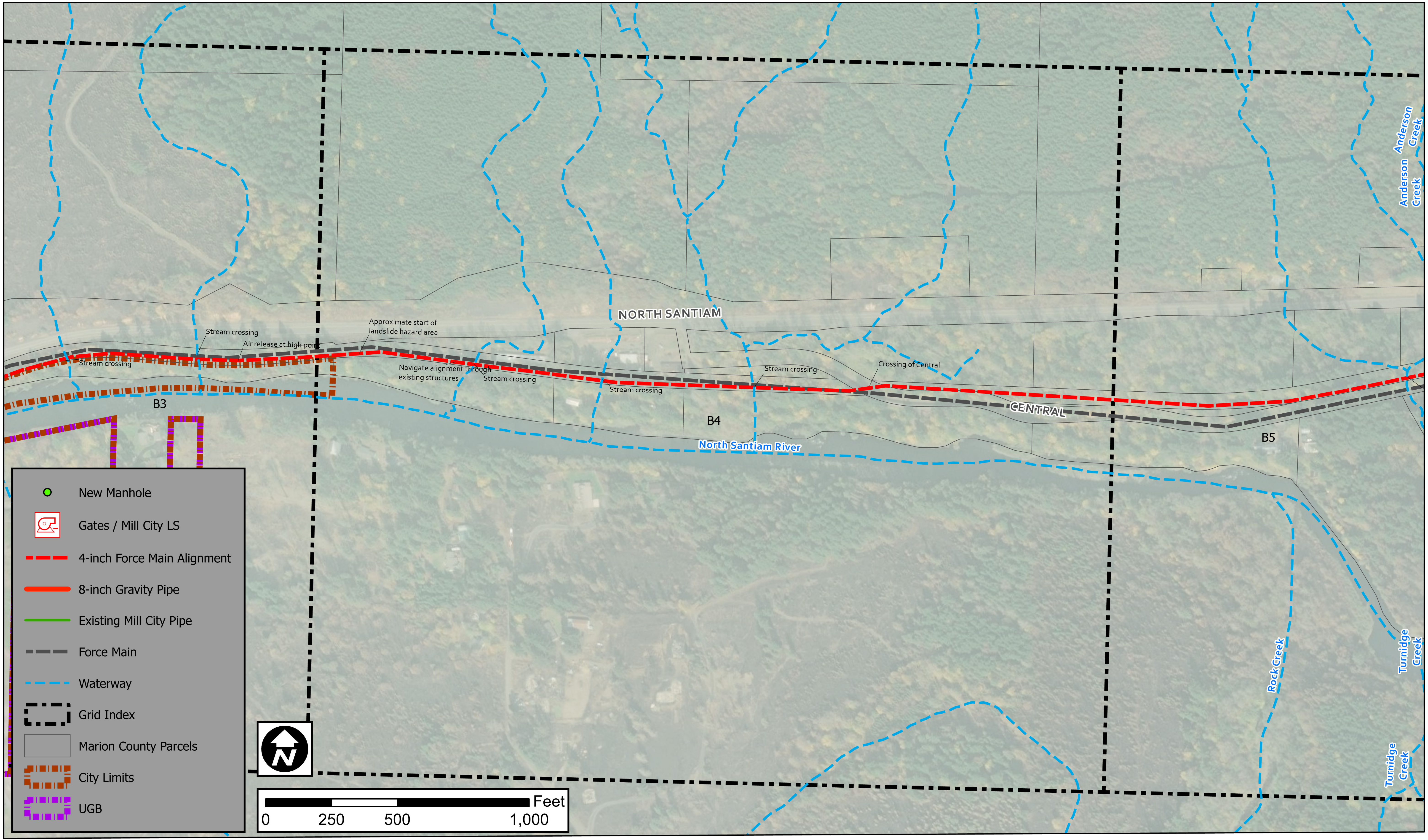


●	New Manhole
	Gates / Mill City LS
🟥	4-inch Force Main Alignment
🟥	8-inch Gravity Pipe
🟩	Existing Mill City Pipe
⬛	Force Main
🟦	Waterway
⬛	Grid Index
⬜	Marion County Parcels
🟫	City Limits
🟪	UGB

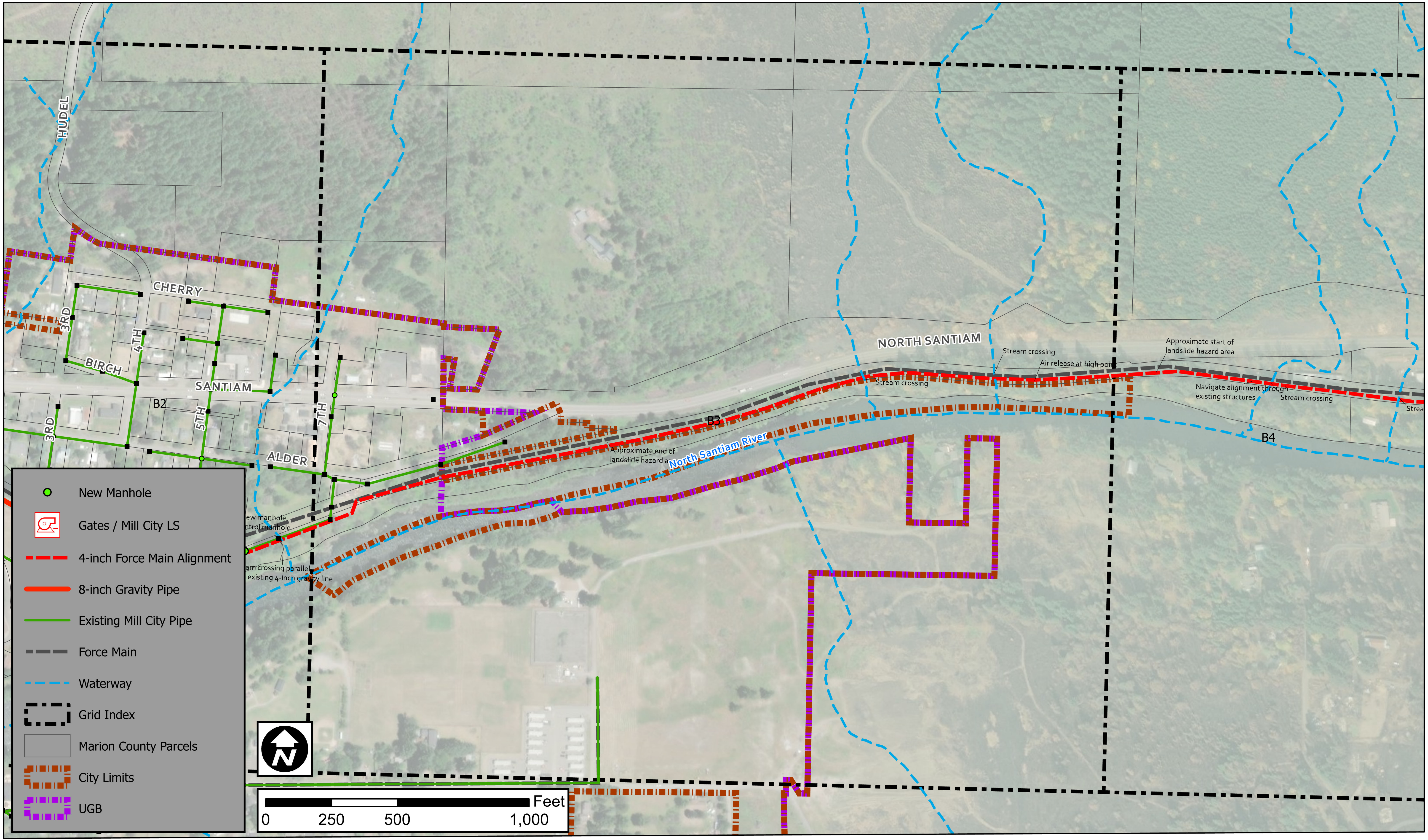
Gates to Mill City Force Main Alignment

Mill City / Gates WWFPS

North Santiam
Sewer Authority

Page Name: B4

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\ArcGIS Pro Maps\MCG Model R



●	New Manhole
	Gates / Mill City LS
	4-inch Force Main Alignment
	8-inch Gravity Pipe
	Existing Mill City Pipe
	Force Main
	Waterway
	Grid Index
▭	Marion County Parcels
	City Limits
	UGB

KELLER ASSOCIATES

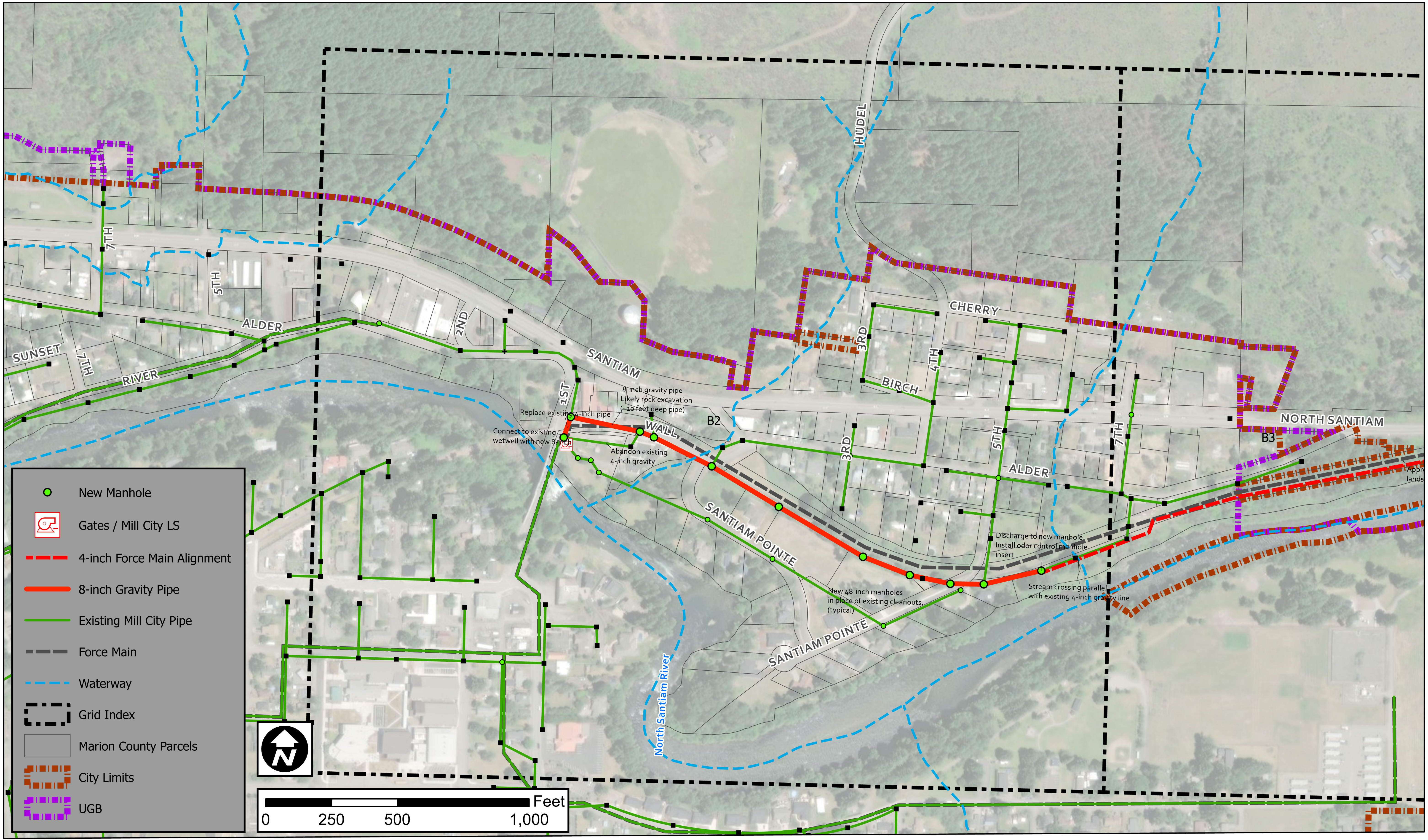
Gates to Mill City Force Main Alignment

Mill City / Gates WWFPS

North Santiam Sewer Authority

Page Name: B3

Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\zGIS\b_MXDs\ArcGIS Pro Maps\MCG Model R



KELLER ASSOCIATES

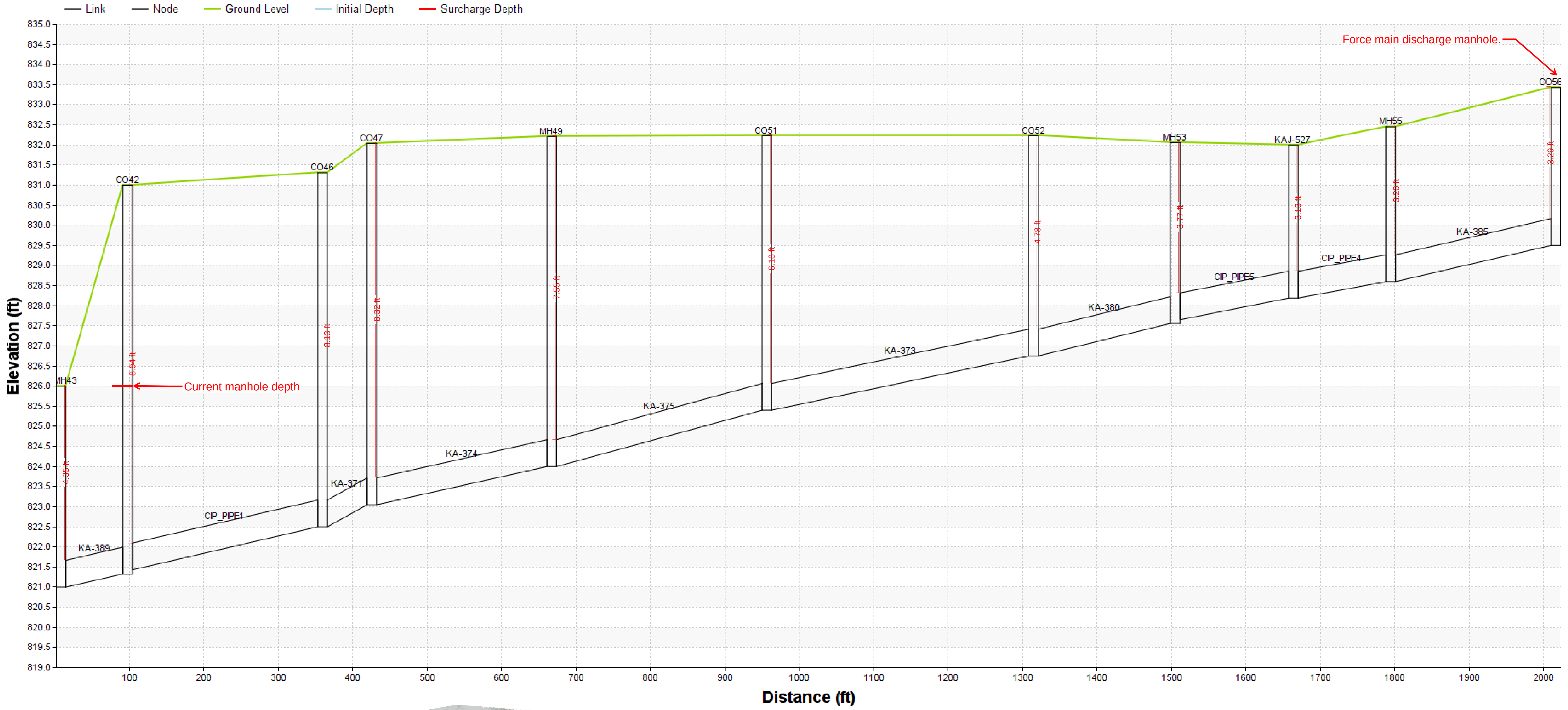
Gates to Mill City Force Main Alignment

Mill City / Gates WWFPS

North Santiam Sewer Authority

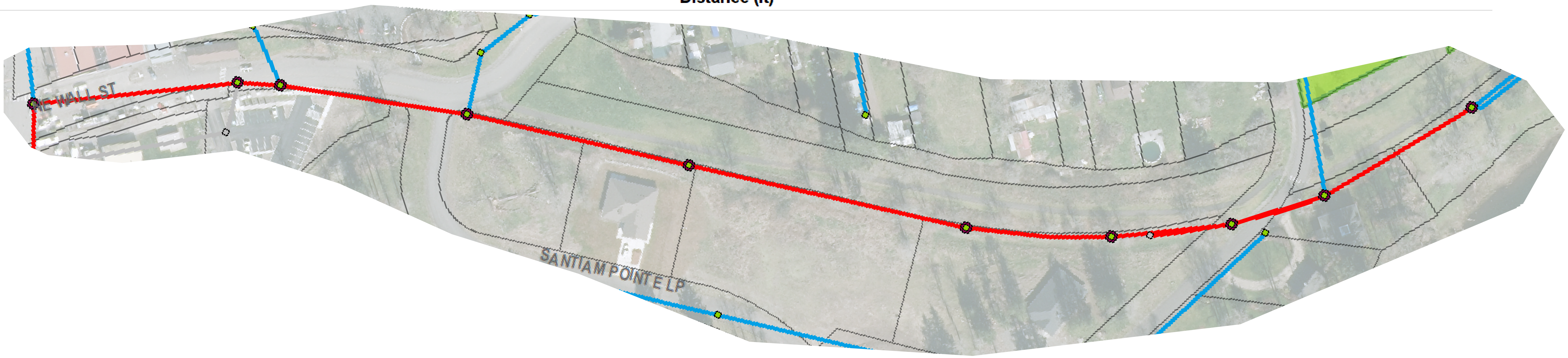
Page Name: B2

Mill City new 8-inch gravity line profile

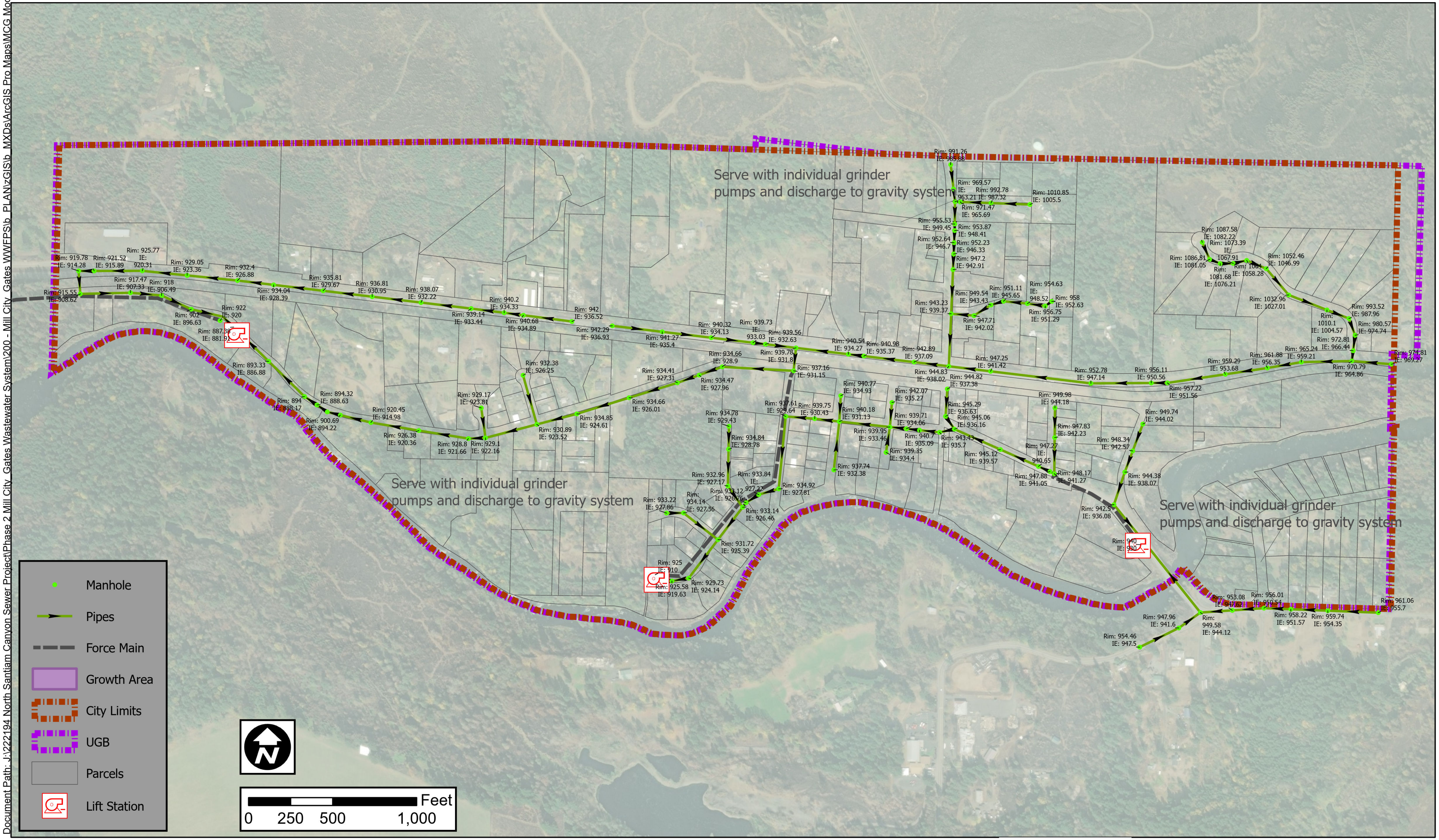


Current manhole depth

Force main discharge manhole.



Document Path: J:\222194 North Santiam Canyon Sewer Project\Phase 2 Mill City_Gates Wastewater System\200 - Mill City_Gates WWFPS\b_PLAN\z_GIS\b_MXDs\ArcGIS Pro Maps\MCG Model R



KELLER ASSOCIATES

Gates System Layout

Mill City / Gates WWFPS

NSSA
North Santiam Sewer Authority

Years	2023								2024												2025												2026											
Quarters	Q2		Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4		
Months	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Engineering Schedule				CM/GC Contract				WWFPS	30% Design							60% Design						90% Design																						
CM/GC Milestones																		GMP Execution																						Substantial Completion				Final Completion	
Preconstruction					Initial Cost Estimates			Alternatives Analysis and Constructability Reviews							Develop GMP		GMP Approval																											
Financial Reviews											Financial Viability Evaluation										Value Engineering, Construciton Cost			Submittals		Value Engineering, Construciton Cost																		
Long-Lead Equipment															Release LLE	Submittals			Equipment Delivered																									
Treatment Plant																							Civil & Structural										Mechanical and Electrical						C&SU		Operations Training and Support			
Outfall Pipeline																										Outfall Pipeline																		
Infiltration Basin																										Infiltration Basins																		
Gates Pump Station																													Gates Pump Station															
Force Main to Mill City																													Sewer Main to Mill City															
Gates Collection System																	Public Outreach																											
																																	Gates Sewer Main								Connections			

KELLER ASSOCIATES

Mill City and Gates Preliminary Project Schedule

Mill City / Gates WWFPS

North Santiam Sewer Authority

Mill City / Gates
Wastewater Facility Planning Study

Alder Street Upsizing

Priority Project 2.1

Location: Alder Street

General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2022 Dollars)
Goods and Services					
8-inch Pipe - Excavation, Backfill	1,000	LF	$ 170	$ 170,000	
48-Inch, Concrete Manhole	6	EA	$ 7,900	$ 47,400	
Connect to Existing Manhole	1	EA	$ 4,000	$ 4,000	
Reconnect Services (existing)	5	EA	$ 1,000	$ 5,000	
Roadway Restoration (Full Lane)	1,000	LF	$ 93	$ 93,100	
Traffic Control w/o Flaggers	1,000	LF	$ 10	$ 10,000	
Bypass Pumping	1	LS	$ 25,000	$ 25,000	
				Construction Subtotal	***$ 354,500***
Additional Elements (estimated % of above)					
Mobilization and Administration			10%	$ 35,000	
Bonding			2.5%	$ 9,000	
Contractor Overhead and Profit			15%	$ 53,000	
Prevailing Wages			0%	$ -	
Contingency			30%	$ 106,000	
				Total Construction Subtotal	***$ 558,000***
Plans and Contract Documents					
Engineering Design and Bid Phase Services			15%	$ 84,000	
Engineering - Construction Contract Administration			5%	$ 28,000	
Engineering -- Inspection			8%	$ 45,000	
Geotechnical Investigation			LS	$ 15,000	
SCADA Integration			LS	$ -	
Surveying			LS	$ 10,000	
Environmental & Permitting			LS	$ -	
Legal, Administrative, and Funding			2%	$ 11,000	
				Total Project Costs (rounded)	**$ 760,000**

EA = each, LF = linear foot, LS = lump sum

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the cost presented herein.

Spring Street Lift Station Upsizing
Priority Project 3.1

Location: Spring Street Lift Station

General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2022 Dollars)
Goods and Services					
Spring Street Pump Upsize	2	EA	$ 35,000	$ 70,000	
Spring Street Electrical Upgrades	1	LS	$ 40,000	$ 40,000	
				Construction Subtotal	***$ 110,000***
Additional Elements (estimated % of above)					
Mobilization and Administration			10%	$ 11,000	
Bonding			2.5%	$ 3,000	
Contractor Overhead and Profit			15%	$ 17,000	
Prevailing Wages			0%	$ -	
Contingency			30%	$ 33,000	
				Total Construction Subtotal	***$ 174,000***
Plans and Contract Documents					
Engineering Design and Bid Phase Services			15%	$ 26,000	
Engineering - Construction Contract Administration			5%	$ 9,000	
Engineering -- Inspection			8%	$ 14,000	
Geotechnical Investigation			LS	$ -	
SCADA Integration			LS	$ 15,000	
Surveying			LS	$ -	
Environmental & Permitting			LS	$ -	
Legal, Administrative, and Funding			2%	$ 3,000	
				Total Project Costs (rounded)	**$ 250,000**

EA = each, LF = linear foot, LS = lump sum
The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the cost presented herein.

Spring Street Basin Trunkline Upsize

Priority Project 3.2

Location: Kingwood Ave and High Street

General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2022 Dollars)
Goods and Services					
6-inch Pipe - Excavation, Backfill	1,400	LF	$ 160	$ 224,000	
8-inch Pipe - Excavation, Backfill	850	LF	$ 170	$ 144,500	
48-Inch, Concrete Manhole	10	EA	$ 7,900	$ 79,000	
Connect to Existing Manhole	2	EA	$ 4,000	$ 8,000	
Reconnect Services (existing)	21	EA	$ 1,000	$ 21,000	
Roadway Restoration (Full Lane)	2,250	LF	$ 93	$ 209,500	
Traffic Control w/o Flaggers	2,250	LF	$ 10	$ 22,500	
Bypass Pumping	1	LS	$ 25,000	$ 25,000	
				Construction Subtotal	***$ 733,500***
Additional Elements (estimated % of above)					
Mobilization and Administration			10%	$ 73,000	
Bonding			2.5%	$ 18,000	
Contractor Overhead and Profit			15%	$ 110,000	
Prevailing Wages			0%	$ -	
Contingency			30%	$ 220,000	
				Total Construction Subtotal	***$ 1,155,000***
Plans and Contract Documents					
Engineering Design and Bid Phase Services			15%	$ 173,000	
Engineering - Construction Contract Administration			5%	$ 58,000	
Engineering -- Inspection			8%	$ 92,000	
Geotechnical Investigation			LS	$ 20,000	
SCADA Integration			LS	$ -	
Surveying			LS	$ 22,500	
Environmental & Permitting			LS	$ -	
Legal, Administrative, and Funding			2%	$ 23,000	
				Total Project Costs (rounded)	**$ 1,550,000**

EA = each, LF = linear foot, LS = lump sum

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the cost presented herein.

Remine Road Collection System

Priority Project 3.3

Location: Remine Road

General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2022 Dollars)
Goods and Services					
8-inch Pipe - Excavation, Backfill	6,500	LF	$ 170	$ 1,105,000	
48-Inch, Concrete Manhole	22	EA	$ 7,900	$ 173,800	
Roadway Restoration (Full Lane)	6,500	LF	$ 93	$ 605,200	
4-inch Pressure Pipe - Excavation, Backfill	2,400	LF	$ 100	$ 240,000	
Remine Road Lift Station (Wetwell, pumps, valves, electrical)	1	LS	$ 500,000	$ 500,000	
				Construction Subtotal	***$ 2,624,000***
Additional Elements (estimated % of above)					
Mobilization and Administration			10%	$ 262,000	
Bonding			2.5%	$ 66,000	
Contractor Overhead and Profit			15%	$ 394,000	
Prevailing Wages			0%	$ -	
Contingency			30%	$ 787,000	
				Total Construction Subtotal	***$ 4,133,000***
Plans and Contract Documents					
Engineering Design and Bid Phase Services			15%	$ 620,000	
Engineering - Construction Contract Administration			5%	$ 207,000	
Engineering -- Inspection			8%	$ 331,000	
Geotechnical Investigation			LS	$ 20,000	
SCADA Integration			LS	$ 20,000	
Surveying			LS	$ 65,220	
Environmental & Permitting			LS	$ -	
Legal, Administrative, and Funding			2%	$ 83,000	
				Total Project Costs (rounded)	**$ 5,480,000**

EA = each, LF = linear foot, LS = lump sum

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the cost presented herein.

APPENDIX H

Current WPCF Influent Analysis

WATERLAB CORP.

2603 - 12th Street, SE
Salem, OR 97302
Voice: (503) 363-0473
FAX: (503) 363-8900

TEST REPORT

TO: City of Mill City c/o City Recorder
P. O. Box 256
Mill City, OR 97360

05/09/2023

CITMILC

PO#:

Collection Information

Date: 05/02/2023
Time: 0900
By: Russ
Lab #: 20230502-095
Location: 360 Remine Rd Mill City INF

Lab Receipt Information

05/02/2023
1045
SW

Case Narrative

The analyses were performed according to the guidelines in the WATERLAB Corp Quality Assurance Program. This report contains analytical results for the sample(s) as received by the laboratory.

Analyte	Method	Acc*	Results	Qual	MRL	Units	EPA Limit	Analysis Date Time	Tech
Alkalinity, Total - 1927	SM2320 B		279.		10.	mg/l CaCO3		05/04/2023	AS
Bicarbonate Alkalinity	SM2320B		340.4		10	HC03		05/04/2023	AS
Hardness as CaCO3	SM2340C		86.		10.	mg/l CaCO3	250	05/04/2023	AS

ND- No Detection at @ MRL
SM-"Standard Methods for the Examination of Water & Wastewater",19th ed
EPA- "Methods for Chemical Analysis for Water and Wastes",USEPA
MRL-"Method Reporting Limit"
* Accreditation
A- Waterlab Corporation, ORELAP 100039
The results relate only to the parameters tested or to the sample as received by the laboratory.

This report shall not be reproduced except in full, without the written approval of Waterlab Corporation.

Approved by: ______________________

WATERLAB CORP.

2603 - 12th Street, SE
Salem, OR 97302
Voice: (503) 363-0473
FAX: (503) 363-8900

TEST REPORT

TO: City of Mill City c/o City Recorder
P. O. Box 256
Mill City, OR 97360

05/22/2023

CITMILC

PO#:

Collection Information

Date: 05/02/2023
Time: 0900
By: Russ
Lab #: 20230502-096
Location: 360 Remine Rd Mill City Inf

Lab Receipt Information

05/02/2023
1045
SW

Case Narrative

The analyses were performed according to the guidelines in the WATERLAB Corp Quality Assurance Program. This report contains analytical results for the sample(s) as received by the laboratory.

Analyte	Method	Acc*	Results	Qual	MRL	Units	Analysis Date Time		Tech
Inorganic Chemicals									
Antimony	SM3113B		ND		0.005	mg/l	05/12/2023		bem
Arsenic	SM3113B		ND		0.002	mg/l	05/08/2023		bem
Barium	SM3113B	B	0.0109		0.0005	mg/l	05/12/2023	1515	cbb
Beryllium	SM3113B		ND		0.001	mg/l	06/05/2023		bem
Cadmium	SM3113B		ND		0.001	mg/l	05/11/2023		bem
Chromium	SM3113B		ND		0.02	mg/l	05/09/2023		bem
Fluoride	EPA300.0		7.41		0.2	mg/l	05/02/2023		bem
Lead	SM3113 B		ND		0.001	mg/l	05/15/2023		bem
Mercury	SM3112B		ND		0.001	mg/l	05/17/2023		bem

ND- No Detection at @ MRL
SM-"Standard Methods for the Examination of Water & Wastewater",19th ed
EPA- "Methods for Chemical Analysis for Water and Wastes",USEPA
MRL-"Method Reporting Limit"
* Accreditation
A- Waterlab Corporation, ORELAP 100039
The results relate only to the parameters tested or to the sample as received by the laboratory.

This report shall not be reproduced except in full, without the written approval of Waterlab Corporation.
B=Neilson Research Corporation, ORELAP ID#OR100016

Approved by: ____________________

TEST REPORT

							Analysis		
Analyte	**Method**	**Acc***	**Results**	**Qual**	**MRL**	**Units**	**Date**	**Time**	**Tech**
Nickel	SM3113B		ND		0.05	mg/l	05/09/2023		bem
Nitrogen, Nitrate	EPA300.0		ND		0.2	mg/l N	05/02/2023	1640	as
Nitrogen, Nitrite	EPA300.0		ND		0.2	mg/l N	05/02/2023	1640	as
Selenium	SM3113B		ND		0.005	mg/l	05/12/2023		bem
Sodium	SM3111B		50.2		1.0	mg/l	05/09/2023		as
Thallium	SM3113B		ND		0.001	mg/l	05/11/2023		bem
Aluminum	SM3113B		0.275		0.050	mg/l	05/30/2023		bem
Copper	SM3113 B		ND		0.002	mg/l	05/31/2023		bem
Iron	SM3111B		0.286		0.1	mg/l	05/31/2023		as
Manganese	SM3111B		ND		0.05	mg/l	05/31/2023		as
Silver	SM3113B		ND		0.01	mg/l	05/22/2023		bem
Zinc	SM3111 B		0.0547		0.01	mg/l	05/31/2023		bem

ND- No Detection at @ MRL
SM-"Standard Methods for the Examination of Water & Wastewater",19th ed
EPA- "Methods for Chemical Analysis for Water and Wastes",USEPA
MRL-"Method Reporting Limit"
* Accreditation
A- Waterlab Corporation, ORELAP 100039
The results relate only to the parameters tested or to the sample as received by the laboratory.

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B=Neilson Research Corporation, ORELAP ID#OR100016

Approved by: ____________________

ANALYTICAL SUMMARY REPORT

June 09, 2023

Waterlab Corp
2603 12th St SE
Salem, OR 97302-2154

Work Order: C23050297

Project Name: Mill City WWTP

Energy Laboratories, Inc. Casper WY received the following 1 sample for Waterlab Corp on 5/8/2023 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C23050297-001	20230502-094 Mill City WWTP	05/02/23 8:30	05/08/23	Waste Water	Metals by ICP/ICPMS, Drinking Water Metals Preparation by EPA 200.2 Gross Alpha, Gross Beta, Total Radium 226 + Radium 228, Total Radium 226, Total Radium 228, Total

The analyses presented in this report were performed by Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601, unless otherwise noted. Any exceptions or problems with the analyses are noted in the report package. Any issues encountered during sample receipt are documented in the Work Order Receipt Checklist.

The results as reported relate only to the item(s) submitted for testing. This report shall be used or copied only in its entirety. Energy Laboratories, Inc. is not responsible for the consequences arising from the use of a partial report.

If you have any questions regarding these test results, please contact your Project Manager .

Report Approved By:

Ashley Wilson
Project Manager

Digitally signed by
Ashley L. Wilson
Date: 2023.06.09 14:46:22 -06:00

CLIENT: Waterlab Corp
Project: Mill City WWTP
Work Order: C23050297

Report Date: 06/09/23

CASE NARRATIVE

ENERGY LABORATORIES, INC. - CASPER,WY certifies that certain method selections contained in this report meet requirements as set forth by the above accrediting authorities. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative. Please verify ELI's certification coverage by visiting www.energylab.com.

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Waterlab Corp
Project: Mill City WWTP
Lab ID: C23050297-001
Client Sample ID: 20230502-094 Mill City WWTP

Report Date: 06/09/23
Collection Date: 05/02/23 08:30
DateReceived: 05/08/23
Matrix: Waste Water

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
RADIONUCLIDES - TOTAL							
Uranium	ND	mg/L		0.0003	0.03	E200.8	05/17/23 04:23 / eli-b
Uranium, Activity	ND	pCi/L		0.2		E200.8	05/17/23 04:23 / eli-b
RADIONUCLIDES, TOTAL							
Gross Alpha	-5	pCi/L	U			E900.0	05/27/23 02:30 / haw
Gross Alpha precision (±)	1.7	pCi/L				E900.0	05/27/23 02:30 / haw
Gross Alpha MDC	3.1	pCi/L				E900.0	05/27/23 02:30 / haw
Gross Beta	14.8	pCi/L				E900.0	05/27/23 02:30 / haw
Gross Beta precision (±)	3.1	pCi/L				E900.0	05/27/23 02:30 / haw
Gross Beta MDC	3.9	pCi/L				E900.0	05/27/23 02:30 / haw
Radium 226	-0.05	pCi/L	U			E903.0	05/23/23 11:12 / kdk
Radium 226 precision (±)	0.2	pCi/L				E903.0	05/23/23 11:12 / kdk
Radium 226 MDC	0.3	pCi/L				E903.0	05/23/23 11:12 / kdk
Radium 228	2.5	pCi/L				RA-05	05/18/23 13:08 / trs
Radium 228 precision (±)	1.1	pCi/L				RA-05	05/18/23 13:08 / trs
Radium 228 MDC	1.6	pCi/L				RA-05	05/18/23 13:08 / trs
Radium 226 + Radium 228	2.6	pCi/L				A7500-RA	05/24/23 12:54 / dmf
Radium 226 + Radium 228 precision (±)	1.1	pCi/L				A7500-RA	05/24/23 12:54 / dmf
Radium 226 + Radium 228 MDC	1.6	pCi/L				A7500-RA	05/24/23 12:54 / dmf

Report Definitions:

RL - Analyte Reporting Limit
QCL - Quality Control Limit
U - Not detected at Minimum Detectable Concentration (MDC)
MCL - Maximum Contaminant Level
ND - Not detected at the Reporting Limit (RL)

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Waterlab Corp **Work Order:** C23050297 **Report Date:** 05/17/23

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8							Analytical Run: ICPMS207-B_230515A			
Lab ID: QCS		Initial Calibration Verification Standard								05/17/23 02:09
Uranium		0.0476	mg/L	0.00030	95	90	110			
Lab ID: CCV		Continuing Calibration Verification Standard								05/17/23 03:40
Uranium		0.0476	mg/L	0.00030	95	90	110			
Method: E200.8										Batch: 178689
Lab ID: MB-178689	2	Method Blank				Run: ICPMS207-B_230515A				05/17/23 02:58
Uranium		0.00003	mg/L	0.00002						
Uranium, Activity		0.02	pCi/L	0.01						
Lab ID: LCS4-178689		Laboratory Control Sample				Run: ICPMS207-B_230515A				05/17/23 03:04
Uranium		0.0932	mg/L	0.00030	93	85	115			
Lab ID: B23050597-001AMS4		Sample Matrix Spike				Run: ICPMS207-B_230515A				05/17/23 03:58
Uranium		0.0960	mg/L	0.00030	95	70	130			
Lab ID: B23050597-001AMSD		Sample Matrix Spike Duplicate				Run: ICPMS207-B_230515A				05/17/23 04:04
Uranium		0.102	mg/L	0.00030	101	70	130	6.0	20	

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Waterlab Corp **Work Order:** C23050297 **Report Date:** 06/01/23

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **E900.0**										Batch: GrAB-3184
Lab ID: **Th230-GrAB-3184**	3	Laboratory Control Sample			Run: G542M-2_230523A					05/27/23 02:30
Gross Alpha		98	pCi/L		98	70	130			
Gross Alpha precision (±)		20	pCi/L							
Gross Alpha MDC		3.8	pCi/L							
Lab ID: **Sr90-GrAB-3184**	3	Laboratory Control Sample			Run: G542M-2_230523A					05/27/23 02:30
Gross Beta		550	pCi/L		115	70	130			
Gross Beta precision (±)		56	pCi/L							
Gross Beta MDC		3.6	pCi/L							
Lab ID: **MB-GrAB-3184**	6	Method Blank			Run: G542M-2_230523A					05/27/23 02:30
Gross Alpha		-5	pCi/L							U
Gross Alpha precision (±)		2	pCi/L							
Gross Alpha MDC		3	pCi/L							
Gross Beta		-4	pCi/L							U
Gross Beta precision (±)		2	pCi/L							
Gross Beta MDC		4	pCi/L							
Lab ID: **C23050241-001AMS**	3	Sample Matrix Spike			Run: G542M-2_230523A					05/27/23 02:30
Gross Alpha		350	pCi/L		87	70	130			
Gross Alpha precision (±)		72	pCi/L							
Gross Alpha MDC		16	pCi/L							
Lab ID: **C23050241-001AMSD**	3	Sample Matrix Spike Duplicate			Run: G542M-2_230523A					05/27/23 02:30
Gross Alpha		400	pCi/L		99	70	130	12	30	
Gross Alpha precision (±)		81	pCi/L							
Gross Alpha MDC		18	pCi/L							
- The RER result is 0.42.										
Lab ID: **C23050585-010AMS1**	3	Sample Matrix Spike			Run: G542M-2_230523A					05/31/23 08:46
Gross Beta		3800	pCi/L		118	70	130			
Gross Beta precision (±)		380	pCi/L							
Gross Beta MDC		19	pCi/L							
Lab ID: **C23050585-010AMSD**	3	Sample Matrix Spike Duplicate			Run: G542M-2_230523A					05/31/23 08:46
Gross Beta		3700	pCi/L		115	70	130	3.1	30	
Gross Beta precision (±)		370	pCi/L							
Gross Beta MDC		20	pCi/L							
- The RER result is 0.22.										

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

U - Not detected at Minimum Detectable Concentration (MDC)

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Waterlab Corp **Work Order:** C23050297 **Report Date:** 06/01/23

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E903.0										Batch: RA226-10894
Lab ID: LCS-RA226-10894	3	Laboratory Control Sample				Run: TENNELEC-3_230512B				05/23/23 11:12
Radium 226		11	pCi/L		114	70	130			
Radium 226 precision (±)		2.3	pCi/L							
Radium 226 MDC		0.22	pCi/L							
Lab ID: MB-RA226-10894	3	Method Blank				Run: TENNELEC-3_230512B				05/23/23 11:12
Radium 226		0.1	pCi/L							U
Radium 226 precision (±)		0.2	pCi/L							
Radium 226 MDC		0.2	pCi/L							
Lab ID: C23050423-001FDUP	3	Sample Duplicate				Run: TENNELEC-3_230512B				05/23/23 11:12
Radium 226		1.9	pCi/L					5.6	30	
Radium 226 precision (±)		0.48	pCi/L							
Radium 226 MDC		0.23	pCi/L							

- The RER result is 0.15.

Qualifiers:

RL - Analyte Reporting Limit

U - Not detected at Minimum Detectable Concentration (MDC)

ND - Not detected at the Reporting Limit (RL)

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Waterlab Corp **Work Order:** C23050297 **Report Date:** 06/01/23

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **RA-05**									Batch: RA228-7094	
Lab ID: **LCS-228-RA226-10894**	3	Laboratory Control Sample				Run: TENNELEC-3_230512A			05/18/23 13:08	
Radium 228		5.7	pCi/L		81	70	130			
Radium 228 precision (±)		1.4	pCi/L							
Radium 228 MDC		1.2	pCi/L							
Lab ID: **MB-RA226-10894**	3	Method Blank				Run: TENNELEC-3_230512A			05/18/23 13:08	
Radium 228		2	pCi/L							
Radium 228 precision (±)		0.8	pCi/L							
Radium 228 MDC		1	pCi/L							
Lab ID: **C23050423-001FDUP**	3	Sample Duplicate				Run: TENNELEC-3_230512A			05/18/23 13:08	
Radium 228		2.2	pCi/L					11	30	
Radium 228 precision (±)		0.91	pCi/L							
Radium 228 MDC		1.3	pCi/L							

- The RER result is 0.19.

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

Work Order Receipt Checklist

Waterlab Corp C23050297

Login completed by: Hannah R. Johnson
Reviewed by: cjohnson
Reviewed Date: 5/10/2023

Date Received: 5/8/2023
Received by: cch
Carrier name: UPS

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	12.8°C No Ice		
Containers requiring zero headspace have no headspace or bubble that is <6mm (1/4").	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

The reference date for Radon analysis is the sample collection date. The reference date for all other Radiochemical analyses is the analysis date. Radiochemical precision results represent a 2-sigma Total Measurement Uncertainty.

Contact and Corrective Action Comments:

The sample collection time indicated on the COC is 09:00, the collection time listed on the sample bottles is 08:30, Beth requested we use the collection time on the sample bottles-Chantel S. Johnson

ENERGY LABORATORIES
Trust our People. Trust our Data.

Chain of Custody & Analytical Request Record

www.energylab.com

Page 1 of 1

Account Information (Billing Information)

Company/Name: Waterlab Corp
Contact: Beth Myers
Phone: 503-363-0473
Mailing Address: 2603 12th St SE
City, State, Zip: Salem, OR 97302
Email: beth@waterlabcorp.com
Receive Invoice: ☐Hard Copy ☒Email
Receive Report: ☐Hard Copy ☒Email
Purchase Order:
Quote:
Bottle Order:

Report Information (If different than Account Information)

Company/Name:
Contact: Beth Myers
Phone:
Mailing Address:
City, State, Zip:
Email: beth@waterlabcorp.com
Receive Report: ☐Hard Copy ☒Email
Special Report/Formats: ☐LEVEL IV ☒NELAC ☐EDD/EDT (contact laboratory) ☐Other

Comments

Please do not return cooler !!!!!!!!

Project Information

Project Name, PWSID, Permit, etc. Mill City WWTP
Sampler Name:
Sampler Phone: (503) 363-0473
Sample Origin State: Oregon
EPA/State Compliance: ☐Yes ☒No
MINING CLIENTS, please indicate sample type.
*If ore has been processed or refined, call before sending.
☐ Byproduct 11 (e)2 material ☐ Unprocessed ore (NOT ground or refined)*

Matrix Codes
A - Air
W - Water
S - Soils/Solids
V - Vegetation
B - Bioassay
O - Other
DW - Drinking Water

All turnaround times are standard unless marked as RUSH.
Energy Laboratories MUST be contacted prior to RUSH sample submittal for charges and scheduling – See Instructions Page

Analysis Requested

	Sample Identification (Name, Location, Interval, etc.) SW	Collection Date	Collection Time	Number of Containers	Matrix (See Codes Above)	Gross Alpha	Radium 226/228	Uranium	Gross Beta						See Attached	RUSH TAT	ELI LAB ID Laboratory Use Only
1	20230502-094 Mill City WWTP	5/2/23	9:00 am	4	W ☒	✓	✓	✓	✓								C23050221
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Custody Record MUST be signed

Relinquished by (print): April Stratton	Date/Time: 5/2/23 1600	Signature: April Stratton	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by Laboratory (print): Chance Hancock	Date/Time: 5-8-23 9am	Signature:

LABORATORY USE ONLY

Shipped By	Cooler ID(s)	Custody Seals Y N C B	Intact Y N	Receipt Temp °C	Temp Blank Y N	On Ice Y N	Payment Type CC Cash Check	Amount $	Receipt Number (cash/check only)

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All subcontracted data will be clearly notated on your analytical report.

WATERLAB CORP.

2603 - 12th Street, SE
Salem, OR 97302
Voice: (503) 363-0473
FAX: (503) 363-8900

TEST REPORT

TO: City of Mill City c/o City Recorder
P. O. Box 256
Mill City, OR 97360

05/22/2023

CITMILC

PO#:

Collection Information

Date: 05/02/2023
Time: 0900
By: Russ
Lab #: 20230502-097
Location: 360 Remine Rd. Mills City/ Influent

Lab Receipt Information

05/02/2023
1045
SW

Case Narrative

The analyses were performed according to the guidelines in the WATERLAB Corp Quality Assurance Program. This report contains analytical results for the sample(s) as received by the laboratory.

Analyte	Method	Acc*	Results	Qual	MRL	Units	Analysis Date	Time	Tech
Synthetic Organic Contaminants									
Synthetic Organics, Regulated									
1,2-Dibromo-3-chloropropane	EPA 504.1	B	ND		0.0000	mg/liter	05/04/2023	2017	TJW
Ethylene Dibromide	EPA 504.1	B	ND		0.0000	mg/liter	05/04/2023	2017	TJW
Chlordane	EPA 508	B	ND		0.0002	mg/liter	05/10/2023	0806	TJW
Endrin	EPA 508	B	ND		0.00001	mg/liter	05/10/2023	0806	TJW
BHC-Gamma Lindane	EPA 508	B	ND		0.00001	mg/liter	05/10/2023	0806	TJW

ND- No Detection at @ MRL
SM-"Standard Methods for the Examination of Water & Wastewater",19th ed
EPA- "Methods for Chemical Analysis for Water and Wastes",USEPA
MRL-"Method Reporting Limit"
* Accreditation
A- Waterlab Corporation, ORELAP 100039
The results relate only to the parameters tested or to the sample as received by the laboratory.

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B=Neilson Research Corporation, ORELAP ID#OR100016

Approved by: ______________________

TEST REPORT

							Analysis		
Analyte	**Method**	**Acc***	**Results**	**Qual**	**MRL**	**Units**	**Date**	**Time**	**Tech**
Heptachlor	EPA 508	B	ND		0.00001	mg/liter	05/10/2023	0806	TJW
Heptachlor Epoxide	EPA 508	B	ND		0.00001	mg/liter	05/10/2023	0806	TJW
Methoxychlor	EPA 508	B	ND		0.0000	mg/liter	05/10/2023	0806	TJW
Polychlorinated Biphenyls	EPA 508	B	ND		0.0002	mg/liter	05/10/2023	0806	TJW
Toxaphene	EPA 508	B	ND		0.0003	mg/liter	05/10/2023	0806	TJW
2,4,5-TP Silvex	EPA 515.3	B	ND		0.005	mg/liter	05/16/2023	0026	TJW
Dalapon	EPA 515.3	B	ND		0.005	mg/liter	05/16/2023	0026	TJW
Dinoseb	EPA 515.3	B	ND		0.001	mg/liter	05/16/2023	0026	TJW
Pentachlorophenol	EPA 515.3	B	ND		0.0005	mg/liter	05/16/2023	0026	TJW
Picloram	EPA 515.3	B	ND		0.005	mg/liter	05/16/2023	0026	TJW
Alachlor	EPA 525.2	B	ND		0.0002	mg/liter	05/18/2023	1628	TJW
Atrazine	EPA 525.2	B	ND		0.0003	mg/liter	05/18/2023	1628	TJW
Benzo(a)pyrene	EPA 525.2	B	ND		0.0001	mg/liter	05/18/2023	1628	TJW
Bis(2-ethylhexyl)phthalate	EPA 525.2	B	0.00901		0.002	mg/liter	05/18/2023	1628	TJW
Bis(2-ethylhexyl)adipate	EPA 525.2	B	ND		0.004	mg/liter	05/18/2023	1628	TJW
Hexachlorobenzene	EPA 525.2	B	ND		0.0003	mg/liter	05/18/2023	1628	TJW
Hexachlorocyclopentadiene	EPA 525.2	B	ND		0.005	mg/liter	05/18/2023	1628	TJW
Simazine	EPA 525.2	B	ND		0.0004	mg/liter	05/18/2023	1628	TJW
Carbofuran	EPA 531.2	B	ND		0.004	mg/liter	05/03/2023	1809	TJW
Vydate	EPA 531.2	B	ND		0.004	mg/liter	05/03/2023	1809	TJW
Endothall	EPA 548.1	B	ND		0.01	mg/liter	05/17/2023	1726	TJW
Diquat	EPA 549.2	B	ND		0.01	mg/liter	05/11/2023	1548	TJW
2,4-D	EPA 515.3	B	ND		0.002	mg/liter	05/16/2023	0026	TJW

ND- No Detection at @ MRL
SM-"Standard Methods for the Examination of Water & Wastewater",19th ed
EPA- "Methods for Chemical Analysis for Water and Wastes",USEPA
MRL-"Method Reporting Limit"
* Accreditation
A- Waterlab Corporation, ORELAP 100039
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Approved by: ____________________

2603 - 12th Street, SE
Salem, OR 97302
Voice: (503) 363-0473
FAX: (503) 363-8900

TEST REPORT

LAB # : 20230502-097 (Cont) CITMILC Page: 3

Analyte	Method	Acc*	Results	Qual	MRL	Units	Analysis Date Time		Tech
Glyphosate	EPA 547	B	ND		0.05	mg/liter	05/08/2023	1220	TJW

ND- No Detection at @ MRL
SM-"Standard Methods for the Examination of Water & Wastewater",19th ed
EPA- "Methods for Chemical Analysis for Water and Wastes",USEPA
MRL-"Method Reporting Limit"
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Approved by: ______________________

WATERLAB CORP.

2603 - 12th Street, SE
Salem, OR 97302
Voice: (503) 363-0473
FAX: (503) 363-8900

TEST REPORT

TO: City of Mill City c/o City Recorder
P. O. Box 256
Mill City, OR 97360

05/22/2023

CITMILC

PO#:

Collection Information

Date: 05/02/2023
Time: 0900
By: Russ

Lab #: 20230502-098
Location: 360 Remine Rd. Mills City/ Influent

Lab Receipt Information

05/02/2023
1045
SW

Case Narrative

The analyses were performed according to the guidelines in the WATERLAB Corp Quality Assurance Program. This report contains analytical results for the sample(s) as received by the laboratory.

Analyte	Method	Acc*	Results	Qual	MRL	Units	Analysis Date	Time	Tech
Volatile Organics, Regulated									
1,1,1-Trichloroethane	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
1,1,2-Trichloroethane	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
1,1-Dichloroethylene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
1,2,4-Trichlorobenzene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
1,2-Dichloroethane	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
1,2-Dichloropropane	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Benzene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW

ND- No Detection at @ MRL
SM-"Standard Methods for the Examination of Water & Wastewater",19th ed
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Approved by: Bettie E. Myers

TEST REPORT

							Analysis		
Analyte	**Method**	**Acc***	**Results**	**Qual**	**MRL**	**Units**	**Date**	**Time**	**Tech**
Carbon Tetrachloride	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
cis-1,2-Dichloroethylene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Dichloromethane	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Ethylbenzene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Monochlorobenzene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
o-Dichlorobenzene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
p-Dichlorobenzene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Styrene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Tetrachloroethylene (PCE)	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Toluene	E524.2	B	0.0496		0.0005	mg/liter	05/05/2023	0024	TJW
trans-1,2-Dichloroethylene	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Trichloroethylene (TCE)	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Vinyl Chloride	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW
Xylenes, Total	E524.2	B	ND		0.0005	mg/liter	05/05/2023	0024	TJW

ND- No Detection at @ MRL
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Approved by: Bitti E. Myers

APPENDIX I

GSI Reports

TECHNICAL MEMORANDUM

Gates/Mill City Shallow Soil Characterization and Infiltration Testing Results, Marion and Linn Counties, Oregon

To: Chris Einmo / Marion County

From: Matt Kohlbecker, RG / GSI Water Solutions, Inc.
Jason Keller, RG / GeoSystems Analysis, Inc.
Jesse Hall, GIT / GSI Water Solutions, Inc.

Cc: Peter Olsen / Keller Associates, Inc.
Pamela Villarreal / Keller Associates, Inc.
Brian Nicholas / Marion County
Dave Kinney / City of Mill City
Russ Foltz / City of Mill City
Kari Low / Commonstreet Consulting
Tamisha Schrunk / Commonstreet Consulting
Mary Camarata / Department of Environmental Quality

Date: June 23, 2023

EXP: 5/2024

This Technical Memorandum (TM), prepared by GSI Water Solutions, Inc. (GSI) and GeoSystems Analysis, Inc. (GSA), summarizes the first phase of a subsurface characterization to evaluate the feasibility of treated wastewater infiltration in Gates and Mill City, Oregon. This first phase focused on shallow soils, and consisted of excavating test pits in four study areas to classify soil types, conduct infiltration tests, and collect soil samples. The objective of the shallow subsurface characterization was to collect data that can be used to select three of the four study areas for a second phase, which is a deep soil characterization.

1. Introduction

The North Santiam Sewer Authority (NSSA) is planning to dispose of treated wastewater using infiltration basins. Two infiltration basins are planned—one in the Gates/Mill City area and another in the Detroit/Idanha area. The project will be authorized by a Water Pollution Control Facilities (WPCF) permit from the Oregon Department of Environmental Quality (DEQ).

In the Gates/Mill City area, four study areas were chosen to be assessed for potential infiltration basins: the Baughman-Lucas Site (GM1), the Shepherd Site (GM2), the 4th Ave Right of Way (ROW) Site (GM4), and the Weyerhaeuser Site (GM5) (see Figure 1). Because infiltration projects require characterization of subsurface soils to inform infiltration feasibility and basin design, it is necessary to characterize soil properties at each study area.

In March 2023, GSI and its teaming partner GSA conducted the first phase of subsurface soil characterization (referred as the “Gates/Mill City Phase I Subsurface Characterization” in this TM) in general accordance with the *Santiam Canyon Treated Wastewater Disposal - Subsurface Characterization Work Plan* (the Work Plan) (GSI and GSA, 2023). Specifically, GSI and GSA oversaw excavation of test pits in each study area (see Figures 2a through 2d) to measure soil infiltration rates, classify soil types, and collect samples for laboratory analysis. This TM summarizes methods (Section 2) and results (Section 3) of the Gates/Mill City Phase I Subsurface Characterization, describes a ranking system to evaluate the favorability of each study area for infiltration (Section 4), and provides conclusions and recommendations based on collected data and site ranking (Section 5).

2. Methods

This section describes the methods that were used during the Phase I Subsurface Characterization to: (1) locate utilities (Subsection 2.1), (2) excavate test pits, classify soil types, and collect soil samples (Subsection 2.2), and (3) conduct infiltration tests (Subsection 2.3).

2.1 Utility Locating

A total of 15 test pit locations were located and cleared for utilities in the study area by Pacific Northwest Locating, LLC on March 9th, 2023. The only utilities found near the proposed test pit locations were residential utility lines crossing 4th Ave approximately 10-feet north of the initially-proposed location for 4th Ave ROW Test Pit 1 (GM4-TP1)[1]. To remain clear of subsurface utilities, GM4-TP1 was relocated approximately 30-feet south of where this utility crosses 4th Ave (see Figure 2c).

2.2 Test Pit Excavation, Soil Logging, and Soil Sampling

Test pits were excavated by McKillip Excavation, Inc. using a John Deere 50G or a John Deere 85G excavator outfitted with a 36-inch or 24-inch bucket (the test pit logs in Attachment A indicate the type of excavator that was used for each test pit). Table 1 shows the dates test pits were excavated, the excavation depths, and the soil quality samples that were collected. GSI personnel continuously logged soils excavated from each pit in general accordance with the visual-manual method of the Unified Soil Classification System (USCS).

Soil samples were collected for analysis of soil physical properties (specific gravity and particle size distribution) and soil quality (a multi-residue pesticide screen):

- **Soils Physical Properties.** Samples were collected from each soil horizon in each test pit to represent the soil types that were encountered in the study area, and a subset of the samples was submitted to the GSA lab in Tucson, Arizona for specific gravity testing by ASTM D854-15 and particle size distribution analysis by ASTM D69-13-17 and ASTM D7928-17.
- **Soil Quality Samples.** Samples were collected at a depth of 5 feet below ground surface (bgs) and were submitted to Matrix Laboratories for multi-residue pesticide analysis using the Modified Environmental Protection Agency (EPA) Method 8270D and 8321B.

---

[1] According to the utility locator, the utility line was a residential gas line.

Table 1. Test Pit Depths, Soil Samples, and Infiltration Tests.

Test Pit ID	Date of Excavation	Test Pit Depth feet bgs	Soil Physical Properties[1] Sample ft bgs (analyses)	Infiltration Test[2] ft bgs (test type)	Soil Quality Sample [3] ft bgs (test type)
GM1-TP1	03/23/2023	12	--	--	5 feet (P)
GM1-TP2	03/23/2023	12	6 feet (PSD, SG)	2 feet (TI)	5 feet (P)
GM1-TP3	03/23/2023	11	5 feet (PSD, SG)	2 feet (CI)	5 feet (P)
GM1-TP4	03/23/2023	12	5 feet (PSD)	2 feet (CI) 3 feet (TI)	5 feet (P)
GM2-TP1	03/21/2023	13	--	2 feet (CI)	5 feet (P)
GM2-TP2	03/21/2023	13	--	2 feet (CI)	5 feet (P)
GM2-TP3	03/22/2023	13	--	No Test – Groundwater in Test Pit	5 feet (P)
GM2-TP4	03/22/2023	9	--	2 feet (CI)	5 feet (P)
GM4-TP1	03/20/2023	9	--	3 feet (CI)	5 feet (P)
GM4-TP2	03/20/2023	2	--	3 feet (CI)	--
GM4-TP3	03/20/2023	8	4.5 feet (PSD, SG) 6 feet (PSD)	2 feet (CI) 4.5 feet (TI)	5 feet (P)
GM5-TP1	03/21/2023	9	--	2 feet (CI)	5 feet (P)
GM5-TP2	03/22/2023	13	8 feet (PSD)	2 feet (CI)	5 feet (P)

Notes

(1) Soil physical properties include specific gravity (SG) and/or particle size distribution (PSD)
(2) CI – Single ring cylinder infiltrometer test; TI – Test pit infiltration test
(3) P – multi-residue pesticide analysis
(--) no sample collected or infiltration test performed
bgs = below ground surface ft = feet

2.3 Infiltration Testing

GSA conducted one or more infiltration tests at each test pit. A total of 13 infiltration tests were conducted with the purpose of targeting different soil units that were observed near the location of proposed infiltration basins. Ten infiltration tests were conducted using the single ring infiltrometer method with lateral divergence correction (Bouwer et al., 1999). Three infiltration tests were conducted using a modified test pit infiltration method with lateral divergence correction due to the soils having a large fraction of gravels, cobbles, and/or boulders that restricted the ability to create an adequate seal between the coarse clasts and the ring infiltrometer. For both methods, the lateral and vertical extent of the wetting front and ponding height were measured to calculate the effective saturated hydraulic conductivity (K) of the soil. Effective K values provide a good estimate of the potential infiltration rate in the absence of surface clogging and/or restricting or compacted layers present deeper in the profile (Bouwer et al., 1999; Rice et al., 2014). A technical memorandum prepared by GSA to document the methods and results of the infiltration testing is provided in Attachment B. Following infiltration testing, the test pits were backfilled with excavated soils and compacted by tamping down the soil with the bucket and tracks of the excavator.

3. Results

This section presents soil characterization and infiltration testing results, including: shallow geology (Subsection 3.1), effective saturated hydraulic conductivity measured during infiltration tests (Subsection 3.2), and soil sampling results (Subsection 3.3).

3.1 Shallow Geology

Shallow geology in the Gates/Mill City area varied between study areas. Test pit logs showing soil classifications are provided in Attachment A, and photologs of each test pit are provided in Attachment C. The following sections summarize the shallow geology at each study area.

3.1.1 Baughman Lucas Study Area (GM1) Shallow Geology

The Baughman-Lucas Study Area (GM1) is located near the City of Mill City, 0.25 miles south of the Santiam River at an approximate elevation of 850 feet above mean sea level (amsl) (Figure 2a). Study Area GM1 is comprised of two relatively flat benches: a southern bench with an elevation of about 860 feet amsl (approximately 3.6 acres) and a northern bench with an elevation of about 850 feet amsl (approximately 5.3 acres) (see Figure 2a). The infiltration basin would be sited on the lower, northern bench.

Shallow soils at GM1 are characterized by a higher proportion of gravel and sand relative to the other study areas. Generally, surficial geology in the study area consists of 1 to 2 feet of silt underlain by sand or coarse gravel, cobbles, and boulders. The geology at GM1 is heterogeneous. Specifically, the sands are fine to medium, and the gravels range from silty (i.e., “GM,” with a significant fines content making them less permeable) to sandy (i.e., “GW,” with few fines making them more permeable). The underlying sands and gravels do not follow a layer-cake geometry and appear to occur as discrete lenses, which is consistent with the fluvial depositional environment. Detailed geologic descriptions of the soils in the GM1 Study Area are provided in Attachment A.

3.1.2 Shepherd Study Area (GM2) Shallow Geology

The Shepherd Study Area (GM2) is located 0.8 miles from the Santiam River, southeast of the City of Mill City at an elevation that ranges from 900 to 960 feet amsl (Figure 2b). Study Area GM2 is comprised of two terraces separated by a steep slope, with the northern terrace (approximately 7.3 acres) 40 to 50 feet in elevation lower than the southern terrace (approximately 12.6 acres). Shallow geology at Site GM2 includes surficial deposits of silty sand and clay underlain by gravels. The silty sand and clay are over 9 feet thick with the exception of test pit GM2-TP4, where silty sand is 5.5 feet thick. It should also be noted that the gravel was not encountered in test pit GM2-TP2 (excavated to 13 feet bgs). Groundwater was observed as shallow as 2 feet below ground surface in test pits GM2-TP3 and GM2-TP4, both of which are located on the northern, lower terrace. Detailed geologic descriptions of the soils in the GM1 Study Area are provided in Attachment A.

3.1.3 4th Ave ROW Study Area (GM4) Shallow Geology

The 4th Ave ROW Study Area (GM4) is located within the 4th Avenue right-of-way in the City of Mill City (Figure 2c). Study Area GM4 is approximately 0.55 miles from the Santiam River at an elevation of 880 to 890 feet amsl. Surficial geology at the site was generally consistent between test pits and showed deposits of silty sand (3.5 to 5 feet thick) underlain by silty gravels with low proportions of sand. The geology appeared to be layer-cake, but this could be due to the test pits being excavated over a relatively small area. Detailed geologic descriptions of the soils in the GM1 Study Area are provided in Attachment A.

3.1.4 Weyerhaeuser Study Area (GM5) Shallow Geology

The Weyerhaeuser Study Area (GM5) is located adjacent to the Shepherd Study Area (GM2) southeast of the city of Mill City at elevations ranging from 960 to 1020 feet amsl, approximately 0.85 miles from the Santiam River (Figure 2d). The study area is comprised of two parcels that the property owner has proposed for sale: Parcel A (24.7 acres) and Parcel B (11.8 acres). Only two test pits were excavated at Study Area GM5 due to weather conditions (snow) and access constraints. The two test pits that were excavated, test pits GM5-1 and GM5-2, show similar shallow geology generally consisting of approximately 5 feet of dry to moist silty sand underlain by silty gravels, cobbles, and boulders. There were large areas of ponded water throughout Site GM5 at the time of test pit excavation. Detailed geologic descriptions of the soils in the GM1 Study Area are provided in Attachment A.

3.2 Infiltration Test Results

Effective saturated hydraulic conductivity (K) values measured from the infiltration testing are shown in Table 2 and Appendix B. Note that these effective K rates are raw measurements that do not include a safety factor to account for clogging over time or uncertainties related to spatial variability in soil properties.

Table 2. Test Pit Depths, Soil Samples, and Infiltration Tests.

Test Pit ID	Depth	Geology	Effective Saturated Hydraulic Conductivity ft/day
GM1-TP2	2.0	Silty GRAVEL (GM)	12.66
GM1-TP3	2.0	Well graded SAND with silt (SW-SM)	3.25
GM1-TP4	2.0	Silty GRAVEL (GM)	3.70
GM1-TP4	3.0	Well graded GRAVEL with silt (GW-GM)	8.31
		GM1 Geometric Mean	5.97
GM2-TP1	2.0	Silty SAND (SM)	1.17
GM2-TP2	2.0	Lean CLAY (CL)	< 0.01
GM2-TP4	2.0	Silty SAND (SM)	2.03
		GM2 Geometric Mean	0.12
GM4-TP1	3.0	Silty SAND (SM)	0.52
GM4-TP2	3.5	Silty SAND (SM)	1.19
GM4-TP3	2.0	Silty SAND with gravel (SM)	0.93
GM4-TP3	4.5	Silty SAND with gravel (SM)	0.65
		GM4 Geometric Mean	0.78
GM5-TP1	2.0	Silty SAND (SM)	0.01
GM5-TP2	2.0	Silty SAND (SM)	2.29
		GM5 Geometric Mean	0.18

Notes

(1) Soil physical properties include specific gravity (SG) and/or particle size distribution (PSD)
(2) CI – Sing ring cylinder infiltrometer test; TI – Test pit infiltration test
(3) P – multi-residue pesticide analysis
(--) no sample collected or infiltration test performed
bgs = below ground surface ft/day = feet per day ID = identification

The geometric mean soil effective K increased with decreasing fines content, ranging from less than 0.01 ft/day for Lean Clay (CL) to 12.66 ft/day for silty Gravel (GM). Study area geometric mean effective K values were greatest at the Baughman-Lucas Study Area (GM1, 5.97 ft/day), followed by the 4th Ave ROW Study Area (GM4, 0.78 ft/day), the Weyerhaeuser Study Area (GM5, 0.18 ft/day), and the Shepherd Study Area

(GM2, 0.12 ft/day). Note the GM5 study area was limited to two infiltration tests due to access and weather constraints. As a result, there is increased uncertainty of the GM5 study area effective K, however, based on proximity to the GM2 study area and similarity of soils to those observed at the GM2 and GM4 study areas, the GM5 study area effective K likely ranges between the values measured at GM2 and GM4 study areas.

3.3 Soil Quality and Soil Physical Parameter Results

Laboratory reports are tabulated and presented in Attachment D (soil quality results) and Attachment E (soil physical properties).

3.3.1 Soil Quality Results

All soil samples were nondetect for pesticides. These results indicate that infiltration through the surficial soils in the study area is not likely to violate DEQ's groundwater protection rules due to leaching of soil contaminants. These rules require that groundwater is protected to its highest beneficial use (usually drinking water). WPCF-permitted projects are required to meet these rules, which, in practice, require that infiltration projects do not degrade background groundwater quality at a receptor point (i.e., a water well).

3.3.2 Soil Physical Parameters

Results of soil particle specific gravity and soil grain size analyses on the less than 4.75 millimeter (mm) size fraction are provided in Table 3 and Figure 3, respectively, and in Attachment E. The percent fines in soils (<0.075 mm) ranged between 47 percent and 8 percent. Laboratory PSD results were used to calibrate field PSD estimates for the sand and fines and the USCS visual-manual classifications on the test pit logs (Attachment B) were updated based on the lab results. For the gravel units, USCS visual-manual classifications on test pit logs were not updated because the lab results were not necessarily representative of soil conditions in the field (i.e., because cobble and boulder-sized sediment were not included in the laboratory analyses).

A linear regression equation was developed to correlate field estimates of fines to the laboratory measured results (Figure 3). The correlation for fines ($R^2 = 0.99$) was used to adjust the field-estimated values to the laboratory-measured values (calculations are provided in Attachment B). Sample GM1-TP4-5 was considered an outlier and excluded from the correlation analysis.

Table 3. Laboratory-Measured Soil Specific Gravity.

Test Pit ID	Depth (feet)	Specific Gravity g/cm^3
GM1-TP2-6	6.0	2.80
GM1-TP3-5	5.0	2.79
GM4-TP3-4.5	4.5	2.67

Notes

g/cm^3 = grams per cubic centimeter

4. Study Area Scoring Methods and Scoring Results

4.1 Scoring methods

A scoring system was developed to rank the favorability of each study area for infiltration from the perspectives of distance to nearest surface water (i.e., the Santiam River), predominant soil types, depth to groundwater (i.e., ability of the unsaturated zone to accommodate a groundwater mound), and permeability (i.e., effective saturated hydraulic conductivity). The objective of ranking was to select three of the four study areas for a deep subsurface soil investigation. Table 4 summarizes the scoring system. One point was awarded for a positive ranking, zero points for neutral ranking, and one point was subtracted (-1) for negative ranking.

Table 4. Scoring Criteria.

Score	Distance to Surface Water (miles)	Predominant Soil Type(s)	Depth to Groundwater (feet)	K_{sat} (feet/day)
Negative (-1)	< 0.25	Silty SAND (SM) Clay (CL)	< 10	< 0.50
Neutral (0)	0.25 to 0.50	Silty SAND (SM) Silty GRAVEL (GM)	10 to 20	0.5 – 1.0
Positive (1)	> 0.50	Clean GRAVEL (GW) Silty GRAVEL (GM)	> 20	> 1.0

Notes

K_{sat} = Saturated hydraulic conductivity

Once all categories were considered and points awarded, study areas were ranked and ordered from highest to lowest infiltration potential.

4.2 Scoring results

Table 5 summarizes the results of the study area scoring. Based on the scoring, the Baughman Lucas Study Area (GM1), Weyerhaeuser Study Area (GM5), and 4th Avenue ROW Study Area (GM4) appear to be more favorable for infiltration than the Shepherd Study Area (GM2).

Table 5. Site Scoring

Rank	Study Area	Distance to River Score	Predominant Soil Type Score	Depth to Groundwater Score	Infiltration Rate Score	Total Score
1	Baughman-Lucas (GM1)	0	1	0	1	2
2	4th Avenue ROW (GM4)	1	0	1	0	2
3	Weyerhaeuser (GM5)	1	0	1	-1	1
4	Shepherd (GM2)	1	-1	-1	-1	-2

5. Conclusions and Recommendations

GSI and GSA make the following conclusions based on the Gates/Mill City Phase I Subsurface Investigation:

- Measured soil effective K values were greatest at the GM1 study area, indicating the potential for high infiltration rates relative to the other sites tested. The GM4 study area had moderate soil effective K rates, whereas GM2 and GM5 project areas had low soil effective K rates, indicating potentially limiting infiltration rates at the GM2 and GM5 project areas.
- The GM1 study area and GM4 study area are closest to the Santiam River and, therefore, may require a higher level of wastewater treatment to be compliant with the Three Basin Rule. The Weyerhaeuser (GM5) and Shepherd (GM2) study areas are the farthest from the Santiam River and may require less treatment, but the soils do not appear to be favorable to infiltration based on both measured soil effective K values (less than 0.2 feet per day) and observed soils types (silty gravels or silty sands). In addition, shallow groundwater was noted at GM2.

GSI and GSA make the following recommendations based on the Gates/Mill City Phase I Subsurface Investigation:

- The effective K rates presented in this TM do not account for uncertainties related to the spatial variability of soil properties and clogging of the basin over time. We recommend applying a safety factor to these effective K rates to account for these uncertainties. For effective saturated hydraulic conductivity results from cylinder infiltrometer measurements, 10 to 15% is a reasonable assumption. Additionally, we recommend the selected site undergo large scale (i.e., 4 ft diameter) and long term (i.e., 8 hours) infiltration testing to refine long term estimated infiltration rates and safety factors as a part of preliminary design and prior to basin construction.
- Infiltration basin designs based on the results of the Phase I Subsurface Investigation, which focused on shallow soils (less than 13 feet bgs) should be considered preliminary because we have not yet evaluated the potential for less permeable soil horizons deeper in the soil profile. In addition, we have not yet evaluated the aquifer potential to dissipate the groundwater mound that will occur during recharge, which depends on aquifer properties. Deep soils will be evaluated as part of the Phase II Subsurface Investigation, which completed field investigations in May and June 2023.
- We recommend that the project team consider basin designs that include a single recharge basin as well as multiple recharge basins. Use of multiple basins provides benefits including the capability to continue recharge while conducting maintenance activities (e.g., clogging layer removal) and regular cycling of recharge between basins (i.e., periods of loading followed by periods of resting) should groundwater or perched water mounding beneath a basin reduce infiltration rates.
- Based on the ranking system, GSI recommends Phase II groundwater monitoring at the Baughman-Lucas study area (GM1), the 4th Ave ROW study area (GM4), and the Weyerhaeuser study area (GM5).
- Should Phase II testing further support the GM5 study area as a potentially viable infiltration basin location, we recommend completing the Phase I near surface infiltration testing previously planned for the site that could not be completed due to weather and access constraints.

6. References

Bouwer, H., Back, J.T., Oliver, J.M. 1999. Predicting Infiltration and Groundwater Mounds for Artificial Recharge, J Hydro Eng, ASCE, (4) pp. 350-357.

Bouwer, H. 2002. Artificial recharge of groundwater: hydrogeology and engineering. Hydrogeology Journal.

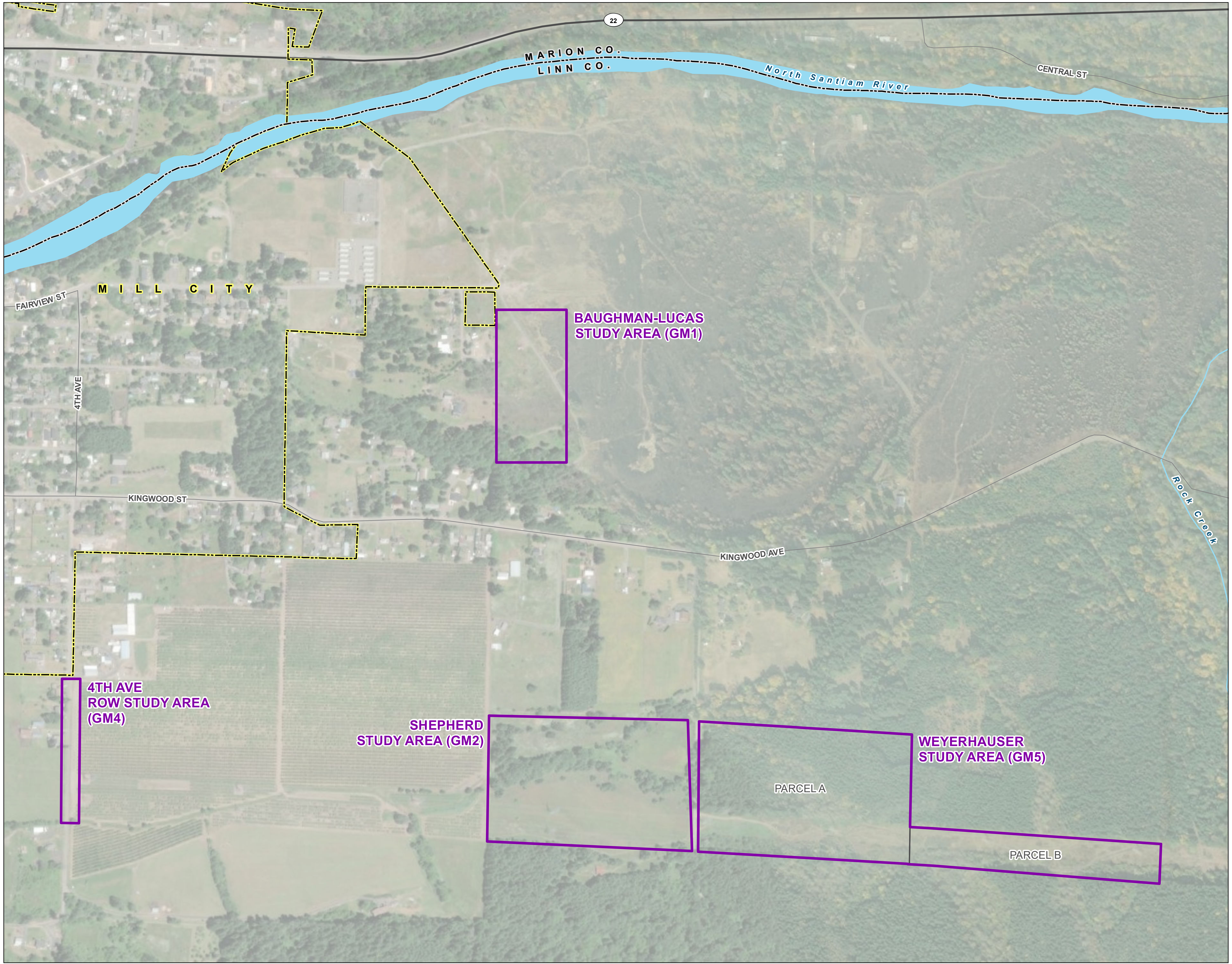
Rice, R.C., M. Milczarek, J. Keller. 2014. A Critical Review of Single Ring Cylinder Infiltrometers with Lateral Flow Compensation. Proceedings 14th Biennial Symposium on Managed Aquifer Recharge, July 31-August 1, 2014 – Orange, CA.

GSI and GSA. 2023. Santiam Canyon Treated Wastewater Disposal – Subsurface Characterization Work Plan. March 3.

FIGURE 1

Project Location

Phase I Soil Characterization and Infiltration Testing



LEGEND

- ☐ Study Area
- ☐ Site Parcel

All Other Features

- ☐ City Boundary
- ☐ County Boundary
- ╱╲ Major Road
- 〰 Watercourse
- ▨ Waterbody

N

0 300 600 900

Feet

Date: June 8, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

GSI
Water Solutions, Inc.

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FIGURE 2a

Baughman-Lucas Study Area (GM1)

Phase I Soil Characterization and Infiltration Testing

LEGEND

- 🟨 Test Pit
- ▭ Study Area
- ▨ Steep Slope
- ▭ Soils

All Other Features

- ⬚ City Boundary
- ⁄\ Major Road

Date: June 8, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

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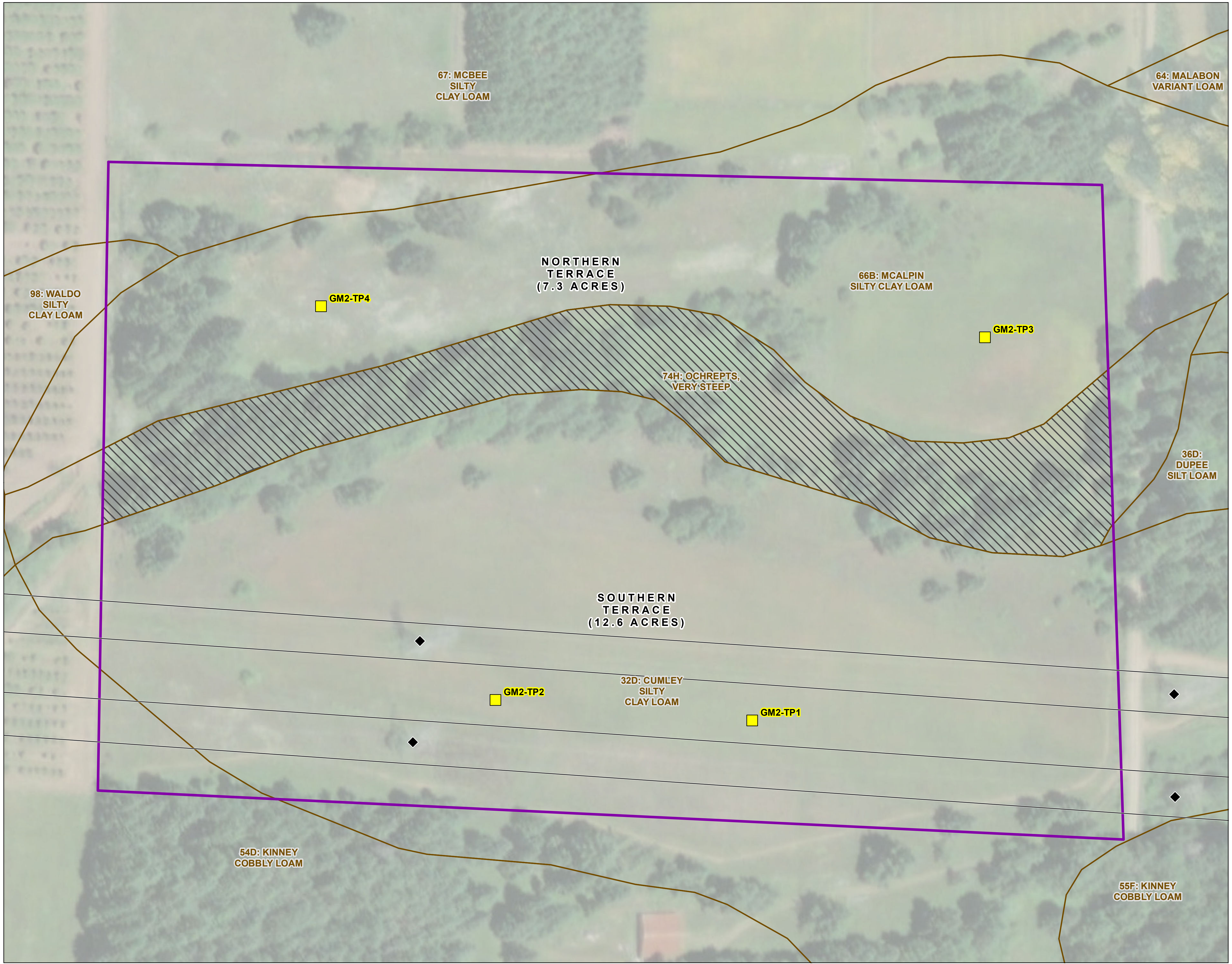
FIGURE 2b

Shepherd Study Area (GM2)

Phase I Soil Characterization and Infiltration Testing



LEGEND

- 🟨 Test Pit
- ◆ Powerline Tower
- — Powerline
- ▭ Study Area
- ▨ Steep Slope
- ▭ Soils

All Other Features

- ⬚ City Boundary
- ╱╲ Major Road

N

0 60 120 180
Feet

Date: June 8, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

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FIGURE 2c

4th Ave ROW Study Area (GM4)

Phase I Soil Characterization and Infiltration Testing

LEGEND

- 🟨 Test Pit
- ◆ Powerline Tower
- — Powerline
- ▭ Study Area
- ▭ Soils

All Other Features

- ⬚ City Boundary
- ╱╲ Major Road

N

0 60 120 180
Feet

Date: June 8, 2023
Data Sources: BLM, ESRI, ODOT, USGS, Aerial Photo 2020

GSI Water Solutions, Inc.

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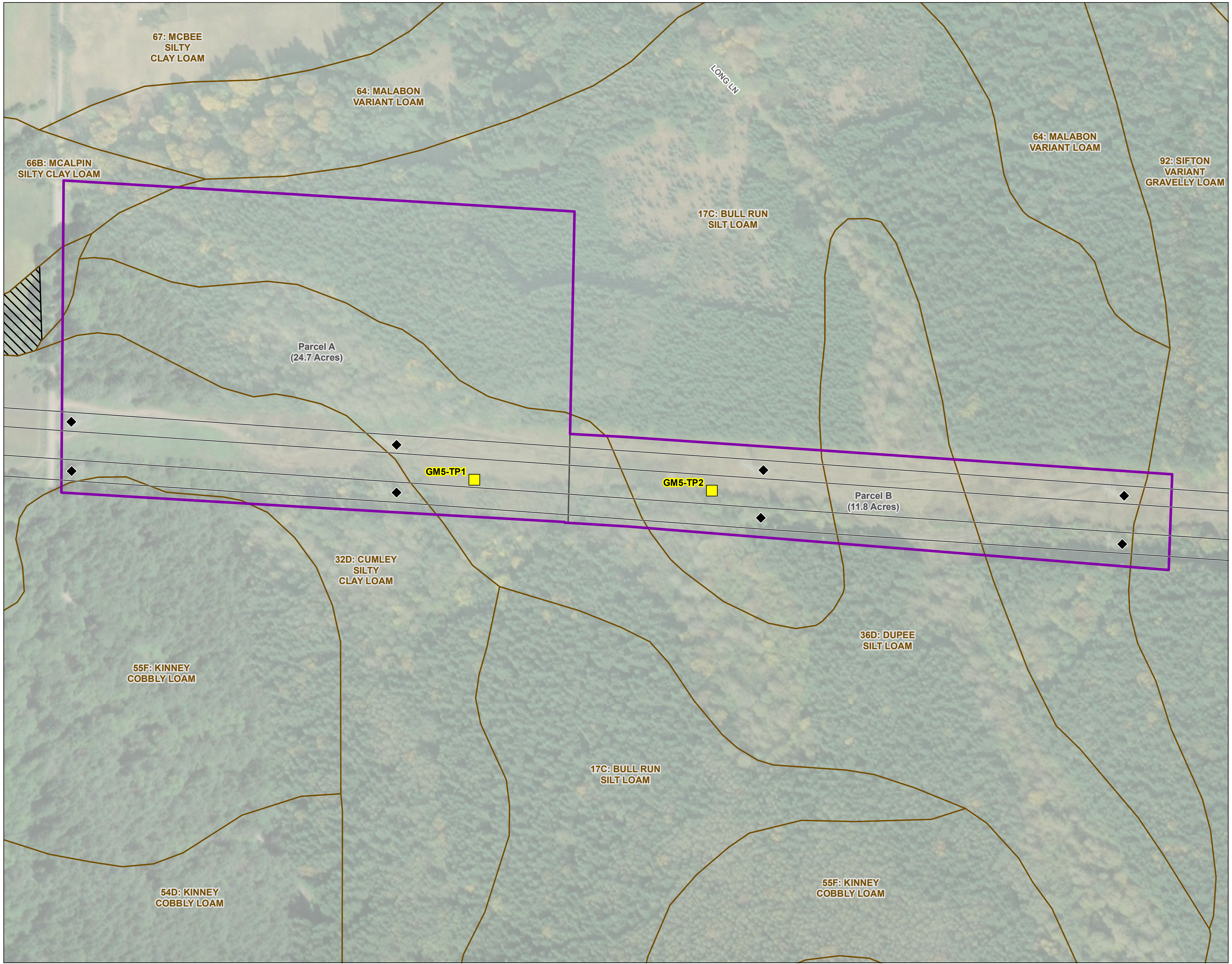

FIGURE 2d

Weyerhaeuser Study Area (GM5)

Phase I Soil Characterization and Infiltration Testing

LEGEND

- 🟨 Test Pit
- ◆ Powerline Tower
- — Powerline
- ☐ Study Area
- ☐ Site Parcel
- ▨ Steep Slope
- ☐ Soils

All Other Features

- ☐ City Boundary
- ╱╲ Major Road

N

0 125 250 375
Feet

Date: June 8, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

GSI Water Solutions, Inc.

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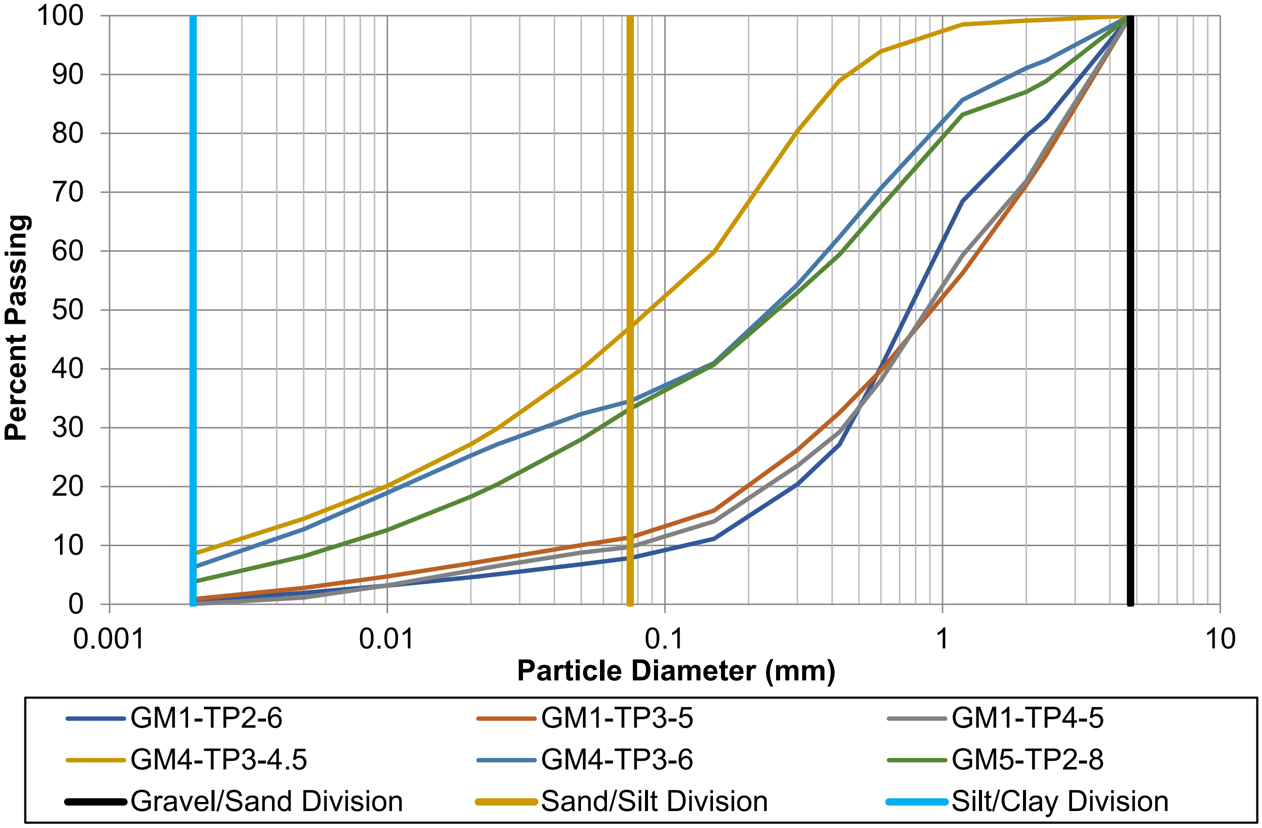
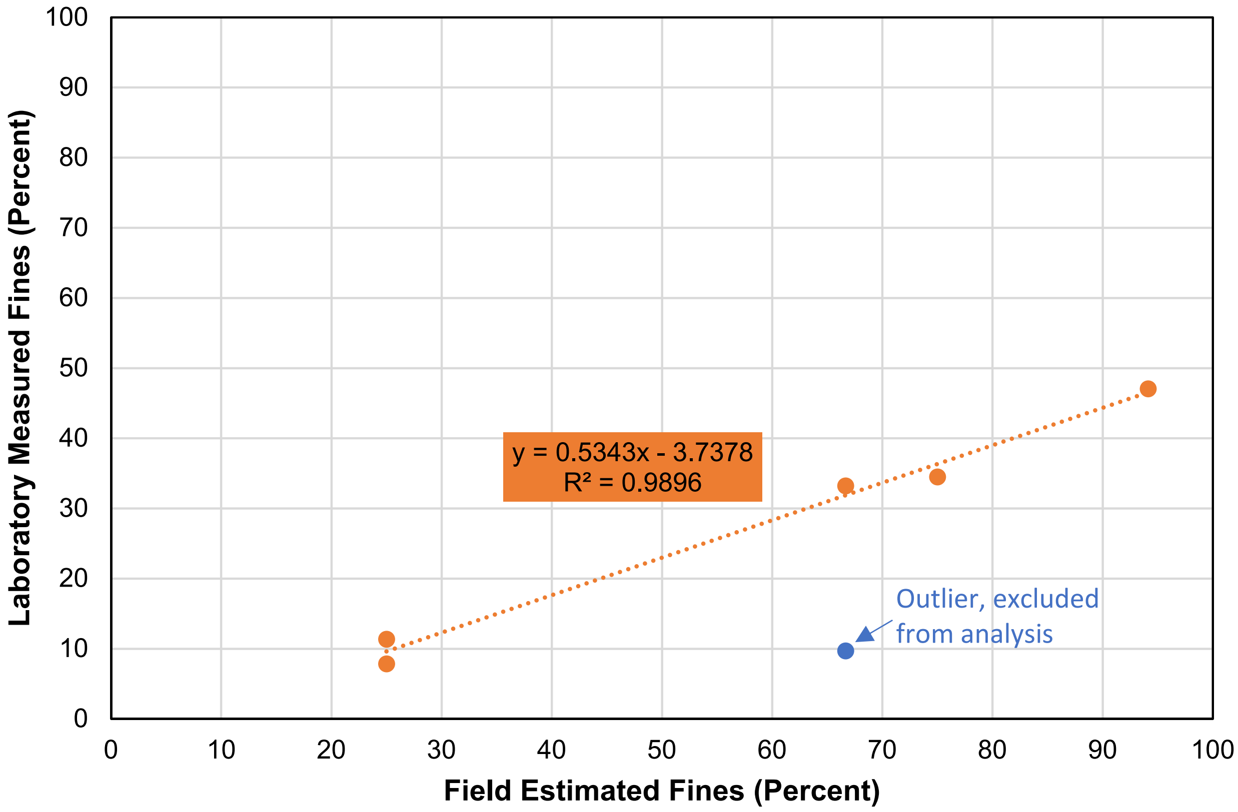
Particle Size Distribution



Laboratory-Measured and Field-Estimated Percent Fines



GeoSystems
Analysis, Inc.
Innovations in Hydrology

FIGURE 3

Grain Size Data

Phase I Soil Characterization and Infiltration Testing

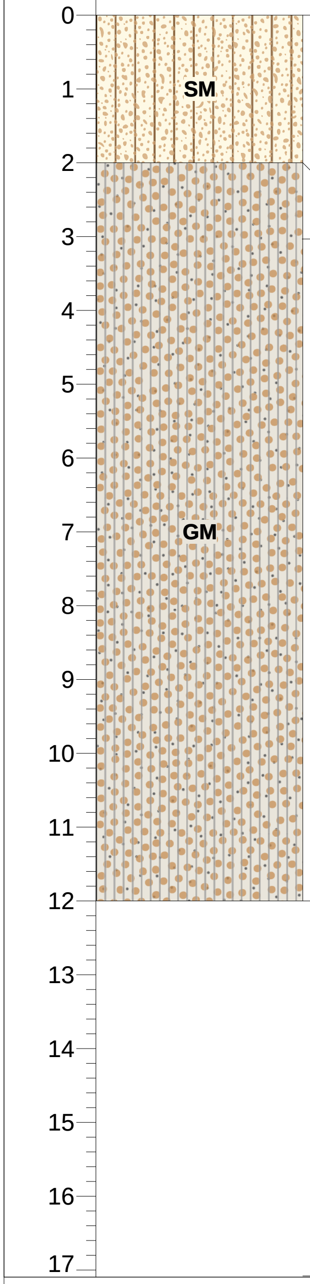
ATTACHMENT A

Test Pit Logs

GSI Water Solutions, Inc.

LOG ID: GM1-TP1

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 861 feet amsl	
TEST PIT LOCATION:	44.749451°, -122.461443°	**TOTAL DEPTH (ft):** 12	**DATE STARTED:** 3/23/2023
CONTRACTOR:	McKillip Excavation, Inc.	**LOGGED BY:** J. Hall	**DATE FINISHED:** 3/23/2023
SAMPLING METHOD:	Continuous	**DEPTH TO WATER (ft bgs)** **FIRST:** -	**COMPLETED:** -
EQUIPMENT:	John Deere 85G		



SAMPLE DESCRIPTION	**% GRAVEL**	**% SAND**	**% SILT**	**COMMENTS**
	FIELD SOIL CLASSIFICATION			**CORRECTED SOIL CLASSIFICATION**
0.0 - 2.0 ft: Very loose, dark brown, moist, Silty SAND with gravel (SM), some sand, sand is medium to coarse, angular to subangular, gravel is fine to coarse, subangular to rounded, some cobbles, subangular to rounded, some boulders (up to 24 inches) [FILL]	35%	<10%	60%	35% Gravel, 45% Sand, 20% Fines
Boulders increase with depth 2.0 - 12.0 ft: Very loose, brown, moist, silty GRAVEL with sand (GM), sand is fine to coarse, angular to subrounded, gravel is fine to coarse, subangular to rounded, many fine to coarse cobbles, subrounded to rounded, many cobbles (up to 12 inches), boulders are subrounded to rounded [QUARTERNARY MIDDLE TERRACE DEPOSITS]	45%	35%	20%	
Total Depth = 12 feet				

Note: Corrected soil grain size percentages and classification based on grain size analysis (see Section 3.3.2).

GSI Water Solutions, Inc.

LOG ID: GM1-TP2

PROJECT: Santiam Canyon Infiltration Evaluation

GROUND SURFACE ELEVATION AND DATUM: 852 feet amsl

TEST PIT LOCATION: 44.749976°, -122.461496°

TOTAL DEPTH (ft): 12

DATE STARTED: 3/23/2023

CONTRACTOR: McKillip Excavation, Inc.

LOGGED BY: J. Hall

DATE FINISHED: 3/23/2023

SAMPLING METHOD: Continuous

DEPTH TO WATER (ft bgs) **FIRST:** - **COMPLETED:** -

EQUIPMENT: John Deere 85G

DEPTH (feet)		SAMPLE DESCRIPTION	% GRAVEL	% SAND	% SILT	COMMENTS
			FIELD SOIL CLASSIFICATION			
0 - 1.5	GM	0.0 - 1.5 ft: Loose, dark brown, moist, silty GRAVEL (GM), few sand, fine to medium, trace rootlets, trace organics, gravel is fine to coarse, rounded to subrounded, cobbles (up to 4 inches) [FILL]	50	<10	40	
1.5 - 6	GM	Increasing sand, decreasing silt with depth 1.5 - 6.0 ft: Loose, dark brown to brown, moist, silty GRAVEL (GM), few fine sand, trace rootlets, cobbles, subrounded to rounded, some boulders (up to 18 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	70	<10	20	Infilitration test at 2 feet bgs (12.7)
6 - 8	GW-GM	6.0 - 8.0 ft: Loose, brown, moist, well graded GRAVEL with silt and sand (GW-GM), trace silt, sand is fine to coarse, angular to subrounded, gravel is fine to coarse, angular to subrounded, cobbles are subrounded to rounded (up to 10 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	60	30	10	
8 - 12	GW	8.0 - 12.0 ft: Loose, brown, moist, well graded GRAVEL (GW), few sand, angular to subangular, gravel is fine to coarse, rounded to subangular, cobbles are subrounded to rounded, boulders (up to 20 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	90	10	<5	
12		Total Depth = 12.0 feet				

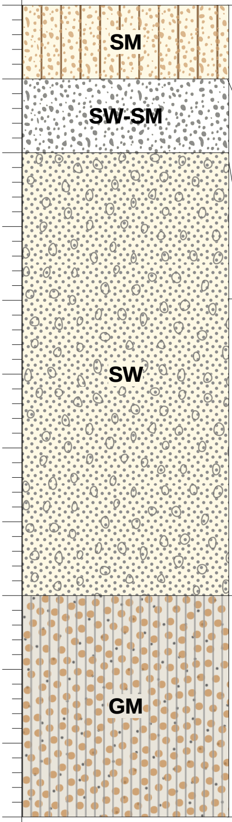
Note: Infiltration test results are in ft/day.

GSI Water Solutions, Inc.

LOG ID: GM1-TP3

PROJECT:	Santiam Canyon Infiltration Evaluation
TEST PIT LOCATION:	44.750628°, -122.461808°
CONTRACTOR:	McKillip Excavation, Inc.
SAMPLING METHOD:	Continuous
EQUIPMENT:	John Deere 85G

GROUND SURFACE ELEVATION AND DATUM: 852 feet amsl		
TOTAL DEPTH (ft): 11		**DATE STARTED:** 3/23/2023
LOGGED BY: J. Hall		**DATE FINISHED:** 3/23/2023
DEPTH TO WATER (ft bgs)	**FIRST:** -	**COMPLETED:** -



DEPTH (feet)	**SAMPLE DESCRIPTION**	**% GRAVEL**	**% SAND**	**% SILT**	**COMMENTS**
		FIELD SOIL CLASSIFICATION			**CORRECTED SOIL CLASSIFICATION**
0 – 1	0.0 - 1.0 ft: Very loose, dark brown, moist, silty SAND (SM), few sand is fine to medium, trace cobbles (up to 4 inches) are subrounded to rounded, rootlets [FILL]	<5%	<10%	85%	5% Gravel, 55% Sand, 40% Fines
1 – 2	1.0 - 2.0 ft: Very loose, dark brown to brown, moist, well graded SAND with silt (SW-SM), trace gravel is fine to medium, trace cobbles, trace rootlets, trace boulders (up to 14 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	<10%	60%	30%	10% Gravel, 80% Sand, 10% Fines Infilitration test at 2 feet bgs (3.25)
2 – 8	Sand decreases with depth 2.0 - 8.0 ft: Very loose, brown, moist, silty SAND with gravel (SW), sand is fine to medium, subrounded to rounded [QUARTERNARY MIDDLE TERRACE DEPOSITS]	20%	60%	20%	20% Gravel, 75% Sand, 5% Fines
8 – 11	8.0 - 11.0 ft: Very loose, brown, dry, silty GRAVEL (GM), trace sand is fine to medium, subangular to subrounded, gravel is fine to coarse, subrounded to rounded, cobbles are subangular to rounded, boulders are subrounded to rounded (up to up to 20 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	85%	<5%	15%	
11	Total Depth = 11.0 feet				

Note: Infiltration test results are in ft/day. Corrected grain size percentages and classification based on grain size analysis (see Section 3.3.2).

GSI Water Solutions, Inc.

LOG ID: GM1-TP4

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 851 feet amsl	
TEST PIT LOCATION:	44.750660°, -122.460875°	**TOTAL DEPTH (ft):** 12	**DATE STARTED:** 3/23/2023
CONTRACTOR:	McKillip Excavation, Inc.	**LOGGED BY:** J. Hall	**DATE FINISHED:** 3/23/2023
SAMPLING METHOD:	Continuous	**DEPTH TO WATER (ft bgs)** **FIRST:** -	**COMPLETED:** -
EQUIPMENT:	John Deere 85G		

DEPTH (feet)		**SAMPLE DESCRIPTION**	**% GRAVEL**	**% SAND**	**% SILT**	**COMMENTS**
			FIELD SOIL CLASSIFICATION			
0 1 2	GM	0.0 - 2.0 ft: Loose, dark brown, moist, silty GRAVEL (GM), trace rootlets, trace organics, anthropogenics (plastic, plywood), trace sand is fine to medium, gravel is fine to coarse, subangular to rounded, cobbles (up to 8 inches) are subrounded to rounded [FILL]	50%	<5%	45%	
2 3 4 5 6 7 8 9 10	GW-GM	Cobbles/Boulders increase with depth 2.0 - 10.0 ft: Loose, brown, dry, well graded GRAVEL with silt (GW-GM), trace rootlets, trace organics, trace sand is fine to coarse, gravel is fine to coarse, subangular to rounded, cobbles are subrounded to rounded [QUARTERNARY MIDDLE TERRACE DEPOSITS]	85%	<5%	10%	Infiltration test at 2 feet bgs (3.70) Infiltration test at 3 feet bgs (8.31)
10 11 12	GW	10.0 - 12.0 ft: Loose, brown, dry, well graded GRAVEL (GW), non-plastic, trace silt, trace sand is fine to coarse, gravel is fine to coarse, subangular to rounded, cobbles are subrounded to rounded, boulders (up to 24 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	95%	<5%	<5%	
12 13 14 15 16 17		Total Depth = 12.0 feet				Note: Infiltration test results are in ft/day.

GSI Water Solutions, Inc.

LOG ID: GM2-TP1

PROJECT: Santiam Canyon Infiltration Evaluation

GROUND SURFACE ELEVATION AND DATUM: 955 feet amsl

TEST PIT LOCATION: 44.742499°, -122.458983°

TOTAL DEPTH (ft): 13

DATE STARTED: 3/21/2023

CONTRACTOR: McKillip Excavation, Inc.

LOGGED BY: J. Hall

DATE FINISHED: 3/21/2023

SAMPLING METHOD: Continuous

DEPTH TO WATER (ft bgs) **FIRST:** - **COMPLETED:** -

EQUIPMENT: John Deere 50G

DEPTH (feet)		SAMPLE DESCRIPTION	% GRAVEL	% SAND	% SILT	COMMENTS
			FIELD SOIL CLASSIFICATION			CORRECTED SOIL CLASSIFICATION
0 - 2	SM	0.0 - 2.0 ft: Stiff, dark brown,dry, silty SAND (SM), trace rootlets, trace organics, Grades to brown at 1.2 feet [QUARTERNARY MIDDLE TERRACE DEPOSITS]	0%	0%	100%	0% Gravel, 65% Sand, 35% Fines Infilitration test at 2 feet bgs (1.17)
2 - 3.5	SM	2.0 - 3.5 ft: Medium stiff, brown to light brown, dry, silty SAND (SM), trace rootlets, sand is medium to coarse, angular to subangular [QUARTERNARY MIDDLE TERRACE DEPOSITS]	0%	20%	80%	0% Gravel, 60% Sand, 40% Fines
3.5 - 6	SM	3.5 - 6.0 ft:Stiff, light brown to brown, dry, silty SAND (SM), sand is medium to coarse, angular to subangular [QUARTERNARY MIDDLE TERRACE DEPOSITS]	10%	20%	70%	10% Gravel, 60% Sand, 30% Fines
6 - 10	SM	6.0 - 10.0 ft: Stiff, dark brown to gray, dry, silty SAND with gravel (SM), sand is medium to coarse, angular to subangular, gravel is medium, poorly sorted, angular to subrounded [QUARTERNARY MIDDLE TERRACE DEPOSITS] Cobbles (up to 8 inches) at 8 feet, angular to rounded. Increase in cobbles with depth	25%	15%	60%	25% Gravel, 55% Sand, 20% Fines
10 - 13	GM	10.0 - 13.0 ft: Loose, dark brown to gray, wet, silty GRAVEL with sand (GM), sand is medium to coarse, angular to subangular, gravel is fine to coarse, subangular to rounded, cobbles (up to 8 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	40%	20%	40%	
13 - 17		Total Depth - 13.0 feet				Note: Infilitration test results are in ft/day. Corrected soil grain size percentages and classification based on grain size analysis (see Section 3.3.2).

GSI Water Solutions, Inc.

LOG ID: GM2-TP2

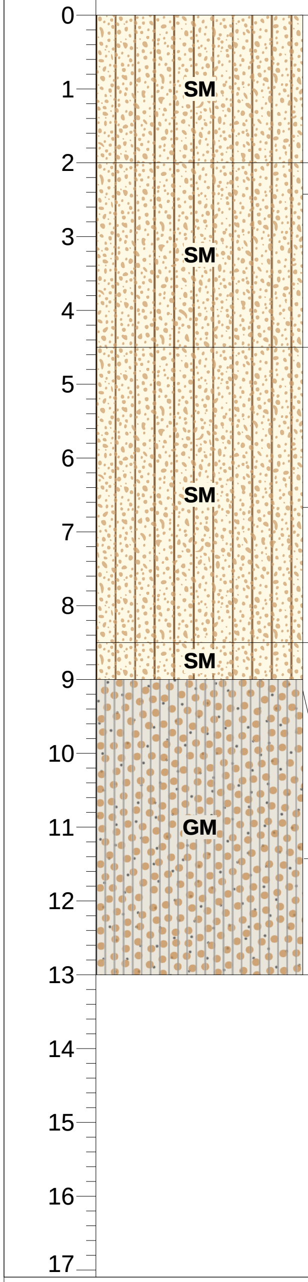
PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 945 feet amsl	
TEST PIT LOCATION:	44.742544°, -122.460223°	**TOTAL DEPTH (ft):** 13	**DATE STARTED:** 3/21/2023
CONTRACTOR:	McKillip Excavation, Inc.	**LOGGED BY:** J. Hall	**DATE FINISHED:** 3/21/2023
SAMPLING METHOD:	Continuous	**DEPTH TO WATER (ft bgs)** **FIRST:** -	**COMPLETED:** -
EQUIPMENT:	John Deere 50G		

DEPTH (feet)		**SAMPLE DESCRIPTION**	**% GRAVEL**	**% SAND**	**% SILT**	**COMMENTS**
			FIELD SOIL CLASSIFICATION			**CORRECTED SOIL CLASSIFICATION**
0 1	**SM**	0.0 - 1.5 ft: Stiff, dark brown, moist, silty SAND (SM), trace rootlets, trace organics, [QUARTERNARY MIDDLE TERRACE DEPOSITS]	0%	0%	100%	0% Gravel, 65% Sand, 35% Fines Infiltration test at 2 feet bgs (<0.01)
2 3 4	**CL**	1.5 - 5.0 ft: Stiff, gray, moist, lean CLAY (CL), trace rootlets, high plasticity [QUARTERNARY MIDDLE TERRACE DEPOSITS]	0%	0%	100%	
5 6	**CL**	5.0 - 7.0 ft: Stiff, light brown to gray, moist, lean CLAY (CL), medium to high plasticity, sand is fine to medium, angular to subangular [QUARTERNARY MIDDLE TERRACE DEPOSITS]	0%	10%	90%	
7 8 9 10 11 12	**CL**	Sand content decreases with depth 7.0 - 13.0 ft: Stiff, light brown to gray, moist, lean CLAY with gravel (CL), high plasticity, sand is fine to medium, angular to subangular, gravel is fine to medium, subangular to angular [QUARTERNARY MIDDLE TERRACE DEPOSITS] Trace sand at 12 feet	10%	<10%	80%	
13 14 15 16 17		Total Depth = 13.0 feet				Note: Infiltration test results are in ft/day. Corrected soil grain size percentages and classification based on grain size analysis (see Section 3.3.2)

GSI Water Solutions, Inc.

LOG ID: GM2-TP3

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 915 feet amsl			
TEST PIT LOCATION:	44.743815°, -122.457928°	**TOTAL DEPTH (ft):** 13		**DATE STARTED:** 3/21/2023	
CONTRACTOR:	McKillip Excavation, Inc.	**LOGGED BY:** J. Hall		**DATE FINISHED:** 3/21/2023	
SAMPLING METHOD:	Continuous	**DEPTH TO WATER (ft bgs)**	**FIRST:** -	**COMPLETED:** -	
EQUIPMENT:	John Deere 85G				



SAMPLE DESCRIPTION	% GRAVEL	% SAND	% SILT	COMMENTS
	FIELD SOIL CLASSIFICATION			**CORRECTED SOIL CLASSIFICATION**
0.0 - 2.0 ft: Loose, dark brown, moist, silty SAND (SM), trace rootlets, sand is fine to coarse, [QUARTERNARY MIDDLE TERRACE DEPOSITS]	0%	<5%	95%	0% Gravel, 55% Sand, 45% Fines Pit saturated at 2 feet bgs. Unable to complete infiltration test.
Increasing clay content with depth 2.0 - 4.5 ft: Medium dense, wet, dark brown, silty SAND (SM), trace rootlets, sand is fine to medium [QUARTERNARY MIDDLE TERRACE DEPOSITS]	0%	<5%	95%	0% Gravel, 55% Sand, 45% Fines Water flowing from top of clay layer at 4.5 feet bgs.
4.5 - 8.5 ft: Stiff, brown to gray, moist, silty SAND (SM), trace sand is fine to medium, trace rootlets Grades to gray at 6 to 7.5 feet [QUARTERNARY MIDDLE TERRACE DEPOSITS]	0%	<5%	95%	0% Gravel, 55% Sand, 45% Fines Water flowing from bottom of clay layer at 8.5 feet bgs.
8.5 - 9.0 ft: Medium stiff, brown, wet, silty SAND with gravel (SM), sand is fine to coarse, gravel is fine to coarse, subangular to subrounded [QUARTERNARY MIDDLE TERRACE DEPOSITS]	20%	10%	70%	20% Gravel, 55% Sand, 25% Fines
9.0 - 13.0 ft: Loose, brown, wet, silty GRAVEL (GM), trace sand, gravel is fine to coarse, subrounded to subangular, trace cobbles (up to 8 inches) Increasing gravel with depth [QUARTERNARY MIDDLE TERRACE DEPOSITS]	50%	<10%	40%	Water accumulating at bottom of pit at 11 feet bgs.
Total Depth = 13.0 feet				

Note: Corrected soil grain size percentages and classification based on grain size analysis (see Section 3.3.2)

LOG ID: GM2-TP4

PROJECT: Santiam Canyon Infiltration Evaluation

GROUND SURFACE ELEVATION AND DATUM: 898 feet amsl

TEST PIT LOCATION: 44.743894°, -122.461166°

TOTAL DEPTH (ft): 9

DATE STARTED: 3/22/2023

CONTRACTOR: McKillip Excavation, Inc.

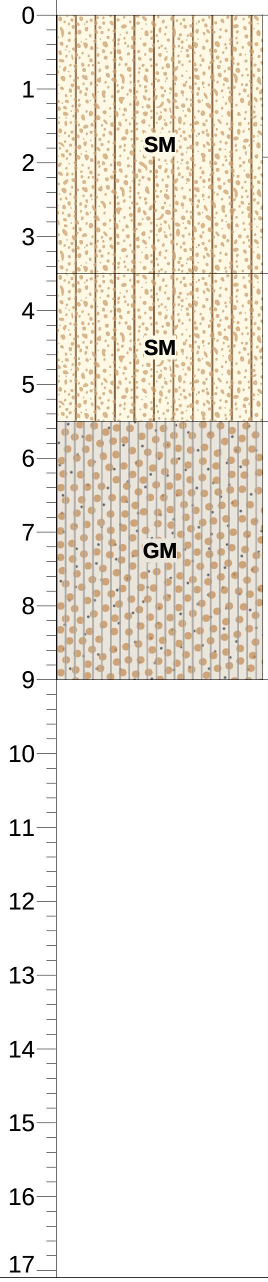
LOGGED BY: J. Hall

DATE FINISHED: 3/22/2023

SAMPLING METHOD: Continuous

DEPTH TO WATER (ft bgs) **FIRST:** - **COMPLETED:** -

EQUIPMENT: John Deere 85G



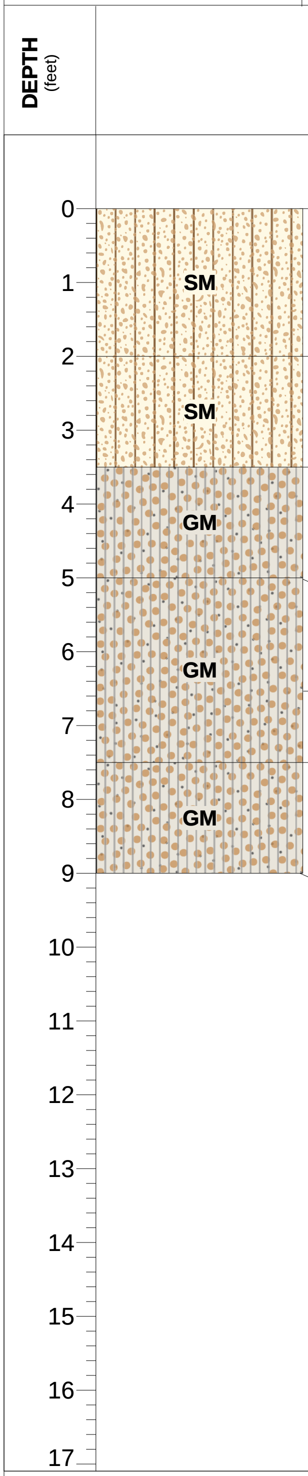
SAMPLE DESCRIPTION	% GRAVEL	% SAND	% SILT	COMMENTS
	FIELD SOIL CLASSIFICATION			CORRECTED SOIL CLASSIFICATION
0.0 - 3.5 ft: Loose, dark brown, dry, silty SAND (SM), trace rootlets, trace organics Increasing gravel with depth [QUARTERNARY MIDDLE TERRACE DEPOSITS]	<5%	0%	100%	5% Gravel, 50% Sand, 45% Fines Infilitration test at 2 feet bgs (2.03)
3.5 - 5.5 ft: Medium stiff, brown, wet, silty SAND with gravel (SM), sand is medium, subangular to angular, gravel is fine to coarse, angular to rounded, cobbles (up to 6 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	20%	40%	40%	20% Gravel, 65% Sand, 15% Fines
5.5 - 9.0 ft: Loose, brown, wet, silty GRAVEL with sand (GM), sand is fine to coarse, angular to subangular, gravel is fine to coarse, angular to rounded, cobbles, rounded to subrounded, boulders (up to 14 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	60%	20%	20%	Water accumulating in bottom of pit at 6 feet bgs
* Hit refusal on cobbles/boulders at 9 feet				

Note: Infiltration test results are in ft/day. Corrected soil and grain size percentages and classification based on grain size analysis (see Section 3.3.2).

LOG ID: GM4-TP1

PROJECT: Santiam Canyon Infiltration Evaluation
TEST PIT LOCATION: 44.744493°, -122.472179°
CONTRACTOR: McKillip Excavation, Inc.
SAMPLING METHOD: Continuous
EQUIPMENT: John Deere 50G

GROUND SURFACE ELEVATION AND DATUM: 884 feet amsl
TOTAL DEPTH (ft): 9
DATE STARTED: 3/20/2023
LOGGED BY: J. Hall
DATE FINISHED: 3/20/2023
DEPTH TO WATER (ft bgs) **FIRST:** - **COMPLETED:** -



SAMPLE DESCRIPTION	% GRAVEL	% SAND	% SILT	COMMENTS
	FIELD SOIL CLASSIFICATION			CORRECTED SOIL CLASSIFICATION
0.0 - 2.0 ft: Stiff, dark brown, dry, silty SAND (SM), trace gravel, rounded to angular, anthropogenics (hairbrush, spoon) [FILL]	<5%	<5%	90%	5% Gravel, 55% Sand, 40% Fines
2.0 - 3.5 ft: Loose, light to dark brown, moist, silty SAND(SM), trace rootlets, boulders at 3.5 feet (up to 16 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	<1%	<5%	95%	1% Gravel, 55% Sand, 45% Fines Infilitration test at 3 feet bgs (0.52)
3.5 - 5.0 ft: Loose, light to dark brown, moist, silty GRAVEL (GM), trace rootlets, trace sand, cobbles, boulders are rounded to subangular (up to 16 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	60%	<5%	35%	
5.0 - 7.5 ft: Loose, light to dark brown, moist, silty GRAVEL (GM), gravel is rounded to subangular, cobbles, rounded to subangular Gradual decrease in silt [QUARTERNARY MIDDLE TERRACE DEPOSITS]	70%	<10%	20%	
7.5 - 9.0 ft: Loose, dark brown, moist, silty GRAVEL with sand (GM), gravel is fine to coarse, rounded to angular, some cobbles, rounded to angular [QUARTERNARY MIDDLE TERRACE DEPOSITS]	60%	20%	20%	

* Hit refusal on cobbles/boulders at 9 feet

Note: Infilitration test results are in ft/day. Corrected soil grain size percentages and classification based on grain size analysis (see Section 3.3.2).

GSI Water Solutions, Inc.

LOG ID: GM4-TP2

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 884 feet amsl	
TEST PIT LOCATION:	44.743935°, -122.472185°	**TOTAL DEPTH (ft):** 2	**DATE STARTED:** 3/20/2023
CONTRACTOR:	McKillip Excavation, Inc.	**LOGGED BY:** J. Hall	**DATE FINISHED:** 3/20/2023
SAMPLING METHOD:	Continuous	**DEPTH TO WATER (ft bgs)** **FIRST:** -	**COMPLETED:** -
EQUIPMENT:	John Deere 50G		

DEPTH (feet)		**SAMPLE DESCRIPTION**	**% GRAVEL**	**% SAND**	**% SILT**	**COMMENTS**
			FIELD SOIL CLASSIFICATION			**CORRECTED SOIL CLASSIFICATION**
0 1 2 3	**SM**	0.0 - 3.0 ft: Stiff, dark brown, dry, silty SAND (SM) [FILL]	<5%	<5%	90%	5% Gravel, 55% Sand, 40% Fines Infilitration test at 3 feet bgs (1.19)
4 5 6 7 8 9 10 11 12 13 14 15 16 17		Total depth = 3.0 feet				

Note: Infilitration test results are in ft/day. Corrected soil grain size percentages and classification based on grain size analysis (see Section 3.3.2).

GSI Water Solutions, Inc.

LOG ID: GM4-TP3

PROJECT: Santiam Canyon Infiltration Evaluation

GROUND SURFACE ELEVATION AND DATUM: 882 feet amsl

TEST PIT LOCATION: 44.743328°, -122.472182°

TOTAL DEPTH (ft): 9

DATE STARTED: 3/20/2023

CONTRACTOR: McKillip Excavation, Inc.

LOGGED BY: J. Hall

DATE FINISHED: 3/20/2023

SAMPLING METHOD: Continuous

DEPTH TO WATER (ft bgs) **FIRST:** - **COMPLETED:** -

EQUIPMENT: John Deere 50G

DEPTH (feet)		**SAMPLE DESCRIPTION**	**% GRAVEL**	**% SAND**	**% SILT**	**COMMENTS**
			FIELD SOIL CLASSIFICATION			**CORRECTED SOIL CLASSIFICATION**
0 1	SM	0.0 - 2.0 ft: Loose, dark brown, moist, silty SAND with gravel (SM), gravel is fine to coarse, rounded to angular, some cobbles (up to 12 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	35%	10%	55%	35% Gravel, 50% Sand, 15% Fines Infiltration test at 2 feet bgs (0.93)
2 3	SM	2.0 - 4.0 ft: Medium stiff, dark brown, moist, silty SAND with gravel (SM), sand is well-graded, angular to subangular, gravel is well graded, angular to subrounded Increase in gravel at 3.5 ft [QUARTERNARY MIDDLE TERRACE DEPOSITS]	20%	10%	70%	20% Gravel, 55% Sand, 25% Fines
4	SM	4.0 - 5.0 ft: Loose, light to dark brown, moist, silty SAND with grave (SM), gravel is rounded to angular [QUARTERNARY MIDDLE TERRACE DEPOSITS]	15%	<5%	80%	15% Gravel, 50% Sand, 35% Fines Infiltration test at 4.5 feet bgs (0.65)
5 6 7	GM	5.0 - 8.0 ft: Loose, dark brown, moist, silty GRAVEL (GM), trace sand, gravel is rounded to subangular, cobbles (up to 12 inches), rounded to subangular Increase in cobbles/boulders at 7 feet [QUARTERNARY MIDDLE TERRACE DEPOSITS]	60%	<10%	30%	
8 9 10 11 12 13 14 15 16 17		* Hit refusal on cobbles/boulders at 8 feet				Note: Infiltration test results are in ft/day. Corrected soil grain size percentages and classification based on grain size analysis (see Section 3.3.2).

GSI Water Solutions, Inc.

LOG ID: GM5-TP1

PROJECT: Santiam Canyon Infiltration Evaluation

GROUND SURFACE ELEVATION AND DATUM: 986 feet amsl

TEST PIT LOCATION: 44.742272°, -122.452914°

TOTAL DEPTH (ft): 9

DATE STARTED: 3/21/2023

CONTRACTOR: McKillip Excavation, Inc.

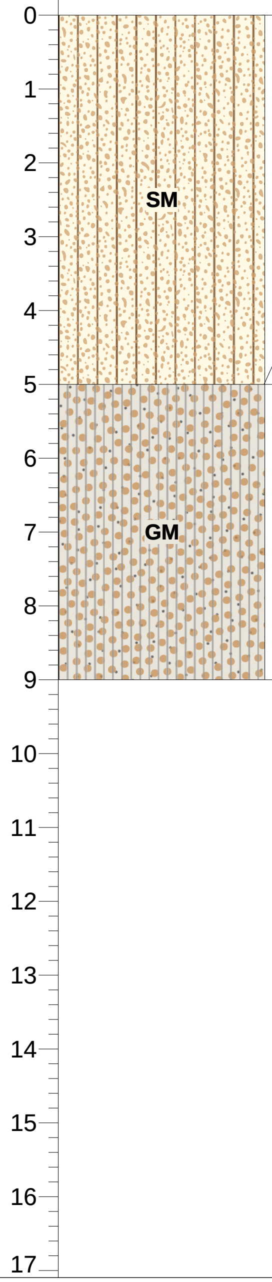
LOGGED BY: J. Hall

DATE FINISHED: 3/21/2023

SAMPLING METHOD: Continuous

DEPTH TO WATER (ft bgs) **FIRST:** - **COMPLETED:** -

EQUIPMENT: John Deere 50G



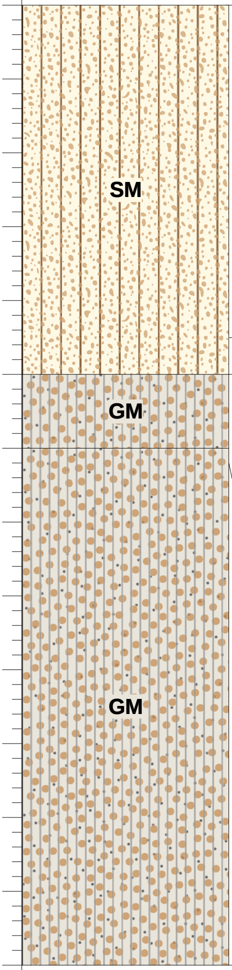
SAMPLE DESCRIPTION	% GRAVEL	% SAND	% SILT	COMMENTS
	FIELD SOIL CLASSIFICATION			CORRECTED SOIL CLASSIFICATION
0.0 - 5.0 ft: Loose, dark brown to dark gray, moist, silty SAND (SM), sand is fine, trace rootlets [QUARTERNARY MIDDLE TERRACE DEPOSITS] Increasing plastisity with depth (medium to high at 5 feet). Trace rootlets at 5 feet	0%	<5%	95%	Infilitration test at 2 feet bgs (0.01) 0% Gravel, 55% Sand, 45% Fines
5.0 - 9.0 ft: Loose, brown to gray, wet, silty GRAVEL (GM), trace sand, gravel is subangular to angular, cobbles are rounded to subrounded, boulders (up to 20 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS]	60%	<5%	40%	Water accumulating in bottom of pit at 8 feet bgs.
* Hit refusal on large boulders at 9 feet				

Note: Infiltration test results are in ft/day. Corrected soil grain size percentages and classifcation based on grain size analysis (see Section 3.3.2).

GSI Water Solutions, Inc.

LOG ID: GM5-TP2

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 1005 feet amsl	
TEST PIT LOCATION:	44.742237°, -122.450529°	**TOTAL DEPTH (ft):** 13	**DATE STARTED:** 3/22/2023
CONTRACTOR:	McKillip Excavation, Inc.	**LOGGED BY:** J. Hall	**DATE FINISHED:** 3/22/2023
SAMPLING METHOD:	Continuous	**DEPTH TO WATER (ft bgs)** **FIRST:** -	**COMPLETED:** -
EQUIPMENT:	John Deere 85G		



DEPTH (feet)	**SAMPLE DESCRIPTION**	**% GRAVEL**	**% SAND**	**% SILT**	**COMMENTS**
		FIELD SOIL CLASSIFICATION			**CORRECTED SOIL CLASSIFICATION**
0 - 5	0.0 - 5.0 ft: Loose, dark brown, dry, silty SAND (SM), trace organics, trace rootlets, sand is fine to coarse, gravel is medium to coarse, subrounded to rounded, few cobbles, boulders (up to 16 inches) [QUARTERNARY MIDDLE TERRACE DEPOSITS] Grades to light brown, increase in gravel at 4.5 feet	10%	<10%	80%	Infiltration test at 2 feet bgs (2.29) 10% Gravel, 55% Sand, 35% Fines
5 - 6	5.0 - 6.0 ft: Loose, dark brown to brown, wet, silty GRAVEL (GM), trace sand is fine to medium, gravel is medium to coarse, subangular to angular, cobbles are rounded to subangular, boulders are rounded to subangular (up to 18 inches) Increase in gravel and cobbles at 6.5 feet [QUARTERNARY MIDDLE TERRACE DEPOSITS]	50%	<10%	40%	
6 - 13	6.0 - 13.0 ft: Loose, brown, wet, silty GRAVEL with sand (GM), sand is fine to coarse, subangular to angular, gravel is fine to coarse, rounded to subangular, cobbles are rounded to subangular, boulders are rounded to subangular [QUARTERNARY MIDDLE TERRACE DEPOSITS]	40%	20%	40%	Water accumulating in bottom of pit at 10 feet bgs.
13	Total Depth = 13.0 feet				

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

Note: Infiltration test results are in ft/day. Corrected soil grain size percentages and classification based on grain size analysis (see Section 3.3.2).

Test Pit: GM1-TP1

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-2'	0.35	0.10	0.60	0.14	0.86	0.28	0.72	0.35	0.47	0.18	Silty SAND with gravel (SM)

Test Pit: GM1-TP3

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-1'	0.05	0.10	0.85	0.11	0.89	0.42	0.58	0.05	0.55	0.40	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
1'-2'	0.10	0.60	0.30	0.67	0.33	0.12	0.88	0.10	0.79	0.11	well graded SAND with silt (SW-SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
2'-8'	0.20	0.60	0.20	0.75	0.25	0.07	0.93	0.20	0.74	0.06	silty SAND with gravel (SW)

Test Pit: GM2-TP1

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-2'	0.00	0.00	1.00	0.00	1.00	0.50	0.50	0.00	0.50	0.50	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
2'-3.5'	0.00	0.20	0.80	0.20	0.80	0.39	0.61	0.00	0.61	0.39	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
3.5'-6'	0.10	0.20	0.70	0.22	0.78	0.34	0.66	0.10	0.60	0.30	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
6'-10'	0.25	0.15	0.60	0.20	0.80	0.28	0.72	0.25	0.54	0.21	silty SAND with gravel (SM)

Test Pit: GM2-TP2

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification

0'-1.5'	0.00	0.00	1.00	0.00	1.00	0.50	0.50	0.00	0.50	0.50	silty SAND (SM)

Test Pit: GM2-TP3

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-2'	0.00	0.05	0.95	0.05	0.95	0.47	0.53	0.00	0.53	0.47	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
2'-4.5'	0.00	0.05	0.95	0.05	0.95	0.47	0.53	0.00	0.53	0.47	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
4.5'-8.5'	0.00	0.05	0.95	0.05	0.95	0.47	0.53	0.00	0.53	0.47	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
8.5'-9'	0.20	0.10	0.70	0.13	0.88	0.34	0.66	0.20	0.53	0.27	silty SAND with gravel (SM)

Test Pit: GM2-TP4

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-3.5'	0.05	0.00	0.95	0.00	1.00	0.47	0.53	0.05	0.50	0.45	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
3.5'-5.5'	0.20	0.40	0.40	0.50	0.50	0.18	0.82	0.20	0.66	0.14	silty SAND with gravel (SM)

Test Pit: GM4-TP1

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-2'	0.05	0.05	0.95	0.05	0.95	0.47	0.53	0.05	0.50	0.45	silty SAND (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
2'-3.5'	0.01	0.05	0.94	0.05	0.95	0.46	0.54	0.01	0.53	0.46	silty SAND (SM)

Test Pit: GM4-TP2

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-3'	0.05	0.05	0.90	0.05	0.95	0.44	0.56	0.05	0.53	0.42	silty SAND (SM)

Test Pit: GM4-TP3

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-2'	0.35	0.10	0.55	0.15	0.85	0.26	0.74	0.35	0.48	0.17	silty SAND with gravel (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
2'-4'	0.20	0.10	0.70	0.13	0.88	0.34	0.66	0.20	0.53	0.27	silty SAND with gravel (SM)

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
4'-5'	0.15	0.05	0.80	0.06	0.94	0.39	0.61	0.15	0.52	0.33	silty SAND with gravel (SM)

Test Pit: GM5-TP1

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-5'	0.00	0.05	0.95	0.05	0.95	0.47	0.53	0.00	0.53	0.47	silty SAND (SM)

Test Pit: GM5-TP2

Depth	Original % Gravel	Original % Sand	Original % Fines	Normalized % Sand	Normalized % Fines	Interim Corrected % Fines	Interim Corrected % Sand	Final Corrected % Gravel	Final Corrected % Sand	Final Corrected % Fines	Corrected USCS Classification
0'-5'	0.10	0.10	0.80	0.11	0.89	0.39	0.61	0.10	0.55	0.35	silty SAND (SM)

ATTACHMENT B

GeoSystems Analysis Infiltration Testing Memo

MEMORANDUM

June 2, 2023

TO: Matt Kohlbecker, RG, GSI Water Solutions, Inc.

FROM: Jason Keller, GeoSystems Analysis, Inc.

CC: Jesse Hall, GSI Water Solutions, Inc.
Scott Waibel, GeoSystems Analysis, Inc.

RE: Gates – Mill City Infiltration Testing

1.0 INTRODUCTION

GeoSystems Analysis Inc. (GSA) was contracted to conduct an infiltration assessment to support test pit characterization performed by GSI Water Solutions, Inc (GSI) at four study areas. The infiltration assessment and test pit characterization were conducted to evaluate the feasibility of treated wastewater infiltration in Gates and Mill City, Oregon. The four study areas are shown in Figure 1 and include:

- Baughman Lucas (GM1)
- Shepherd (GM2)
- 4th Ave Right of Way (ROW) (GM4)
- Weyerhaeuser (GM5)

This technical memorandum presents the results of cylinder infiltrometer (CI) testing and test pit infiltration testing to measure the field effective saturated hydraulic conductivity (K) of predominant materials identified from test pit soil logging performed by GSI.

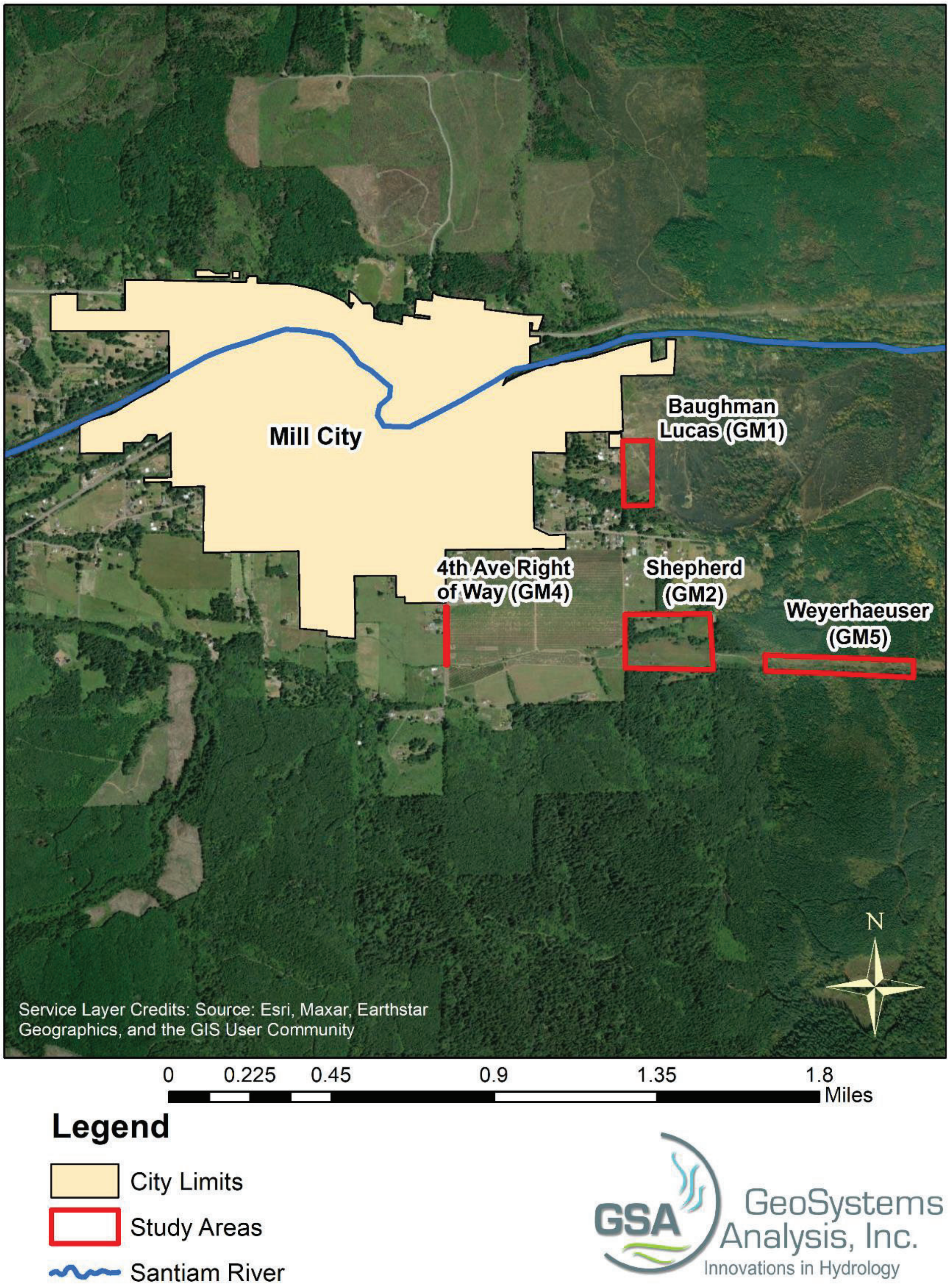


Figure 1. Project study areas

2.0 METHODS

The single-ring CI method with lateral divergence correction (Bouwer et al., 1999) provides an intermediate-scale measurement of the effective K in the tested material. Effective K values provide a good estimate of the potential infiltration rate in the absence of surface clogging and/or restricting or compacted layers present deeper in the profile (Bouwer et al., 1999, Rice et al., 2014). The CI method employs a cylinder measuring 20 inches in diameter and 12 inches in height (Figure 2).

Infiltration tests in soils containing large fraction of gravels, cobbles, and/or boulders were conducted using a modified test pit infiltration with lateral divergence method (Figure 3) due to the inability to create an adequate seal between the coarse gravel and larger size clasts and the ring infiltrometer. Test pit infiltration tests are similar to the CI method except that water is added to an open test pit as opposed to a CI ring. The modified test pit infiltration method may overestimate effective K due to flow through the sidewall of the pit, however, final infiltration measurements were made with pit water heights of approximately 13 inches or less, resulting in flow being predominately vertical flow through the bottom of the test pit and reducing the potential error introduced by sidewall flow. Standard Operating Procedure (SOP) for the CI test method is provided in Appendix A. Modifications to the CI test calculations for the test pit infiltration tests are provided in Appendix B.

Figure 2. Example CI measurement (GM1, TP-4 at 2 ft bgs)

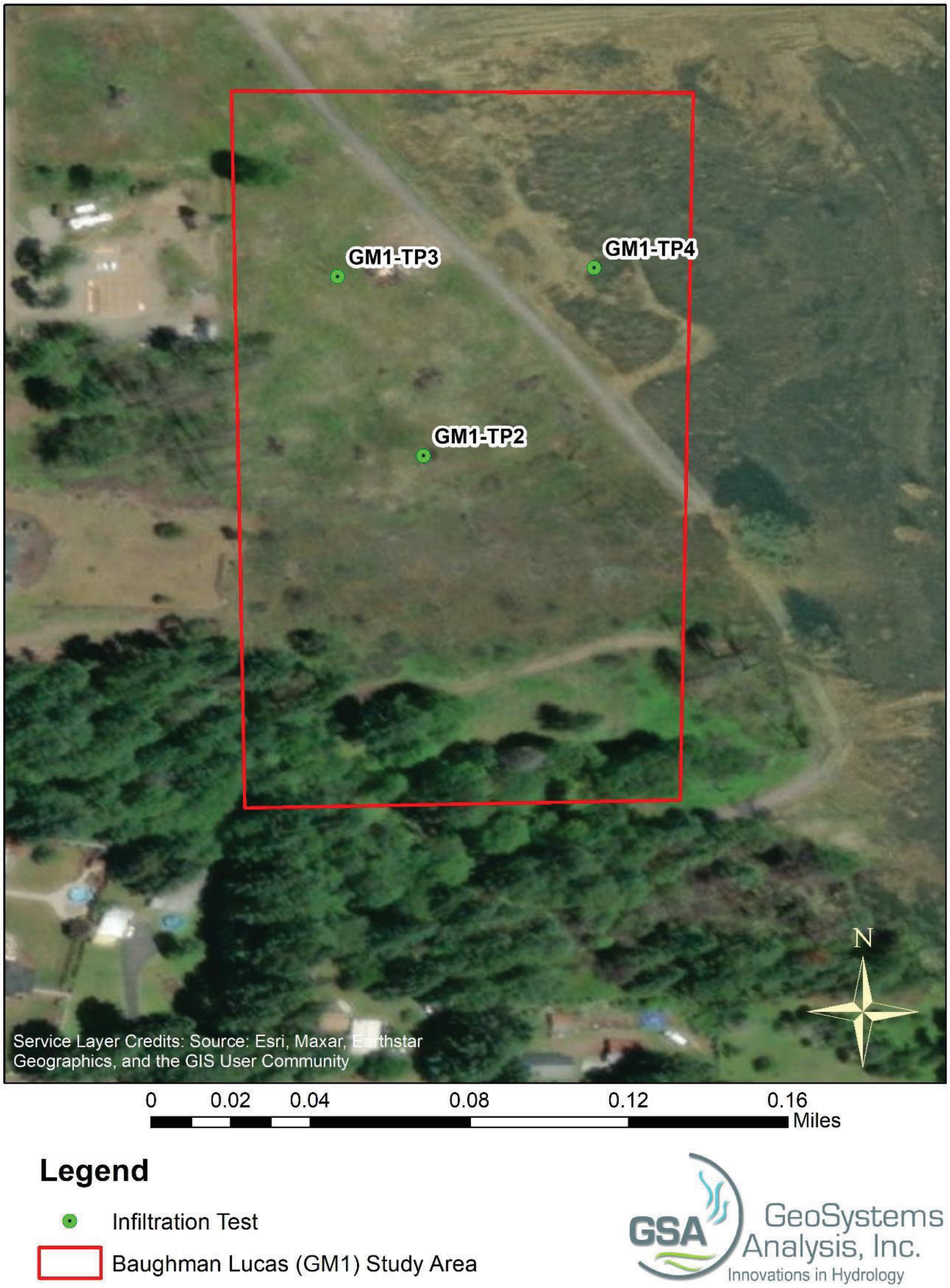
Figure 3. Example modified test pit infiltration measurement (GM1, TP-4 at 3 ft bgs)

Based on GSI's test pit geologic logging results, test pits and depths were selected within each of the four study areas for infiltration testing to measure the effective K of the range of materials encountered. Table 1 summarizes infiltration test ID, infiltration test depth, and test method (i.e., CI method or modified test pit infiltration method). Four infiltration tests were conducted at GM1 (Figure 4), three tests at GM2 (Figure 5), four tests at GM4 (Figure 6), and two tests at GM5 (Figure 7). GM5 was limited to two infiltration tests due to snowy conditions and access constraints.

Table 1. Infiltration test ID, depth and test type

Study Area	Test ID	Test Date	Test Depth (ft bgs)	Test Type[a]
GM1	GM1-TP2	3/23/2023	2	TPI
	GM1-TP3	3/23/2023	2	CI
	GM1-TP4	3/23/2023	2	CI
			3	TPI
GM2	GM2-TP1	3/21/2023	2	CI
	GM2-TP2	3/21/2023	2	CI
	GM2-TP4	3/22/2023	2	CI
GM4	GM4-TP1	3/20/2023	3	CI
	GM4-TP2	3/20/2023	3	CI
	GM4-TP3	3/20/2023	2	CI
			4.5	TPI
GM5	GM5-TP1	3/21/2023	2	CI
	GM5-TP2	3/22/2023	2	CI

a – CI – Single ring cylinder infiltrometer; TPI – Test pit infiltration



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 4. GM1 (Baughman Lucas) infiltration test locations

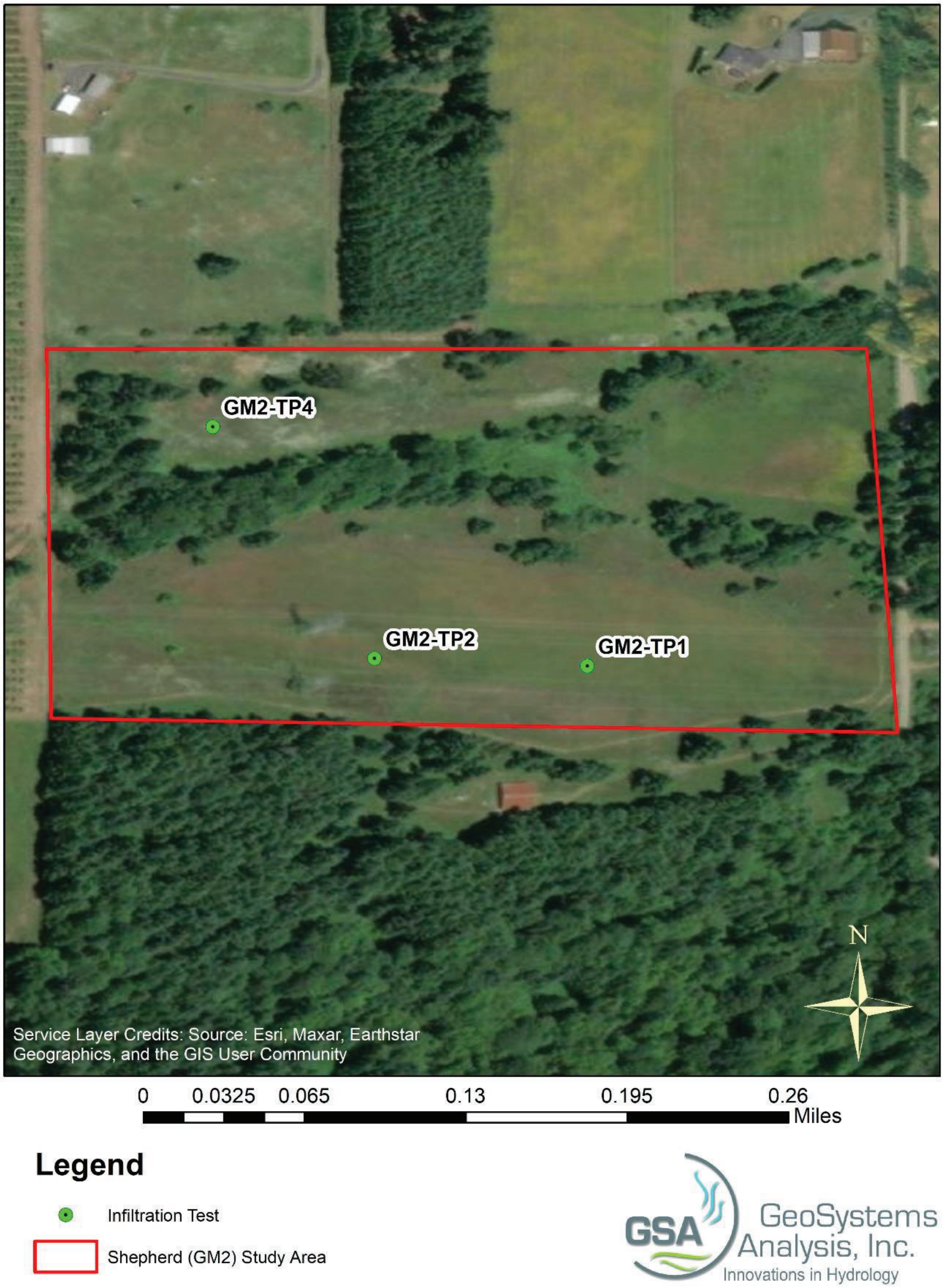


Figure 5. GM2 (Shepherd) infiltration test locations

Figure 6. GM4 (4th Ave ROW) infiltration test locations

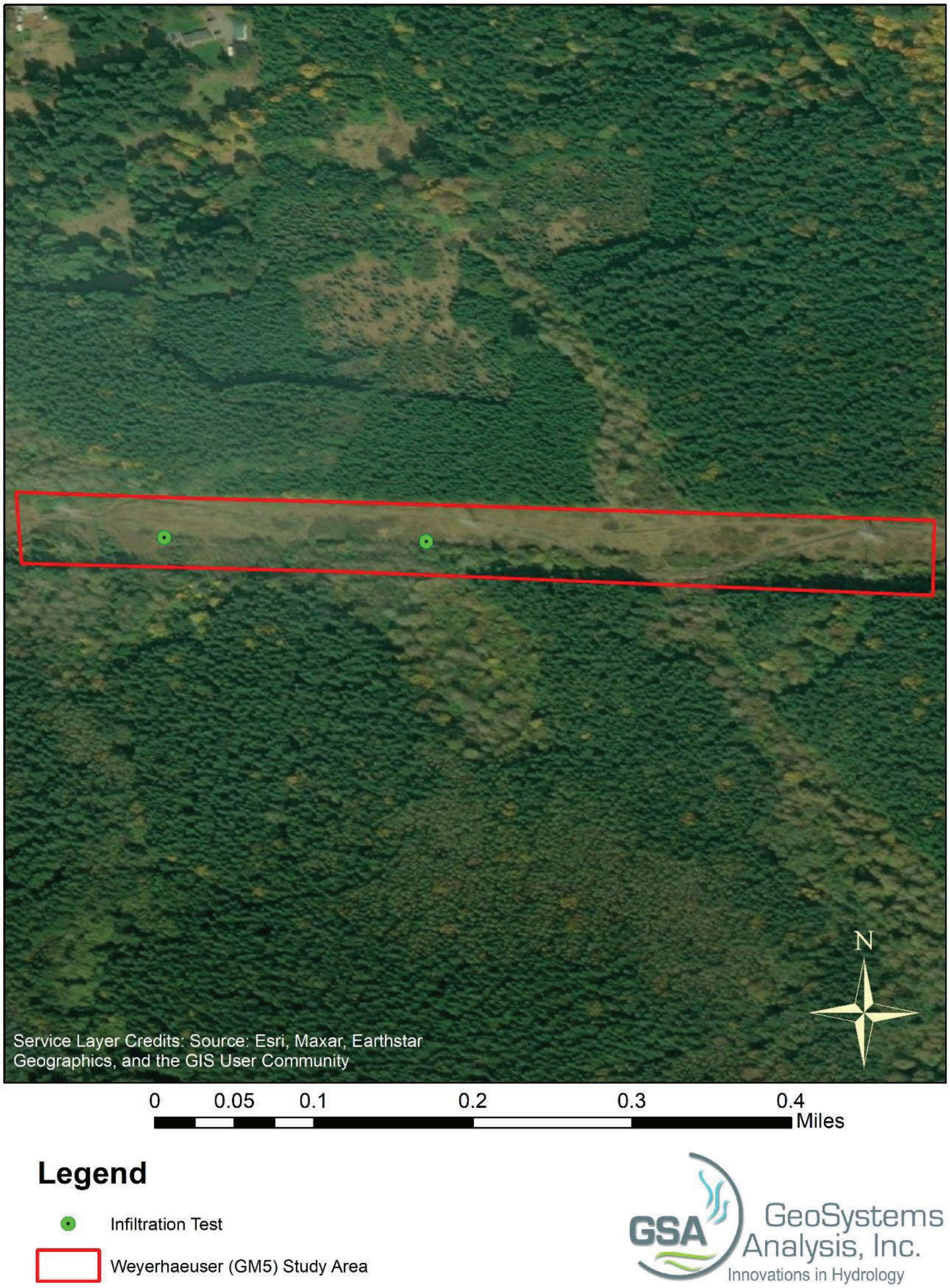


Figure 7. GM5 (Weyerhaeuser) infiltration test locations

3.0 RESULTS

Table 2 presents infiltration testing measured K, United States Department of Agriculture (USDA) soil series, and GSI’s soil classification at the infiltration test depth per the Unified Soil Classification System. Note that the effective K rates do not account for surface clogging over time due to fine soil (i.e., silt and clay) accumulation or biological fouling or uncertainties related to spatial variability in soil properties.

The geometric mean soil effective K increased with decreasing fines content, ranging from less than 0.01 ft/day for USCS Lean Clay (CL) to 12.66 ft/day for USCS Gravel (GM). Study area geometric mean effective K values were greatest at GM1 (Baughman-Lucas, 5.97 ft/day), followed by GM4 (4th Ave ROW, 0.78 ft/day), GM5 (Weyerhaeuser, 0.18 ft/day), and GM2 (Shepherd, 0.12 ft/day).

The GM5 study area was limited to two infiltration tests which had large variability (0.01 ft/day and 2.29 ft/day) and as a result there is increased uncertainty of the GM5 study area effective K. However, based on its proximity to the GM2 study area (Figure 1) and similarity of soils to those observed at the GM2 and GM4 study area (Table 2), the GM5 study area effective K likely ranges between the values measured at GM2 and GM4 study areas (0.12 ft/day to 0.78 ft/day).

Table 2. Infiltration test results

Study Area	Test ID	Depth	USDA Soil Series	USCS Classification[a]	Effective Saturated Hydraulic Conductivity (ft/day)
GM1	GM1-TP2	2	Camas Gravelly Sandy Loam	Gravel (GM)	12.66
	GM1-TP3	2		Sand with gravel (SM)	3.25
	GM1-TP4	2		Gravel with silt (GW-GM)	3.70
	GM1-TP4	3		Gravel with silt (GW-GM)	8.31
	GM1 Geometric Mean				**5.97**
GM2	GM2-TP1	2	Cumley Silty Clay Loam	Silt with sand (ML)	1.17
	GM2-TP2	2		Lean CLAY (CL)	<0.01
	GM2-TP4	2	McAlpin Silty Clay Loam	Silt (ML)	2.03
	GM2 Geometric Mean				**0.12**
GM4	GM4-TP1	3	Sifton Variant Gravelly Loam	Silt (ML)	0.52
	GM4-TP2	3		Silt (ML)	1.19
	GM4-TP3	2	McBee Silty Clay Loam	Silt (ML)	0.93
	GM4-TP3	4.5		Silt (ML)	0.65
	GM4 Geometric Mean				**0.78**
GM5	GM5-TP1	2	Dupee Silt Loam	Silt (ML)	0.01
	GM5-TP2	2	Bull Run Silt Loam	Silt with gravel (ML)	2.29
	GM5 Geometric Mean				**0.18**

a – From GSI test pit logs

4.0 CONCLUSIONS

Measured soil effective K values were greatest at the GM1 project area, indicating the potential for high infiltration rates relative to the other sites tested. The GM4 project area had moderate soil effective K rates, whereas GM2 and GM5 project areas had low soil effective K rates, indicating potentially limiting infiltration rates at the GM2 and GM5 study areas.

Should the Phase II borehole characterization support the GM5 study area as a potentially viable infiltration basin location, we recommend completing the Phase I near surface infiltration testing previously planned for the site that could not be completed due to weather and access constraints.

The effective K rates presented do not account for surface clogging, potentially hydraulically restrictive material layers present deeper in the profile, or uncertainties related to the spatial variability of soil properties. We recommend applying a safety factor to these effective K rates to account for these uncertainties. Additionally, we recommend the selected site undergo large scale (i.e., 4 ft diameter) and long term (i.e., 8 hours) infiltration testing to refine long term estimated infiltration rates.

5.0 REFERENCES

Bouwer, H., Back, J.T., Oliver, J.M., 1999. Predicting Infiltration and Groundwater Mounds for Artificial Recharge, J Hydro Eng, ASCE, (4) pp. 350-357.

Bower, H. 2002. Artificial recharge of groundwater: hydrogeology and engineering. Hydrogeology Journal. 10:121-142.

Rice, R.C., M. Milczarek, J. Keller, 2014. A Critical Review of Single Ring Cylinder Infiltrometers with Lateral Flow Compensation. Proceedings 14th Biennial Symposium on Managed Aquifer Recharge, July 31-August 1, 2014 – Orange, CA.

Appendix A

Cylinder Infiltrometer Standard Operating Procedure

STANDARD OPERATING PROCEDURE 4.4

Single Ring Infiltrometer with Lateral Divergence Correction

Version 1.0

Prepared by:	RR	Date:	08/06/2015
Reviewed by:	JB	Date:	10/09/2020
Approved by:		Date:	

TABLE OF CONTENTS

FIGURES

TABLES

1.0 GENERAL STATEMENT

The single-ring cylinder infiltrometer (CI) method is described by Bouwer et al. (1999). The method is a short-term infiltration test, which provides an in-situ measurement of the effective saturated hydraulic conductivity (K) of soil material.

2.0 OBJECTIVE

The CI is driven into the material to be tested and then filled with water to the top of the ring. The decline of water in the ring is then monitored (Figure 1). After the water falls about 5 cm, the time and exact decrease in water level is recorded and the cylinder is refilled. This process is continued until about 40 cm of water have infiltrated or four hours have expired. A shovel is then used to dig outside of the cylinder to determine the distance of lateral divergence (Figure 1). The depth of the wetting front is also determined by augering in the center of the wetted surface to dryness or the wetting front, if evident. The final infiltration rate, wetting depth and divergence are then used to calculate K.

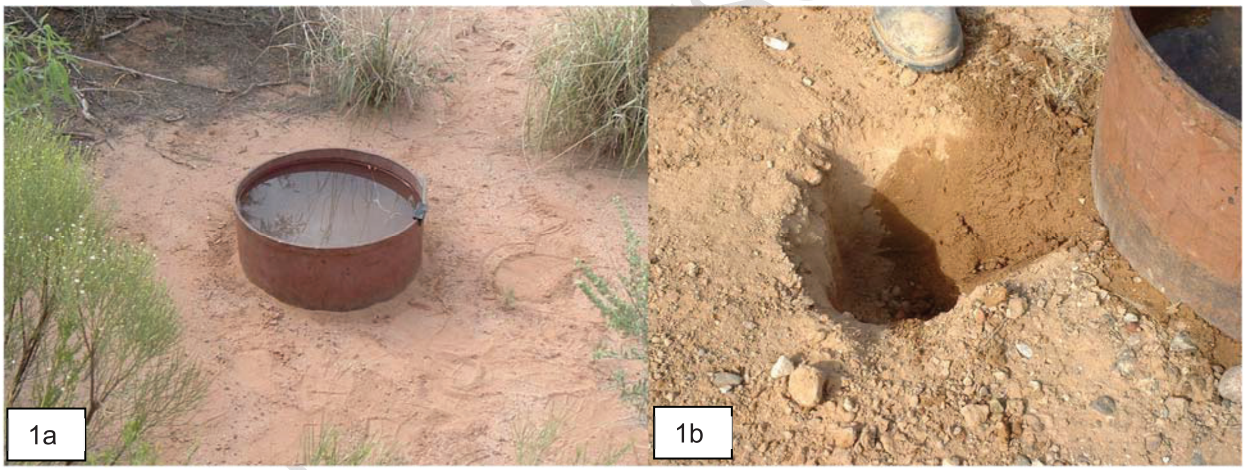


Figure 1. Cylinder infiltrometer testing (1a); measurement of lateral divergence (1b)

3.0 EQUIPMENT AND/OR INSTRUMENTATION

The following field equipment shall be used to run a CI test:

- Cylinder infiltrometer, minimum diameter of 50 cm, depth of 30 cm.
- 20 to 60-liter water-filled containers to supply water.
- Bubble wrap to place inside the ring while filling with water.
- Stopwatch or watch.
- Thermometer.
- Ruler or tape measure.
- Sledge hammer or equivalent driver and three foot 2x4's for driving the CI into the soil.
- Shovel.
- Pick or breaking bar.
- Hand auger
- Knee pads and/or chair (optional).

4.0 PREPARATION

The following procedures shall be used to prepare the site and the equipment for running the CI test:

- The measuring surface should be relatively level.
- Large rocks or stones should be removed from the cylinder perimeter.
- The method is not recommended for use on rocky soil that prevents the insertion of the cylinder.
- When measurements are not taken at the ground surface, the site should be leveled after excavation. Care is to be taken to remove loose, disturbed soil.
- The area leveled should be at least one meter larger than the cylinder diameter.

5.0 PROCEDURES

The following procedures shall be used to run the CI test in the field. Data collected shall be recorded in Table 1.

- Drive the CI approximately 4 to 7 cm into the ground using a sledge hammer or driver and 2x4's placed across the CI top.
- In cases where the soil is too compacted to drive the CI to the required depth, the soil may be loosened around the outside perimeter of the cylinder with a pick or breaking bar and then driven in.
- Lightly compact the soil against the inside and outside of the CI ring to minimize preferential flow at the ring-soil contact.
- Place bubble wrap on the soil surface inside the CI ring to prevent soil disturbance during filling with water.
- Fill the CI ring with water to the top, remove bubble wrap and measure water temperature
- Monitor the decline in water level (y). After the water has fallen about 5 cm, record the elapsed time (Δt) and exact decrease in water level (y_n) before the CI is refilled.
- This process is repeated until about 40 cm of water has infiltrated or four hours have expired.
- When the CI has been filled for the last time, water level measurements should be taken more frequently to obtain an accurate infiltration rate.
- At the conclusion of the test, a shovel is used to dig outside of the cylinder to determine the distance (x) of lateral divergence. In moist soils where the lateral wetting cannot be determined by change of color, the lateral wetting can be determined with a portable moisture probe.
- After removing the cylinder, determine the depth of wetting (L) by augering to dryness or the wetting front, when possible.

6.0 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Not applicable.

7.0 EQUIPMENT DECONTAMINATION AND DISPOSAL

Not applicable.

8.0 DOCUMENTATION

In order to calculate K, the downward flow rate, i_w, must first be corrected for the effect of lateral divergence, based on the radius of the observed wetting front:

1) $$i_w = \frac{i_n \pi r^2}{\pi (r + x)^2}$$

Where,

i_n = infiltration rate during the last water drop ($y_n/\Delta t_n$),

r = radius of the CI ring,

x = lateral divergence from the ring, and

Δt_n = elapsed time during last water drop

When the depth of the wetting front at the end of the test, L, is difficult to measure, such as in soil that is already moist, it can be calculated from the cumulative infiltration (y_t) as follows:

2) $$L = \frac{y_t \pi r^2}{n \pi (r + x)^2}$$

Where, n is the estimated fillable porosity of the soil, based on the field description of soil texture and initial moisture content. When the depth of the wetting front was directly measured in the field, Equation 2 may be used to estimate fillable porosity.

Applying Darcy's equation to the downward flow i_w (Equation 1) and assuming vertical flow in the wetted zone yields:

3) $$i_w = K \frac{z + L - h_{we}}{L}$$

where:

K = effective saturated hydraulic conductivity of the wetted zone,

z = average depth of water in the cylinder during the last water drop y_n,

h_{we} = water entry value of the soil (estimate of soil suction, from Bouwer et al., 1999).

Soil texture estimates made in the field (Table 1) are used to assign the water entry value for each sample.

Equation 3 is rearranged to solve for K:

4) $$K = \frac{i_w L}{(z + L - h_{we})}$$

This calculated *K* is an estimate of the effective field saturated hydraulic conductivity. The effective field saturated hydraulic conductivity, may be less than the true hydraulic conductivity due to air entrapment within the pores. Nonetheless, because of scale effects, cylinder infiltrometers provide a more accurate estimation of saturated hydraulic conductivity than smaller-scale laboratory measurements.

Table 1. Water entry values for different soil types

Soil Type	Water-entry Value (cm of water)[1]
Coarse sands	-5
Medium sands	-10
Fine sands	-15
Loamy sands	-20
Sandy loams	-25
Loams	-35
Structured clay soils	-30
Nonstructured clay soils	-100 or less (more negative)

[1] Water entry values taken from Bouwer, 1999

8.1 Spreadsheet

Enter the data into the Standard Field Form Single Ring Cylinder Infiltrometer spreadsheet (see below) to calculate the final K value. The data to be entered is highlighted in yellow. Several tests can be recorded in the same spreadsheet and summarized on the first page.

9.0 QUALITY ASSURANCE

Quality assurance (QA) for running the CI shall be accomplished by following the procedures contained in this SOP. It is especially important that the sites chosen remain as `undisturbed and are as level as possible. In addition, soils with a large percentage of gravel material, or soils that are loosely compacted increase the probability that the *K* will not be representative of the undisturbed soil matrix.

10.0 REFERENCES

Bouwer, H., Back, J.T., Oliver, J.M., 1999. Predicting Infiltration and Ground Water Mounds for Artificial Recharge, J Hydro Eng, ASCE, (4) pp. 350-357

Standard Field Form
Single Ring Cylinder Infiltrometer

Project: ____________________

Location: ____________________

Date: __________ Operators: ____________________

Soil Type: ____________________

Cover and moisture conditions: ____________________

Diameter of cylinder: 50.4 cm Height of cylinder: 30 cm

Depth of penetration: __________

Time	Filled level	Water level drop	Infiltration	Accumulated infiltration
______	______	Filled	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______

Lateral wetting outside cylinder: __________

Wetting depth: __________

Water entry value: __________

Fillable porosity: __________

Final infiltration rate for large area: __________

Appendix B

Test Pit Infiltration Test Lateral Divergence Correction for an Assumed Rectangular Prism

Test Pit Infiltration Test Lateral Divergence Correction for an Assumed Rectangular Prism)

In order to calculate K, the downward flow rate, iw, must first be corrected for the effect of lateral divergence, based on the change in width and length of the observed wetting front in the rectangular plan view:

1) $$i_w = \frac{i_n l w}{(l+2x)(w+2x)}$$

where:

i_n = infiltration rate during the last water drop $\left({}^{y_n}/_{\Delta t_n}\right)$

l = length of rectangular prism plan view face

w = width of rectangular prism plan view face

x = observed lateral divergence distance

Δt_n = elapsed time during last water drop

When the depth of the wetting front at the end of the test, L, is difficult to measure, such as in soil that is already moist, it can be calculated from the cumulative infiltration (y_t) as follows:

2) $$L = \frac{y_t l w}{n(l+2x)(w+2x)}$$

where *n* is the estimated fillable porosity of the soil, based on the field description of soil texture and initial moisture content. When the depth of the wetting front was directly measured in the field, Equation 2 may be used to estimate fillable porosity.

Applying Darcy's equation to the downward flow i_w (Equation 1) and assuming vertical flow in the wetted zone yields:

3) $$i_w = K\left(\frac{z+L-h_{we}}{L}\right)$$

where:

K = effective saturated hydraulic conductivity of the wetted zone

z = average depth of water in the test pit during the last water drop y_n,

h_{we} = water entry value of the soil

Soil texture estimates made in the field are used to assign the water entry value for each sample.

Equation 3 is rearranged to solve for K:

4) $$K = \frac{i_w L}{(z + L - h_{we})}$$

This calculated K is an estimate of the effective field saturated hydraulic conductivity.

ATTACHMENT C

Test Pit Photolog

Test Pit Soil Photologs

Santiam Canyon Infiltration Evaluation, Phase I Subsurface Characterization

GSI Water Solutions, Inc.

Baughman-Lucas (GM1) TP1
0.0 – 2.0 feet bgs

Baughman-Lucas (GM1) TP1 2.0 – 12.0 feet bgs

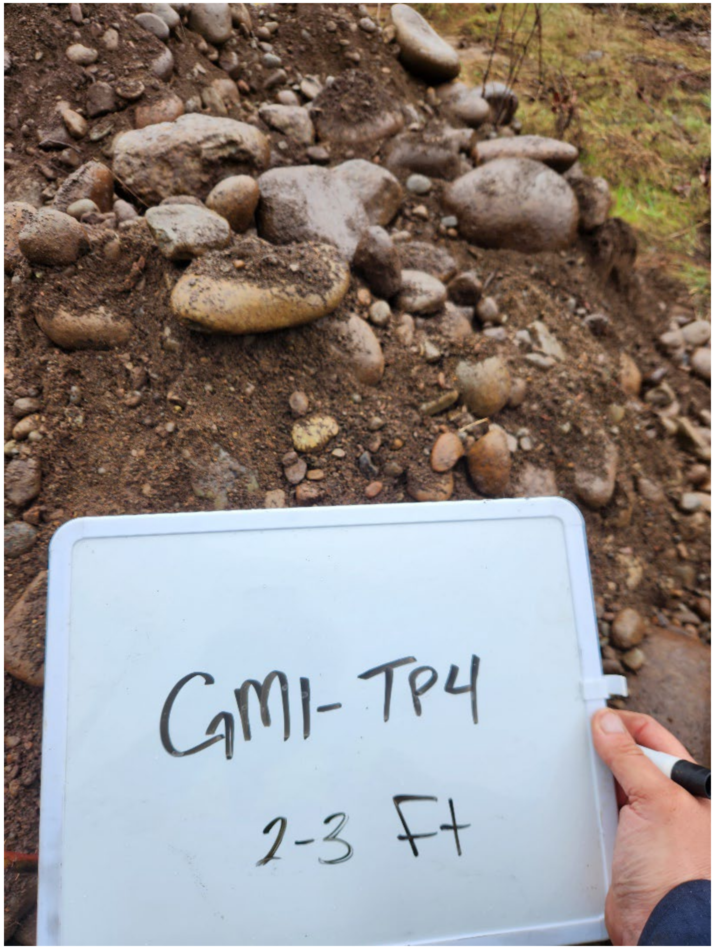
Baughman-Lucas (GM1) TP2 0.0 – 1.5 feet bgs

Baughman-Lucas (GM1) TP2 1.5 – 6.0 feet bgs

Baughman-Lucas (GM1) TP2
6.0 – 8.0 feet bgs

Baughman-Lucas (GM1) TP4 0.0 – 2.0 feet bgs

Baughman-Lucas (GM1) TP4 2.0 – 10.0 feet bgs



Baughman-Lucas (GM1) TP4 10.0 – 12.0 feet bgs

Shepherd (GM2) TP1
0.0 – 2.0 feet bgs

Shepherd (GM2) TP1
3.5 – 6.0 feet bgs

Shepherd (GM2) TP1
6.0 – 10.0 feet bgs

Shepherd (GM2) TP1 10.0 – 13.0 feet bgs

Shepherd (GM2) TP2
0.0 – 1.5 feet bgs

Shepherd (GM2) TP2
1.5 – 5.0 feet bgs

Shepherd (GM2) TP2
5.0 – 7.0 feet bgs

Shepherd (GM2) TP2
7.0 – 13.0 feet bgs

Shepherd (GM2) TP2
0.0 – 2.0 feet bgs

Shepherd (GM2) TP2

Shepherd (GM2) TP3

Shepherd (GM2) TP3

Shepherd (GM2) TP4
0.0 – 3.5 feet bgs

Shepherd (GM2) TP4
3.5 – 5.5 feet bgs

Shepherd (GM2) TP4
5.5 – 9.0 feet bgs

4th Ave. ROW (GM4) TP1
0.0 – 2.0 feet bgs

4th Ave. ROW (GM4) TP1
2.0 – 3.5 feet bgs

4th Ave. ROW (GM4) TP3
0.0 – 2.0 feet bgs

4th Ave. ROW (GM4) TP3 2.0 – 4.0 feet bgs

4th Ave. ROW (GM4) TP3
4.0 – 5.0 feet bgs

4th Ave. ROW (GM4) TP3
5.0 – 8.0 feet bgs

Weyerhaeuser (GM5) TP1
0.0 – 5.0 feet bgs

Weyerhaeuser (GM5) TP1
5.0 – 9.0 feet bgs

Weyerhaeuser (GM5) TP2
0.0 – 5.0 feet bgs

Weyerhaeuser (GM5) TP1
5.0 – 6.0 feet bgs

Weyerhaeuser (GM5) TP2 6.0 – 13.0 feet bgs

ATTACHMENT D

Soil Quality Results Lab Report

Matrix SCIENCES
PAL PACIFIC AGRICULTURAL LABORATORY

PACAGLAB.COM
503.626.7943
21830 S.W. Alexander Ln
Sherwood, OR 97140

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

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Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

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Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 91 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

4/10/23	4/11/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Atrazine	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/11/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/11/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethomorph	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
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Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/11/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluridone	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
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Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/11/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/11/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/11/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/11/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Norflurazon	ND	0.0067 mg/kg	

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Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/11/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/11/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP1
Matrix: soil

PAL Sample ID: P230392-01
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/11/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/11/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/11/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 52 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 83 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Atrazine	ND	0.0067 mg/kg	

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/11/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/11/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethomorph	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/11/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluridone	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/11/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/11/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/11/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/11/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Norflurazon	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

GSI Water Solutions, Inc.
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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/11/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/11/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP2
Matrix: soil

PAL Sample ID: P230392-02
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/11/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/11/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/11/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 68 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 72 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Atrazine	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/11/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/11/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethomorph	ND	0.0067 mg/kg	

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Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/11/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluridone	ND	0.0067 mg/kg	

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Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/11/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/11/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/11/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/11/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Norflurazon	ND	0.0067 mg/kg	

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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/11/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/11/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP3
Matrix: soil

PAL Sample ID: P230392-03
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/11/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/11/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/11/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 61 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

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Kara Greer, Project Manager

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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 124 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Atrazine	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/11/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/11/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethomorph	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/11/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluridone	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
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Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/11/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/11/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/11/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/11/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Norflurazon	ND	0.0067 mg/kg	

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/11/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/11/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GMI-TP4
Matrix: soil

PAL Sample ID: P230392-04
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/11/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/11/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/11/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 72 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 106 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Atrazine	ND	0.0067 mg/kg	

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/11/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/11/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethomorph	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/11/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluridone	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/11/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/11/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/11/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/11/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Norflurazon	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/11/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/11/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP1
Matrix: soil

PAL Sample ID: P230392-05
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/11/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/11/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/11/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 62 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Method: Modified EPA 8270D (GC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 105 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Atrazine	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/11/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/11/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethomorph	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/11/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluridone	ND	0.0067 mg/kg	

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/11/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/11/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/11/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/11/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Norflurazon	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/11/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/11/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP2
Matrix: soil

PAL Sample ID: P230392-06
Sample Date: 3/21/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/11/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/11/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/11/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 66 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 124 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Atrazine	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/11/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/11/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethomorph	ND	0.0067 mg/kg	

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/11/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluridone	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/11/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/11/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/11/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/11/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Norflurazon	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/11/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/11/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP3
Matrix: soil

PAL Sample ID: P230392-07
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/11/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/11/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/11/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 73 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 123 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Atrazine	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/11/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/11/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/11/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Dimethomorph	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/11/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/11/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluridone	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/11/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/11/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/11/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/11/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/11/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Norflurazon	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/11/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/11/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/11/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM2-TP4
Matrix: soil

PAL Sample ID: P230392-08
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/11/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/11/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/11/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/11/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/11/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/11/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/11/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/11/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/11/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/11/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 54 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

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Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 103 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Atrazine	ND	0.0067 mg/kg	

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/12/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/12/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/12/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/12/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/12/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Dimethomorph	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/12/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/12/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/12/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluridone	ND	0.0067 mg/kg	

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Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/12/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/12/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/12/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/12/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/12/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/12/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Norflurazon	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/12/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/12/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP1
Matrix: soil

PAL Sample ID: P230392-09
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/12/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/12/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/12/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 66 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 76 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

4/10/23	4/12/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Atrazine	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/12/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/12/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/12/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/12/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/12/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Dimethomorph	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/12/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/12/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/12/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluridone	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/12/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/12/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/12/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/12/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/12/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/12/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Norflurazon	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/12/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/12/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM4-TP3
Matrix: soil

PAL Sample ID: P230392-10
Sample Date: 3/20/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/12/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/12/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/12/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 58 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Method: Modified EPA 8270D (GC-MS/MS) — Notes: H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 77 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Atrazine	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/12/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/12/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/12/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/12/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/12/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Dimethomorph	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/12/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/12/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/12/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluridone	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/12/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/12/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/12/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/12/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/12/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/12/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Norflurazon	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/12/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/12/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP1
Matrix: soil

PAL Sample ID: P230392-11
Sample Date: 3/22/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/12/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/12/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/12/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 62 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8270D (GC-MS/MS)					H1
4/10/23	4/13/23	2,6-Dichlorobenzamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	a-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Acetochlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Alachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ametryn	ND	0.0067 mg/kg	
4/10/23	4/13/23	Aspon	ND	0.0067 mg/kg	
4/10/23	4/13/23	b-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Benfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bifenthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bolstar	ND	0.0067 mg/kg	
4/10/23	4/13/23	Bromopropylate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Buprofezin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Captan	ND	0.067 mg/kg	
4/10/23	4/13/23	Chlordane	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenapyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorfenvinphos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorobenzilate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chloroneb	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpropham	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Chlorpyrifos-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	cis-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Cyfluthrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Cypermethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Dacthal	ND	0.0067 mg/kg	
4/10/23	4/13/23	d-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Deltamethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Demeton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diazinon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlobenil	ND	0.0067 mg/kg	

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GSI Water Solutions, Inc.
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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Dichlorofenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dichlorvos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diclofop-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dicloran	ND	0.034 mg/kg	
4/10/23	4/13/23	Dicofol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dieldrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dimethenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenamid	ND	0.0067 mg/kg	
4/10/23	4/13/23	Diphenylamine	ND	0.0067 mg/kg	
4/10/23	4/13/23	Disulfoton	ND	0.0067 mg/kg	
4/10/23	4/13/23	Dithiopyr	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endosulfan I	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan II	ND	0.013 mg/kg	
4/10/23	4/13/23	Endosulfan sulfate	ND	0.013 mg/kg	
4/10/23	4/13/23	Endrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Endrin ketone	ND	0.0067 mg/kg	
4/10/23	4/13/23	EPN	ND	0.0067 mg/kg	
4/10/23	4/13/23	Esfenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethalfluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethofumesate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ethoprop	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etoxazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Etridiazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenarimol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenitrothion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenoxaprop-ethyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fenthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fenvalerate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fipronil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluazifop-p-butyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Fludioxonil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Fluroxypyr-meptyl	ND	0.013 mg/kg	
4/10/23	4/13/23	Flutolanil	ND	0.0067 mg/kg	

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Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Fonofos	ND	0.0067 mg/kg	
4/10/23	4/13/23	g-BHC	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Heptachlor epoxide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Hexachlorobenzene	ND	0.0067 mg/kg	
4/10/23	4/13/23	Kresoxim-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	lambda-Cyhalothrin	ND	0.013 mg/kg	
4/10/23	4/13/23	Leptophos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Malathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Mefenoxam	ND	0.0067 mg/kg	
4/10/23	4/13/23	Methoxychlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Metolachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	MGK-264	ND	0.0067 mg/kg	
4/10/23	4/13/23	Myclobutanil	ND	0.0067 mg/kg	
4/10/23	4/13/23	Napropamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ovex	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxadiazon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Oxyfluorfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDD	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDE	ND	0.0067 mg/kg	
4/10/23	4/13/23	p,p'-DDT	ND	0.0067 mg/kg	
4/10/23	4/13/23	Paclobutrazol	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion	ND	0.0067 mg/kg	
4/10/23	4/13/23	Parathion-methyl	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCA	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCB	ND	0.0067 mg/kg	
4/10/23	4/13/23	PCNB	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pendimethalin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pentachlorothioanisole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Permethrin	ND	0.034 mg/kg	
4/10/23	4/13/23	Phorate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Procymidone	ND	0.0067 mg/kg	
4/10/23	4/13/23	Prodiamine	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/13/23	Pronamide	ND	0.0067 mg/kg	
4/10/23	4/13/23	Propachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Pyriproxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Quinoxyfen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Ronnel	ND	0.0067 mg/kg	
4/10/23	4/13/23	Spirodiclofen	ND	0.0067 mg/kg	
4/10/23	4/13/23	Sulfotep	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tefluthrin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Terbufos	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetraconazole	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tetradifon	ND	0.0067 mg/kg	
4/10/23	4/13/23	Thionazin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Tokuthion	ND	0.0067 mg/kg	
4/10/23	4/13/23	trans-Nonachlor	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trichloronate	ND	0.0067 mg/kg	
4/10/23	4/13/23	Trifluralin	ND	0.0067 mg/kg	
4/10/23	4/13/23	Vinclozalin	ND	0.0067 mg/kg	

Surrogate Recovery: 92 %
Surrogate Recovery Range: 34-134
(TPP-d15 used as Surrogate)

Method: Modified EPA 8321B (LC-MS/MS) H1

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	3-Hydroxycarbofuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Abamectin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acephate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acetamiprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Acibenzolar-S-methyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Afidopyropen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb Sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Aldicarb Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Allethrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ametoctradin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Atrazine	ND	0.0067 mg/kg	

GSI Water Solutions, Inc.
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Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Azinphos-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Azinphos-methyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Azoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bendiocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bensulide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bitertanol	ND	0.0067 mg/kg	
4/10/23	4/12/23	Boscalid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Bromacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbaryl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbendazim	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carbofuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Carfentrazone-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Chlorantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Clethodim	ND	0.013 mg/kg	
4/10/23	4/12/23	Clomazone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Clothianidin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyanazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyantraniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyazofamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyclaniliprole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cycloate	ND	0.013 mg/kg	
4/10/23	4/12/23	Cyflufenamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyflumetofen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyhalofop-butyl	ND	0.013 mg/kg	
4/10/23	4/12/23	Cyprodinil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Cyprosulfamide	ND	0.0067 mg/kg	
4/10/23	4/12/23	DCPMU	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diazoxon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Difenoconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diflubenzuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diflufenican	ND	0.0067 mg/kg	
4/10/23	4/12/23	Dimethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Dimethomorph	ND	0.0067 mg/kg	

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Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Dinotefuran	ND	0.0067 mg/kg	
4/10/23	4/12/23	Disulfoton sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Diuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	d-Phenothrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Emamectin Benzoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ethion	ND	0.0067 mg/kg	
4/10/23	4/12/23	Etofenprox	ND	0.0067 mg/kg	
4/10/23	4/12/23	Famoxadone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Famphur	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamidone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamiphos sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenamiphos sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenazaquin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenbuconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenbutatin oxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenhexamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenobucarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenoxycarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenpropathrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenpyroximate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fenuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flonicamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluazinam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flubendiamide	ND	0.013 mg/kg	
4/10/23	4/12/23	Flufenacet	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flumetsulam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flumioxazin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluometuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluopicolide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluopyram	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluoxastrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flupyradifurone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluridone	ND	0.0067 mg/kg	

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Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Flutianil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Flutriafol	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluvalinate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fluxapyroxad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Fonofos	ND	0.013 mg/kg	
4/10/23	4/12/23	Hexaconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Hexazinone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Hexythiazox	ND	0.0067 mg/kg	
4/10/23	4/12/23	Imazalil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Imidacloprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Indaziflam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Indoxacarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Ipconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Iprodione	ND	0.034 mg/kg	
4/10/23	4/12/23	Isofetamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Isoxaben	ND	0.0067 mg/kg	
4/10/23	4/12/23	Isoxadifen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Lactofen	ND	0.0067 mg/kg	
4/10/23	4/12/23	Linuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Malaoxon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Mandipropamid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methamidophos	ND	0.034 mg/kg	
4/10/23	4/12/23	Methidathion	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methiocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methomyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Methoxyfenozide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metrafenone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Metribuzin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Mevinphos	ND	0.0067 mg/kg	
4/10/23	4/12/23	Monuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Neburon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Norflurazon	ND	0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Novaluron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Omethoate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oryzalin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxadixyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxamyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Oxydemeton-Methyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Penoxsulam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Penthiopyrad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phorate Sulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phorate Sulfoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosalone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosmet	ND	0.0067 mg/kg	
4/10/23	4/12/23	Phosphamidon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Picoxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Piperonyl Butoxide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pirimicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pirimiphos-methyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prallethrin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prometon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Prometryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propamocarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propanil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propargite	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Propiconazole	ND	0.013 mg/kg	
4/10/23	4/12/23	Pyraclostrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyraflufen-ethyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyrethrin	ND	0.034 mg/kg	
4/10/23	4/12/23	Pyridaben	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyridalyl	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyrimethanil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Pyroxasulfone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Quizalofop-p-ethyl	ND	0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

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Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Analytical Report

Client Sample ID: GM5-TP2
Matrix: soil

PAL Sample ID: P230392-12
Sample Date: 3/23/23
Received Date: 4/6/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
4/10/23	4/12/23	Rotenone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Saflufenacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sethoxydim	ND	0.013 mg/kg	
4/10/23	4/12/23	Siduron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Simazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Simetryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spinetoram	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spinosad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spiromesifen	ND	0.013 mg/kg	
4/10/23	4/12/23	Spirotetramat	ND	0.0067 mg/kg	
4/10/23	4/12/23	Spiroxamine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sulfentrazone	ND	0.0067 mg/kg	
4/10/23	4/12/23	Sulfoxaflor	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebuconazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebufenozide	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tebuthiuron	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbacil	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbuthylazine	ND	0.0067 mg/kg	
4/10/23	4/12/23	Terbutryn	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiabendazole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiacloprid	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiamethoxam	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiobencarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Thiodicarb	ND	0.0067 mg/kg	
4/10/23	4/12/23	Tolfenpyrad	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triadimefon	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triadimenol	ND	0.013 mg/kg	
4/10/23	4/12/23	Triallate	ND	0.0067 mg/kg	
4/10/23	4/12/23	Trifloxystrobin	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triflumizole	ND	0.0067 mg/kg	
4/10/23	4/12/23	Triticonazole	ND	0.0067 mg/kg	

Surrogate Recovery: 61 %
Surrogate Recovery Range: 36-117
(TPP-d15 used as Surrogate)

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Quality Assurance

Method Blank Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/13/23	23D1004-BLK1	2,6-Dichlorobenzamide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	3-Hydroxycarbofuran	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Abamectin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	a-BHC	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Acephate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Acetamiprid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Acetochlor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Acibenzolar-S-methyl	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Afidopyropen	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Alachlor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Aldicarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Aldicarb Sulfone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Aldicarb Sulfoxide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Aldrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Allethrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Ametoctradin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Ametryn	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Aspon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Atrazine	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Azinphos-ethyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Azinphos-methyl	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Azoxystrobin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	b-BHC	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Bendiocarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Benfluralin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Bensulide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Bifenthrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Bitertanol	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Bolstar	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Boscalid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Bromacil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Bromopropylate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Buprofezin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Captan	Not Detected	< 0.067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Carbaryl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Carbendazim	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Carbofuran	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Carfentrazone-ethyl	Not Detected	< 0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Method Blank Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/11/23	23D1004-BLK1	Chlorantraniliprole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Chlordane	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Chlorfenapyr	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Chlorfenvinphos	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Chlorobenzilate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Chloroneb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Chlorpropham	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Chlorpyrifos	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Chlorpyrifos-methyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	cis-Nonachlor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Clethodim	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Clomazone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Clothianidin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyanazine	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyantraniliprole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyazofamid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyclaniliprole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cycloate	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyflufenamid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyflumetofen	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Cyfluthrin	Not Detected	< 0.034 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyhalofop-butyl	Not Detected	< 0.013 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Cypermethrin	Not Detected	< 0.034 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyprodinil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Cyprosulfamide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dacthal	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	d-BHC	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	DCPMU	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Deltamethrin	Not Detected	< 0.034 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Demeton	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Diazinon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Diazoxon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dichlobenil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dichlorofenthion	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dichlorvos	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Diclofop-methyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dicloran	Not Detected	< 0.034 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dicofol	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dieldrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Difenoconazole	Not Detected	< 0.0067 mg/kg	

Method Blank Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/11/23	23D1004-BLK1	Diflubenzuron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Diflufenican	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dimethenamid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Dimethoate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Dimethomorph	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Dinotefuran	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Diphenamid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Diphenylamine	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Disulfoton	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Disulfoton sulfone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Dithiopyr	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Diuron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	d-Phenothrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Emamectin Benzoate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Endosulfan I	Not Detected	< 0.013 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Endosulfan II	Not Detected	< 0.013 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Endosulfan sulfate	Not Detected	< 0.013 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Endrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Endrin ketone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	EPN	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Esfenvalerate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Ethalfluralin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Ethion	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Ethofumesate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Ethoprop	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Etofenprox	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Etoxazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Etridiazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Famoxadone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Famphur	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenamidone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenamiphos sulfone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenamiphos sulfoxide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fenarimol	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenazaquin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenbuconazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenbutatin oxide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenhexamid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fenitrothion	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenobucarb	Not Detected	< 0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Method Blank Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/13/23	23D1004-BLK1	Fenoxaprop-ethyl	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenoxycarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenpropathrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenpyroximate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fenthion	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fenuron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fenvalerate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fipronil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Flonicamid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fluazifop-p-butyl	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fluazinam	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Flubendiamide	Not Detected	< 0.013 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fludioxonil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Flufenacet	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Flumetsulam	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Flumioxazin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fluometuron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fluopicolide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fluopyram	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fluoxastrobin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Flupyradifurone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fluridone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fluroxypyr-meptyl	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Flutianil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Flutolanil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Flutriafol	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fluvalinate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fluxapyroxad	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Fonofos	Not Detected	< 0.013 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Fonofos	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	g-BHC	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Heptachlor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Heptachlor epoxide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Hexachlorobenzene	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Hexaconazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Hexazinone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Hexythiazox	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Imazalil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Imidacloprid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Indaziflam	Not Detected	< 0.0067 mg/kg	

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Kara Greer, Project Manager

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Method Blank Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/11/23	23D1004-BLK1	Indoxacarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Ipconazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Iprodione	Not Detected	< 0.034 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Isofetamid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Isoxaben	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Isoxadifen-ethyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Kresoxim-methyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Lactofen	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	lambda-Cyhalothrin	Not Detected	< 0.013 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Leptophos	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Linuron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Malaoxon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Malathion	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Mandipropamid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Mefenoxam	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Metconazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Methamidophos	Not Detected	< 0.034 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Methidathion	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Methiocarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Methomyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Methoxychlor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Methoxyfenozide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Metolachlor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Metrafenone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Metribuzin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Mevinphos	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	MGK-264	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Monuron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Myclobutanil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Napropamide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Neburon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Norflurazon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Novaluron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Omethoate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/12/23	23D1004-BLK1	Oryzalin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Ovex	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Oxadiazon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Oxadixyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Oxamyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Oxydemeton-Methyl	Not Detected	< 0.0067 mg/kg	

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Method Blank Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/13/23	23D1004-BLK1	Oxyfluorfen	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	p,p'-DDD	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	p,p'-DDE	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	p,p'-DDT	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Paclobutrazol	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Parathion	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Parathion-methyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	PCA	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	PCB	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	PCNB	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Pendimethalin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Penoxsulam	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Pentachlorothioanisole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Penthiopyrad	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Permethrin	Not Detected	< 0.034 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Phorate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Phorate Sulfone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Phorate Sulfoxide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Phosalone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Phosmet	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Phosphamidon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Picoxystrobin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Piperonyl Butoxide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Pirimicarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Pirimiphos-methyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Prallethrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Procymidone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Prodiamine	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Prometon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Prometryn	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Pronamide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Propachlor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Propamocarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Propanil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Propargite	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Propazine	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Propiconazole	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Pyraclostrobin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Pyraflufen-ethyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Pyrethrin	Not Detected	< 0.034 mg/kg	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Method Blank Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/11/23	23D1004-BLK1	Pyridaben	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Pyridalyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Pyrimethanil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Pyriproxyfen	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Pyroxasulfone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Quinoxyfen	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Quizalofop-p-ethyl	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Ronnel	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Rotenone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Saflufenacil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Sethoxydim	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Siduron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Simazine	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Simetryn	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Spinetoram	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Spinosad	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Spirodiclofen	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Spiromesifen	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Spirotetramat	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Spiroxamine	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Sulfentrazone	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Sulfotep	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Sulfoxaflor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Tebuconazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Tebufenozide	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Tebuthiuron	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Tefluthrin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Terbacil	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Terbufos	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Terbuthylazine	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Terbutryn	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Tetraconazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Tetradifon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Thiabendazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Thiacloprid	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Thiamethoxam	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Thiobencarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Thiodicarb	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Thionazin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Tokuthion	Not Detected	< 0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Method Blank Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/11/23	23D1004-BLK1	Tolfenpyrad	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	trans-Nonachlor	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Triadimefon	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Triadimenol	Not Detected	< 0.013 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Triallate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Trichloronate	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Trifloxystrobin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Triflumizole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Trifluralin	Not Detected	< 0.0067 mg/kg	
4/10/23	4/11/23	23D1004-BLK1	Triticonazole	Not Detected	< 0.0067 mg/kg	
4/10/23	4/13/23	23D1004-BLK1	Vinclozalin	Not Detected	< 0.0067 mg/kg	

Kara Greer

Kara Greer, Project Manager

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GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Matrix Spike Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/11/23	23D1004-MS1	Azoxystrobin	92	53-103	
4/10/23	4/11/23	23D1004-MSD1	Azoxystrobin	95	53-103	
4/10/23	4/14/23	23D1004-MS1	Bifenthrin	109	50-151	
4/10/23	4/14/23	23D1004-MSD1	Bifenthrin	106	50-151	
4/10/23	4/11/23	23D1004-MS1	Boscalid	99	52-120	
4/10/23	4/11/23	23D1004-MSD1	Boscalid	101	52-120	
4/10/23	4/11/23	23D1004-MS1	Bromacil	95	64-106	
4/10/23	4/11/23	23D1004-MSD1	Bromacil	95	64-106	
4/10/23	4/14/23	23D1004-MS1	Chlorpyrifos	112	45-145	
4/10/23	4/14/23	23D1004-MSD1	Chlorpyrifos	110	45-145	
4/10/23	4/14/23	23D1004-MS1	Dimethenamid	106	46-142	
4/10/23	4/14/23	23D1004-MSD1	Dimethenamid	106	46-142	
4/10/23	4/14/23	23D1004-MS1	Dithiopyr	102	53-139	
4/10/23	4/14/23	23D1004-MSD1	Dithiopyr	98	53-139	
4/10/23	4/11/23	23D1004-MS1	Diuron	92	59-98	
4/10/23	4/11/23	23D1004-MSD1	Diuron	96	59-98	
4/10/23	4/14/23	23D1004-MS1	Endosulfan I	111	58-126	
4/10/23	4/14/23	23D1004-MSD1	Endosulfan I	107	58-126	
4/10/23	4/11/23	23D1004-MS1	Flumioxazin	95	44-121	
4/10/23	4/11/23	23D1004-MSD1	Flumioxazin	91	44-121	
4/10/23	4/11/23	23D1004-MS1	Imidacloprid	100	56-109	
4/10/23	4/11/23	23D1004-MSD1	Imidacloprid	102	56-109	
4/10/23	4/11/23	23D1004-MS1	Indaziflam	90	49-105	
4/10/23	4/11/23	23D1004-MSD1	Indaziflam	93	49-105	
4/10/23	4/11/23	23D1004-MS1	Iprodione	120	60-116	R1
4/10/23	4/11/23	23D1004-MSD1	Iprodione	122	60-116	R1
4/10/23	4/11/23	23D1004-MS1	Isoxaben	97	58-108	
4/10/23	4/11/23	23D1004-MSD1	Isoxaben	95	58-108	
4/10/23	4/14/23	23D1004-MS1	Myclobutanil	108	42-149	
4/10/23	4/14/23	23D1004-MSD1	Myclobutanil	107	42-149	
4/10/23	4/12/23	23D1004-MS1	Oryzalin	86	34-135	
4/10/23	4/12/23	23D1004-MSD1	Oryzalin	81	34-135	
4/10/23	4/14/23	23D1004-MS1	Pendimethalin	129	45-157	
4/10/23	4/14/23	23D1004-MSD1	Pendimethalin	131	45-157	
4/10/23	4/14/23	23D1004-MS1	Prodiamine	115	35-150	
4/10/23	4/14/23	23D1004-MSD1	Prodiamine	106	35-150	
4/10/23	4/14/23	23D1004-MS1	Pronamide	102	60-140	
4/10/23	4/14/23	23D1004-MSD1	Pronamide	101	60-140	
4/10/23	4/11/23	23D1004-MS1	Pyraclostrobin	100	60-114	
4/10/23	4/11/23	23D1004-MSD1	Pyraclostrobin	101	60-114	
4/10/23	4/14/23	23D1004-MS1	Pyriproxyfen	105	48-158	
4/10/23	4/14/23	23D1004-MSD1	Pyriproxyfen	105	48-158	
4/10/23	4/11/23	23D1004-MS1	Thiabendazole	88	14-104	
4/10/23	4/11/23	23D1004-MSD1	Thiabendazole	84	14-104	

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

GSI Water Solutions, Inc.
650 NE Holladay Street Suite 900
Portland, OR 97232

Report Number: P230392
Report Date: April 20, 2023
Client Project ID: 464.020.002

Matrix Spike Data **Matrix:** soil

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
4/10/23	4/14/23	23D1004-MS1	Trifluralin	94	49-136	
4/10/23	4/14/23	23D1004-MSD1	Trifluralin	96	49-136	

Project Notes

Notes	Definition
R1	Spike recovery is outside of control limits.
H1	The sample was received and extracted outside of recommended hold time.

Kara Greer

Kara Greer, Project Manager

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

ATTACHMENT E

Soil Physical Properties Lab Report

3393 N Dodge Blvd
Tucson, AZ 85716
520-628-9330
Fax: 520-628-1122
www.gsanalysis.com

Date: May 19, 2023
Project Number: **92310**
Project Name: **GSI - Gates/Mill City Soil Characterization**
Job Description: Lab Testing
Client: GSI Water Solutions
Project Contact: Matt Kohlbecker, RG
Billing Address: 650 NE Holladay St., Suite 900
Portland, OR 97232

Test	***Method***	***Qty***
Specific Gravity of Soils	ASTM D854-14	3
Particle Size Analysis with Hydrometer	ASTM D6913-17 / ASTM D7928-17	6

Thank you for choosing GeoSystems Analysis for your material testing needs. We look forward to working with you again. If you have any questions or require additional information, please contact us at 1-520-628-9330

Sincerely,

Prepared By: Nate Blevens
Laboratory Project Manager

Reviewed By: Mike Yao
Laboratory Technical Director

GSA GeoSystems Analysis, Inc.
Innovations in Hydrology

3393 N Dodge Blvd
Tucson, AZ 85716
520-628-9330
Fax: 520-628-1122
www.gsanalysis.com

Laboratory Test Results - Soil Specific Gravity

Date: May 19, 2023
Project Number: **92310**
Project Name: **GSI - Gates/Mill City Soil Characterization**
Client: GSI Water Solutions

Sample ID	Specific Gravity (g/cm^3)
GM1-TP2-6	2.80
GM1-TP3-5	2.79
GM4-TP3-4.5	2.67

GSA GeoSystems Analysis, Inc.
Innovations in Hydrology

3393 N Dodge Blvd
Tucson, AZ 85716
520-628-9330
Fax: 520-628-1122
www.gsanalysis.com

Laboratory Test Results - Particle Size Distribution

Date: May 19, 2023
Project Number: **92310**
Project Name: **GSI - Gates/Mill City Soil Characterization**
Client: GSI Water Solutions

PSD						
		Sample ID				
Sieve		**GM1-TP2-6**	**GM1-TP3-5**	**GM1-TP4-5**	**GM4-TP3-4.5**	**GM4-TP3-6**
(mm)	**US standard**	**Percent Passing**				
4.75	**#4**	100	100	100	100	100
2.36	**#8**	82	76	78	99	92
2	**#10**	80	71	72	99	91
1.18	**#16**	68	56	59	99	86
0.6	**#30**	40	40	38	94	71
0.425	**#40**	27	33	29	89	62
0.3	**#50**	20	26	24	80	54
0.15	**#100**	11	16	14	60	41
0.075	**#200**	7.9	11.4	9.7	47.1	34.5
0.05	**Hydrometer**	6.8	10.0	8.8	39.9	32.3
0.025		5.1	7.7	6.5	29.9	27.2
0.02		4.6	7.0	5.7	27.2	25.3
0.01		3.2	4.7	3.2	20.1	18.9
0.005		1.9	2.8	1.1	14.5	12.7
0.002		0.6	0.9	0.0	8.5	6.3

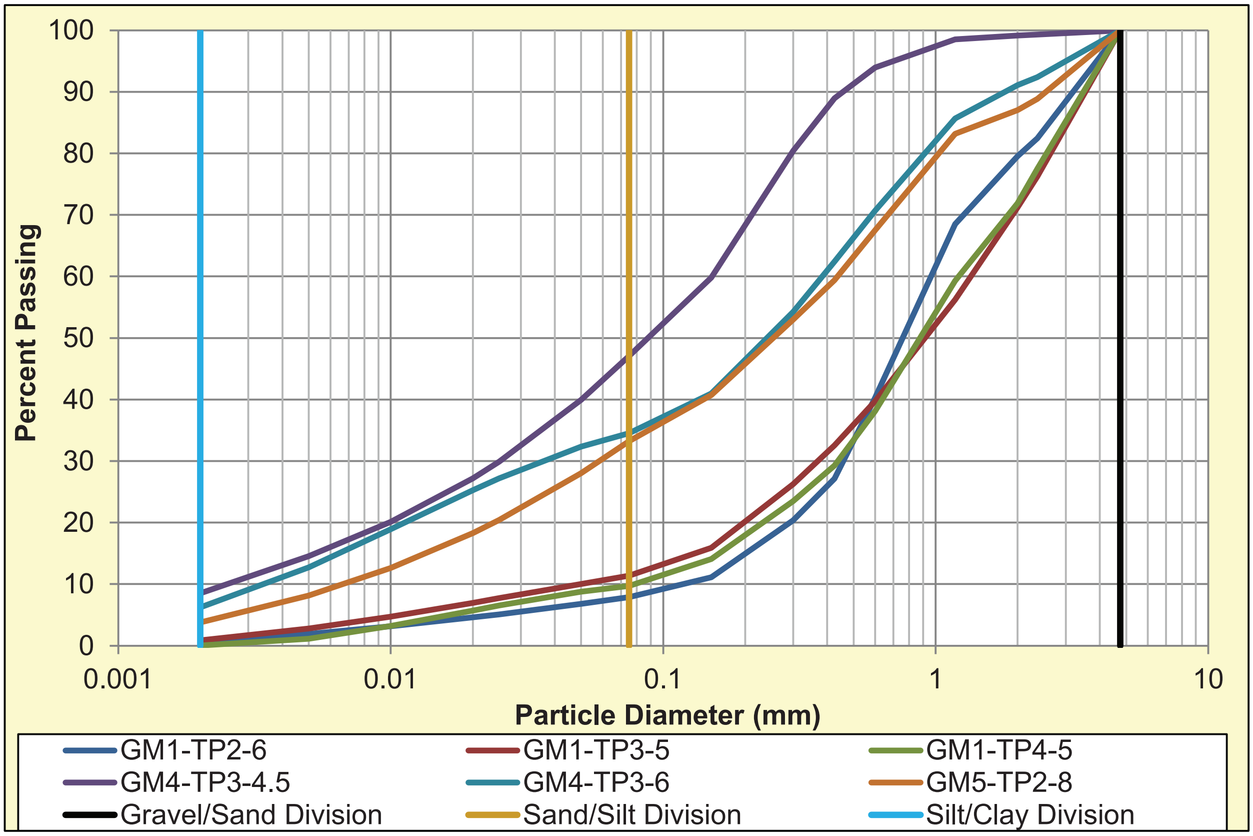
PSD		
		Sample ID
Sieve		**GM5-TP2-8**
(mm)	**US standard**	**Percent Passing**
4.75	**#4**	100
2.36	**#8**	89
2	**#10**	87
1.18	**#16**	83
0.6	**#30**	68
0.425	**#40**	59
0.3	**#50**	53
0.15	**#100**	41
0.075	**#200**	33.2
0.05	**Hydrometer**	28.0
0.025		20.4
0.02		18.3
0.01		12.6
0.005		8.1
0.002		3.8

GSA GeoSystems Analysis, Inc.
Innovations in Hydrology

3393 N Dodge Blvd
Tucson, AZ 85716
520-628-9330
Fax: 520-628-1122
www.gsanalysis.com

Laboratory Test Results - Soil Particle Size Distribution with Hydrometer

Date: May 19, 2023
Project Number: **92310**
Project Name: **GSI - Gates/Mill City Soil Characterization**
Client: GSI Water Solutions



DRAFT TECHNICAL MEMORANDUM

Phase II Subsurface Characterization to Support an Evaluation of Treated Wastewater Infiltration in Gates and Mill City, Marion and Linn Counties, Oregon

To:	Chris Einmo / Marion County
From:	Jesse Hall, GIT / GSI Water Solutions, Inc. Matt Kohlbecker, RG / GSI Water Solutions, Inc. Jason Keller, RG / GeoSystems Analysis, Inc.
CC:	Peter Olsen / Keller Associates, Inc. Pamela Villarreal / Keller Associates, Inc. Brian Nicholas / Marion County Dave Kinney / City of Mill City Russ Foltz / City of Mill City Kari Low / Commonstreet Consulting Tamisha Schrunk / Commonstreet Consulting
Date:	August 11, 2023

This Technical Memorandum (TM), prepared by GSI Water Solutions, Inc. (GSI) and GeoSystems Analysis, Inc. (GSA), summarizes the second phase of a subsurface characterization to evaluate the feasibility of treated wastewater infiltration in Gates and Mill City, Oregon.

1. Introduction

This section summarizes background information about the treated wastewater infiltration project in the Santiam Canyon, including a project overview (Section 1.1) and an overview of the Phase II Subsurface Characterization in Gates and Mill City (Section 1.2).

1.1 Project Overview

The North Santiam Sewer Authority (NSSA) is planning to dispose of treated wastewater by infiltration. Two infiltration facilities are planned—one in the Gates/Mill City area and another in the Detroit/Idanha area. Infiltration facilities will be comprised of rapid infiltration basins and will be authorized by Water Pollution Control Facilities (WPCF) permits from the Oregon Department of Environmental Quality (DEQ).

A phased approach is being used to evaluate infiltration feasibility in the Gates/Mill City area. The phases include:

- **Phase I.** Excavation of test pits and infiltration testing to characterize shallow soils in four study areas.
- **Phase II.** Construction of a single monitoring well and aquifer testing to characterize deep soils in the three study areas that are considered to be the most favorable for infiltration based on the results of Phase I.
- **Phase III.** Construction of two additional monitoring wells, advancement of two temporary borings within the footprint of the planned infiltration basin area, and aquifer testing in the study area that is most favorable to infiltration based on the results of Phase II.

1.2 Phase II Investigation in the Gates/Mill City Area

Permitting and design of an infiltration basin requires characterization of soils and groundwater to evaluate whether infiltration capacity at a site is sufficient to meet the projected volume of wastewater that will be infiltrated. In 2023, GSI developed the *Santiam Canyon Treated Wastewater Infiltration Evaluation Subsurface Characterization Work Plan* (the Work Plan) (GSI, 2023a) to guide Phase I and Phase II of the subsurface characterization. An addendum to the Work Plan will be prepared to guide Phase III of the characterization.

In the Gates/Mill City area, the Phase I Subsurface Characterization was completed in March of 2023 at the four study areas shown in Figure 1. The Phase II Subsurface Characterization was completed in July of 2023 at study areas GM1, GM3, and GM4, which were most favorable to infiltration based on the results of the Phase I Subsurface Characterization (GSI, 2023b).

The objective of the Phase II Subsurface Characterization is to collect data that can be used to select one of the three study areas for the Phase III Subsurface Characterization. This TM summarizes the: (1) Phase II subsurface investigation at GM1, GM3, and GM4 that consisted of installing groundwater monitoring wells and conducting aquifer tests to estimate aquifer permeability, and (2) analytical groundwater modeling to estimate the volume of wastewater that can be infiltrated at each study area based on data collected during the field event. Monitoring well locations are shown in Figure 2a (study area GM1), Figure 2b (study area GM4), and Figure 2c (study area GM5).

This TM summarizes methods (Section 2) and results (Section 3) of the Gates/Mill City Phase II Subsurface Characterization. Finally, this TM provides conclusions and recommendations (Section 4).

2. Methods

This section describes methods used during the Phase II Subsurface Characterization to: (1) locate subsurface utilities (Subsection 2.1), (2) construct monitoring wells (Subsection 2.2), (3) collect samples for analysis of soil physical properties (Subsection 2.3), (4) collect samples for analysis of groundwater and wastewater quality (Subsection 2.4), (5) conduct a slug test to determine aquifer hydraulic conductivity (Subsection 2.5), and (6) estimate the infiltration capacity at each site (Subsection 2.6).

2.1 Utility Locating

Areas chosen for monitoring wells were located and cleared for subsurface utilities by Pacific Northwest Locating, LLC on May 5th, 2023. No utilities were identified near proposed monitoring well locations.

2.2 Monitoring Well Construction and Development

Groundwater monitoring wells were constructed at sites GM1, GM4, and GM5 with the objectives of: (1) identifying potential restrictive layers at depth, (2) collecting soil samples for analysis of physical properties, (3) collecting groundwater quality samples, and (4) testing of aquifer permeability. Monitoring well borings were drilled with a track-mounted Terra Sonic 150cc Compact Crawler rotosonic drilling rig operated by Holt Services of Vancouver, Washington. Monitoring well borings were advanced to approximately 20 feet below the water table. Drilling dates, tooling methods, and total monitoring well depths are provided in Table 1.

Table 1. Overview of Monitoring Well Drilling.

Well ID	Drilling Date(s) [1]	Drill Tooling	Total Depth (feet)
GM1-MW1	5/19/2023 – 5/22/2023	6-inch casing, 4-inch core barrel	40
GM4-MW1	5/17/2023 – 5/18/2023	6-inch casing, 4-inch core barrel	45
GM5-MW1	5/15/2023 – 5/16/2023	6-inch casing, 4-inch core barrel	75

Notes

(1) Does not include well completion activities.

Once monitoring well construction was completed, wells were developed using a Waterra Pump System ® with foot valve and surge block. Wells were pumped and surged until at least ten borehole volumes had been removed, turbidity levels in the well dropped below 100 nephelometric turbidity units (NTUs), and water quality parameters stabilized in accordance with Environmental Protection Agency (EPA) well development guidance (Striggow et al, 2008).

2.3 Soil Physical Properties Logging and Sampling

During drilling, GSI personnel continuously logged soils from each borehole in general accordance with the visual-manual method of the Unified Soil Classification System (USCS) (ASTM, 2016). In addition, the following soil physical properties were measured during the Phase II Subsurface Characterization:

- **Saturated Vertical Hydraulic Conductivity, Particle Size Distribution, and Specific Gravity.** Soils were continuously sampled from each monitoring well boring. A subset of the soil samples, selected to be representative of the range of soil lithologies observed in the boring, was submitted to GSA laboratories for analysis of vertical saturated hydraulic conductivity (K_{sat}) by ASTM Method D5856-95 (ASTM, 1995), particle size distribution by ASTM Method D6913-17 (ASTM, 2017) and ASTM Method D7928-17 (ASTM, 2017) (wet sieve and hydrometer methods), and specific gravity by ASTM Method D854-14 (ASTM, 2014). A summary of soil property sampling is presented in Table 2.

Table 2. Laboratory Analysis of Vertical K_{sat}, Particle Size Distribution, and Specific Gravity.

Well ID	Depth (feet bgs)	Analysis Performed
GM1-MW1	7.5 - 10	K_{sat}; particle size distribution; specific gravity
	15-17.5	K_{sat}
	22.5-25	K_{sat}; particle size distribution
GM4-MW1	15-17.5	K_{sat}; particle size distribution; specific gravity
	17.5-20	K_{sat}
	22.5-25	K_{sat}; particle size distribution
GM5-MW1	10-12.5	K_{sat}; particle size distribution
	20-22.5	K_{sat}
	50-52.5	K_{sat}; particle size distribution; specific gravity

Notes

ft bgs = feet below ground surface

- **Bulk Density and Water Content.** Each section of soil core (i.e., returned in 2.5 foot long increments) from the monitoring well borings was weighed by GSA personnel in the field. Samples of each soil core were submitted to Oregon State University in Corvallis, Oregon, for measurement of gravimetric water content by ASTM Method D2216-19. Dry bulk density was calculated from the gravimetric water content and field-measured mass.

2.4 Water Quality Sampling

After monitoring wells were constructed and developed, GSI personnel returned to each site on May 28, 2023, to sample groundwater for the suite of contaminants regulated under the Safe Drinking Water Act (SDWA) to characterize baseline groundwater quality. Monitoring wells were sampled using a Waterra Pump System ® with foot valve and EPA low-flow (minimal drawdown) groundwater sampling procedures (EPA, 1996). Groundwater samples were collected from GM1-MW1, GM4-MW1, and GM5-MW1, stored in ice-chilled coolers, and immediately couriered to Edge Analytical Laboratories in Wilsonville, Oregon for analysis.

In addition to water quality sampling at monitoring wells, untreated wastewater from the City's wastewater treatment was sampled on May 2, 2023, by City personnel and submitted to Waterlab Corporation laboratories for analysis of synthetic organic compounds (SOCs), volatile organic compounds (VOCs), metals, and radionuclides. Because samples were collected upstream of treatment, the samples represent raw wastewater quality. The objective of the wastewater quality sampling was to develop a preliminary understanding of the types and concentrations of pollutants in the City's wastewater.

2.5 Aquifer Testing

After monitoring wells were constructed and developed, GSI conducted multiple slug tests (including 'slug-in' and 'slug-out' tests) at each monitoring well to estimate hydraulic conductivity of the shallow aquifer (i.e., horizontal hydraulic conductivity). A solid, tapered tube, or slug, was introduced (slug-in) or removed (slug-out) from each monitoring well to instantaneously raise or lower the water level in the well. A pressure transducer was used to monitor changes in water level. Horizontal hydraulic conductivity was calculated using the Hvorslev (1951) method for monitoring wells where the aquifer exhibited an overdamped response, and the Springer-Gelhar (1991) method for monitoring wells where the aquifer exhibited an underdamped response.

2.6 Infiltration Capacity Modeling

GSA conducted a groundwater mounding analysis to determine the infiltration capacity in study areas GM1, GM4, and GM5. The Zlotnik (2017) analytical solution for groundwater mounding as applied in MOUNDSOLV (Hydrosolve, 2023) was used to estimate the steady-state groundwater mound that may develop beneath the potential infiltration facilities in response to recharge of treated wastewater. The required model input parameters for a steady-state simulation include recharge rate, recharge basin infiltration area, aquifer saturated hydraulic conductivity, aquifer initial saturated thickness, and horizontal hydraulic gradient. The output of the MOUNDSOLV model is the rise in groundwater levels beneath the infiltration basin.

Simulations were based on the projected year 2045 effluent generation rate of 0.2375 million gallons per day (MGD). For this initial feasibility assessment, the infiltration facility was conservatively assumed to consist of one, square-shaped basin. The size of the infiltration was selected to be sufficiently large to accept the 0.2375 MGD of treated wastewater. The long-term infiltration rate was assumed to be 15 percent of the mean measured near-surface K_{sat} measured by GSA using a single ring infiltrometer with the lateral divergence correction during the Phase I Subsurface Characterization (GSI, 2023b). The value of 15 percent of K_{sat} was used to account for potential surface clogging (EPA, 1984).

3. Results

This section presents the results of Phase II Subsurface Characterization including monitoring well construction (Subsection 3.1), subsurface geology (Subsection 3.2), saturated hydraulic conductivity (Subsection 3.3), bulk density, gravimetric water content, and specific gravity (Subsection 3.4), water quality sampling (Subsection 3.5), and a groundwater mounding analysis (Subsection 3.6).

3.1 Monitoring Well Construction

Construction information for the monitoring wells installed during the Phase II Subsurface Characterization is summarized in Table 3. Monitoring well locations are shown in Figure 2a (study area GM1), Figure 2b (study area GM4), and Figure 2c (study area GM5). Boring logs showing well construction and soil types are provided in Attachment A.

Table 3. Monitoring Well Construction.

Well ID	Latitude [1]	Longitude [1]	Ground Surface Elevation [1] (ft amsl)	Total Boring Depth (ft bgs)	Depth to Ground-water [2] (ft bgs)	Screened Interval (ft bgs)	Slot Size (inches)	Well Diameter and Material	Filter Pack
GM1-MW1	44.751118°	-122.460715°	852	40	15.4	30 - 40	0.010	2-inch, Sch. 40 PVC	10-20 Silica Sand
GM4-MW1	44.742539°	-122.472156°	880	40	12.7	30 - 40	0.010	2-inch, Sch. 40 PVC	10-20 Silica Sand
GM5-MW1	44.741882°	-122.448286°	1005	76	58.3	65 - 75	0.010	2-inch, Sch. 40 PVC	10-20 Silica Sand

Notes
ft amsl = feet above mean sea level
ft bgs = feet below ground surface
Sch. = schedule
(1) Preliminary latitude, longitude, and ground surface elevation determined by Google Earth. A site survey will occur during Phase III.
(2) At study areas GM4 and GM5, depth to groundwater was measured on June 8, 2023. At study area GM1, depth to groundwater was measured on May 29, 2023.

3.2 Subsurface Geology

Observations of subsurface geology from monitoring well borings are summarized below:

- In each of the three borings, a thin surficial fill layer (less that about 3 feet thick) was encountered overlying the Quaternary middle terrace deposits that comprise the primary alluvial geologic unit in the Gates/Mill City area. The Quaternary middle terrace deposits consisted of gravels with varying amounts of sand and fines (i.e., silt and clay) (see boring logs in Attachment A).
- As shown in Table 4, which summarizes laboratory-measured particle size distribution of soils from the monitoring well borings, the soils at study area GM5 consist of significantly more fine material (silt and clay fraction ranging from 16% to 23%) than the soils at study area GM1 and GM4 (ranging from about 4% to 12%). The finer-grained nature of the soils at GM5 based on lab analyses is consistent with the soil classification using the USCS visual-manual method (see boring logs in Attachment A).

Table 4. Percent Gravel, Sand, Silt and Clay.

Well ID	Depth (feet bgs)	% Gravel (>0.475 mm)	% Sand (4.75 mm – 0.075 mm)	% Silt (0.075 mm – 0.002 mm)	% Clay (<0.002 mm)
GM1-MW1	7.5 – 10.0	52.0%	36.2%	11.4%	0.40%
	22.5 – 25.0	34.0%	61.3%	4.5%	0.20%
GM4-MW1	15.0 – 17.5	84.0%	11.4%	4.4%	0.20%
	22.5 – 25.0	57.0%	33.6%	8.8%	0.6%
GM5-MW1	10.0 – 12.5	70.0%	14.0%	11.0%	5.0%
	50.0 – 52.5	46.0%	30.7%	16.7%	6.6%

Notes

mm = millimeters

feet bgs = feet below ground surface

3.3 Saturated Hydraulic Conductivity

Saturated hydraulic conductivity is a measure of how easily water travels through soil, and is an anisotropic soil property (meaning that hydraulic conductivity may be different in the horizontal and vertical directions). Due to geologic layering, horizontal hydraulic conductivity may be 10 to 100 times greater in vertical hydraulic conductivity. Vertical saturated hydraulic conductivity was measured in the laboratory based on soil samples collected from monitoring well borings (see Attachment B and discussion in Section 3.3.1) and horizontal saturated conductivity was measured in the field at monitoring wells (see Attachment E and discussion in Section 3.3.2).

3.3.1 Vertical Saturated Hydraulic Conductivity (K_{sat})

Laboratory-measured saturated hydraulic conductivities of soils at study areas GM1, GM4, and GM5 are summarized in Table 5. Because the analyses were conducted on soils above and below the water table, the hydraulic conductivities in Table 5 represent unsaturated zone hydraulic conductivity (soils above the water table) or aquifer hydraulic conductivity (soils below the water table).

The vertical saturated hydraulic conductivity of soil in study area GM5 (geometric mean = 0.0005 feet per day) is significantly lower than the saturated hydraulic conductivity of soil in study area GM1 (10.5 feet per day) and GM4 (9.8 feet per day). The low saturated hydraulic conductivity values in study area GM5 indicate that the deeper unsaturated zone sediments may limit percolation of infiltrated water at this location. Additional discussion of the relationship between saturated hydraulic conductivity and the percentage of fine material in soils is provided in Attachment B.

Table 5. Summary of Lab-Measured Vertical Saturated Hydraulic Conductivity.

Well ID	Depth (feet bgs)	Vertical K_{sat} (feet/day)	Geometric Mean Vertical K_{sat} (feet/day)
GM1-MW1	7.5 – 10.0 (unsaturated zone)	2.8	10.5
	15.0 – 17.5 (aquifer)	34.0	

	22.5 – 25.0 (aquifer)	12.2	
GM4-MW1	15.0 – 17.5 (aquifer)	17.6	9.8
	17.5 – 20.0 (aquifer)	6.0	
	22.5 – 25.0 (aquifer)	8.8	
GM5-MW1	10.0 – 12.5 (unsaturated zone)	0.0004	0.0005
	20.0 – 22.5 (unsaturated zone)	0.0015	
	50.0 – 52.5 (unsaturated zone)	0.0002	

Notes

feet bgs = feet below ground surface

3.3.2 Horizontal Saturated Hydraulic Conductivity (Aquifer Hydraulic Conductivity)

Table 6 summarizes geometric mean horizontal saturated hydraulic conductivity in each study area based on multiple slug tests at each monitoring well. Because the slug tests were conducted in saturated soils below the water table, the hydraulic conductivities in Table 6 represent aquifer hydraulic conductivities. The horizontal saturated hydraulic conductivity in study area GM1 (560 feet per day) is significantly higher than in study area GM4 (3.5 feet per day) and GM5 (33 feet per day).

Table 6. Summary of Field-Measured Horizontal Saturated Hydraulic Conductivity.

Well ID	Geometric Mean Horizontal K_{sat} (feet/day)
GM1-MW1	560.3
GM4-MW1	3.54
GM5-MW1	33.0

The following bullets provide additional information about the slug test analyses:

- As shown in Attachment E, some of the slug tests at MW-1 in study area GM-1 exhibited an underdamped response, indicating very high hydraulic conductivities.
- At MW-1 in study area GM-4, the slug tests exhibited an overdamped response, indicating lower hydraulic conductivities. The water level recoveries follow three trends: (1) an early-time trend that reflects the hydraulic conductivity of the monitoring well's filter pack, (2) a middle-time trend that reflects the hydraulic conductivity of the aquifer, and (3) a late-time recovery that reflects deviation of water level recovery from the theoretical aquifer response. The hydraulic conductivities analyzed by the Hvorslev (1951) method represent water level recovery during the middle-time trend (i.e., aquifer response).
- At MW-1 in study area GM-5, slug tests indicated an overdamped response. Water levels exhibited two trends: (1) an early-time trend that reflects aquifer permeability and (2) a late-time trend that reflects deviation of water level recovery from the theoretical aquifer response. The hydraulic conductivities analyzed by the Hvorslev method represent water level recovery during the early-time trend (i.e., aquifer response).

3.4 Bulk Density, Gravimetric Water Content, and Specific Gravity

Graphs showing dry bulk density and water content with depth in each boring are provided in Figure 3 (study area GM1), Figure 4 (study area GM4), and Figure 5 (study area GM5) of GSA's technical memorandum in Attachment B. Water content is variable and a function of soil texture (finer texture soil layers generally have greater water content than coarser-textured soil) and position relative to first-encountered groundwater (soil layers closer to or below first-encountered groundwater have greater water content than soil layers further from or above first-encountered groundwater). The water content in soil above first-encountered groundwater at study area GM5 (ranging from about 7% to 47%) was highly variable relative to the water content at study areas GM1 (ranging from about 5% to 13%) and GM4 (ranging from about 7% to 30%), likely due to the differing layers of fine-textured soil overlaying less fine-textured soils.

Specific gravity results are shown in Table 7. Specific gravity ranged from 2.67 grams per cubic centimeter (g/cm^3) to 2.81 g/cm^3.

Table 7. Summary of Specific Gravity.

Well ID	Depth (feet bgs)	Specific Gravity (grams per cubic centimeter)
GM1-MW1	7.5 – 10.0	2.72
GM4-MW1	15.0 – 17.5	2.81
GM5-MW1	50.0 – 52.5	2.67

3.5 Water Quality Sampling

Groundwater and wastewater quality results are provided in Table 8. Laboratory reports are provided in Attachment C, and groundwater sampling field forms are included in Attachment D. The following bullets summarize the groundwater quality results. Pollutant concentrations are compared to EPA Maximum Contaminant Levels (MCLs) and EPA Secondary Maximum Contaminant Levels (SMCLs). MCLs are legally-enforceable levels for constituents in drinking water; SMCLs are non-mandatory water quality guidelines to assist public water systems in managing drinking water for aesthetic considerations, including taste, color, and odor. MCLs and SMCLs are used by Oregon's Groundwater Protection Rules to evaluate the significance of a particular pollutant concentration and trigger necessary regulatory action[1].

- **VOCs and SVOCs.** No VOCs or SVOCs were detected in groundwater. In untreated wastewater, the only VOCs and SVOCs detected were di(2-ethylhexyl)phthalate (9.01 micrograms per liter or ug/L, which is above the EPA MCL of 6 ug/L) and toluene (49.6 ug/L, which is below the EPA MCL of 1,000 ug/L).
- **General Geochemical and Inorganic Constituents.** The following bullets summarize the quality of untreated wastewater and groundwater for general geochemical and inorganic constituents, many of which are naturally-occurring.
    - In groundwater, concentrations of aluminum, iron, and manganese exceed the EPA MCL or SMCL. The primary source of iron and manganese is likely naturally occurring iron and manganese oxide minerals that are present in alluvial soils of western Oregon, and the aluminum may be related to aluminosilicate minerals (Frank, 1973). Because concentrations of aluminum, iron, and manganese in untreated wastewater are lower than groundwater, infiltration will improve groundwater quality for these constituents.

---

[1] OAR 340 - 040

  - Concentrations of zinc, fluoride, gross alpha, gross beta, and combined radium 226/228 are higher in untreated wastewater than in groundwater. With the exception of fluoride, the concentrations in untreated wastewater are below EPA MCLs.
  - Nitrate is not detected in untreated wastewater because nitrogen is in the form of ammonia prior to treatment.

3.6 Groundwater Mounding Analysis

A technical memorandum summarizing the results of the groundwater mounding analysis performed by GSA is provided in Attachment F. Table 9 summarizes the input parameters used for the mounding analysis.

Table 9. Input Parameters Used for Groundwater Mounding Analysis.

Input Parameter	GM1	GM4	GM5
Recharge Rate [1]	0.2375 MGD	0.2375 MGD	0.2375 MGD
Recharge Duration	Continuous	Continuous	Continuous
Infiltration Area [2]	0.81 acres	6.23 acres	26.99 acres
Long-Term Infiltration Rate [3]	0.90 feet/day	0.12 feet/day	0.03 feet/day
Aquifer Hydraulic Conductivity [4]	370 feet/day	3.5 feet/day	33.0 feet/day
Depth to Water Table [5]	15.4 feet bgs	30.0 feet bgs	58.3 feet bgs
Initial Aquifer Saturated Thickness [6]	44.6 feet	147 feet	122 feet
Initial Horizontal Hydraulic Gradient [7]	0.0139 feet/foot	0.0139 feet/feet	0.0139 feet/foot

Notes

MGD = Million Gallons Per Day bgs = below ground surface

(1) Projected 2045 effluent generation rate

(2) Selected to be sufficiently large to accept the 0.2375 MGD of treated wastewater

(3) 15 percent of the mean measured near-surface K_{sat} for the study area (GSI, 2023b)

(4) See Table 6 in Section 3.3.2

(5) Depth to groundwater at study area GM1 was measured on May 29, 2023 at monitoring well GM1-MW1. Depth to groundwater at study area GM5 was measured on June 8, 2023 at monitoring well GM5-MW1. Depth to groundwater at study area GM4 was selected to be 30 feet below ground surface (bgs) because the depth to groundwater is likely between 12.7 feet bgs (measured near the southern edge of the property near a stream at monitoring well GM4-MW1) and 37 feet bgs (measured in the City's Kingwood Well No. 2, LINN 56359, in April 2013).

(6) Estimated from deep borehole logs. In study area GM1, the nearby 60-feet-deep domestic water well LINN 1443 shows that unconsolidated sediments are at least 60 feet thick (60 feet of unconsolidated sediments – 15.4 feet depth to water = 44.6 feet of aquifer). In study area GM4, the nearby 177-feet-deep domestic water well LINN 2588 shows that unconsolidated sediments are at least 177 feet thick (177 feet of unconsolidated sediments – 30 feet depth to water = 147 feet of aquifer).

(7) Horizontal hydraulic gradient determined based on a groundwater elevation contour map developed from the water levels measured by GSI at GM1-MW1, GM4-MW-1, GM5-MW-1 and water levels from the Oregon Water Resources Department.

The model-predicted steady state groundwater mounding results are provided in Table 10. Contour maps showing the predicted rise in groundwater levels are provided in Figure 2 (study area GM1), Figure 3 (study area GM4) and Figure 4 (study area GM5) of GSA's technical memorandum in Attachment F.

Table 10. Predicted Mounding During Infiltration.

Model Output	GM1	GM4	GM5
Maximum Mound Height	1.6 feet above static	47.4 feet above static	5.0 feet above static
Depth to Groundwater	13.8 feet bgs	0 feet bgs	53.3 feet bgs

Notes

bgs = below ground surface

The following bullets summarize the results of the groundwater mounding analysis:

- At study area GM1, the mounding is predicted to be relatively minor (1.6 feet above the static groundwater level) due to the high aquifer hydraulic conductivity at the site. Because the depth to groundwater in study area GM1 is relatively shallow, the depth to the water table is 13.8 feet bgs during infiltration.
- At study area GM4, a relatively large maximum mound height of 47.4 feet above the static groundwater level was predicted due to the low aquifer hydraulic conductivity at the site. In addition, the water table intersected the ground surface. Preferably, the groundwater mound should be at least 10 feet or greater below ground surface to prevent the groundwater from impacting infiltration rates or resulting in the daylighting of groundwater outside of the basin footprint. Additional model simulations by GSA indicated that an infiltration basin would need to be 364,000 acres to meet the 10 feet bgs depth to groundwater criteria, which exceeds the available acreage of available properties near study area GM4.
- At study area GM5, the mounding is predicted to be relatively minor (5.0 feet above the static groundwater level) due to the high aquifer hydraulic conductivity and large area available for an infiltration basin. However, it’s important to note that the mounding analysis does not consider the impact of potential low permeability soils above the water table. The Phase II Subsurface Investigation indicated that numerous low-permeability layers are present in the unsaturated zone at study area GM5, which would limit infiltration rate and create perched water conditions above the water table.

4. Conclusions and Recommendations

Based on data collected during the Phase II Subsurface Characterization and mounding analysis, study area GM1 is considered to be the most favorable to infiltration:

- The aquifer hydraulic conductivity (560 feet per day), vertical hydraulic conductivity (10.5 feet per day), and soil types in the unsaturated zone (generally gravels with 5 to 15 percent fines by weight) are the most permeable of three sites evaluated as a part of Phase II.
- Based on MOUNDSOLV modeling (included in Attachment F), study area GM1 is capable of infiltrating the projected 2045 effluent generation rate while maintaining a depth to groundwater of more than 10 feet bgs.

<u>Therefore, we recommend conducting Phase III Subsurface Characterization at study area GM1.</u> At the remaining sites:

- **Study Area GM5.** Due to low-permeability soil layers in the unsaturated zone that would limit infiltration, we recommend not considering study area GM5 further. Therefore, monitoring well MW-1 at GM5 should be decommissioned.
- **Study Area GM4.**We recommend retaining study area GM4 as a backup site that could be further-evaluated if: (1) the Phase III Subsurface Characterization at study area GM1 produces data that indicate the study area is not as favorable to infiltration as indicated by the Phase I and Phase II data, or (2) groundwater contaminant fate and transport modeling indicates that attenuation of constituents in infiltrating wastewater does not meet DEQ standards. While the MOUNDSOLV simulations at GM4 indicate the site cannot infiltrate the target volume of treated wastewater while maintaining water levels deeper than 10 feet bgs, additional data collection may indicate that the aquifer permeability measured at monitoring well MW-1 is not representative of overall site conditions. Specifically, additional slug testing at new monitoring wells may indicate that the aquifer

is more permeable in other areas of the study area. It is important to note that we do not consider it to be *likely* that the additional data collection will indicate infiltration is feasible (we only consider it to be possible).

Data collected during the Phase III Subsurface Characterization will be used to complete the following tasks to provide additional information about infiltration basin design and feasibility in study area GM1:

- Install two additional monitoring wells and:
    - Measure the depth to groundwater to calculate a horizontal hydraulic gradient (horizontal hydraulic gradient in MOUNDSOLV currently assumes an "initial horizontal hydraulic gradient" calculated based on water levels from monitoring wells in other study areas and water level collected over many years by the Oregon Water Resources Department).
    - Conduct additional slug tests to evaluate heterogeneity in aquifer hydraulic conductivity (aquifer permeability in MOUNDSOLV is currently based on slug tests at a single monitoring well).
- Install a temporary boring to bedrock to directly-measure the aquifer saturated thickness (the MOUNDSOLV model used an "initial aquifer saturated thickness" assumed from nearby water wells).
- Re-run the MOUNDSOLV model to confirm that an infiltration basin at study area GM1 can infiltrate the projected 2045 effluent generation rate.
- Develop a groundwater fate and transport model to evaluate whether constituents in infiltrating wastewater will be sufficiently attenuated to meet DEQ standards.

5. References

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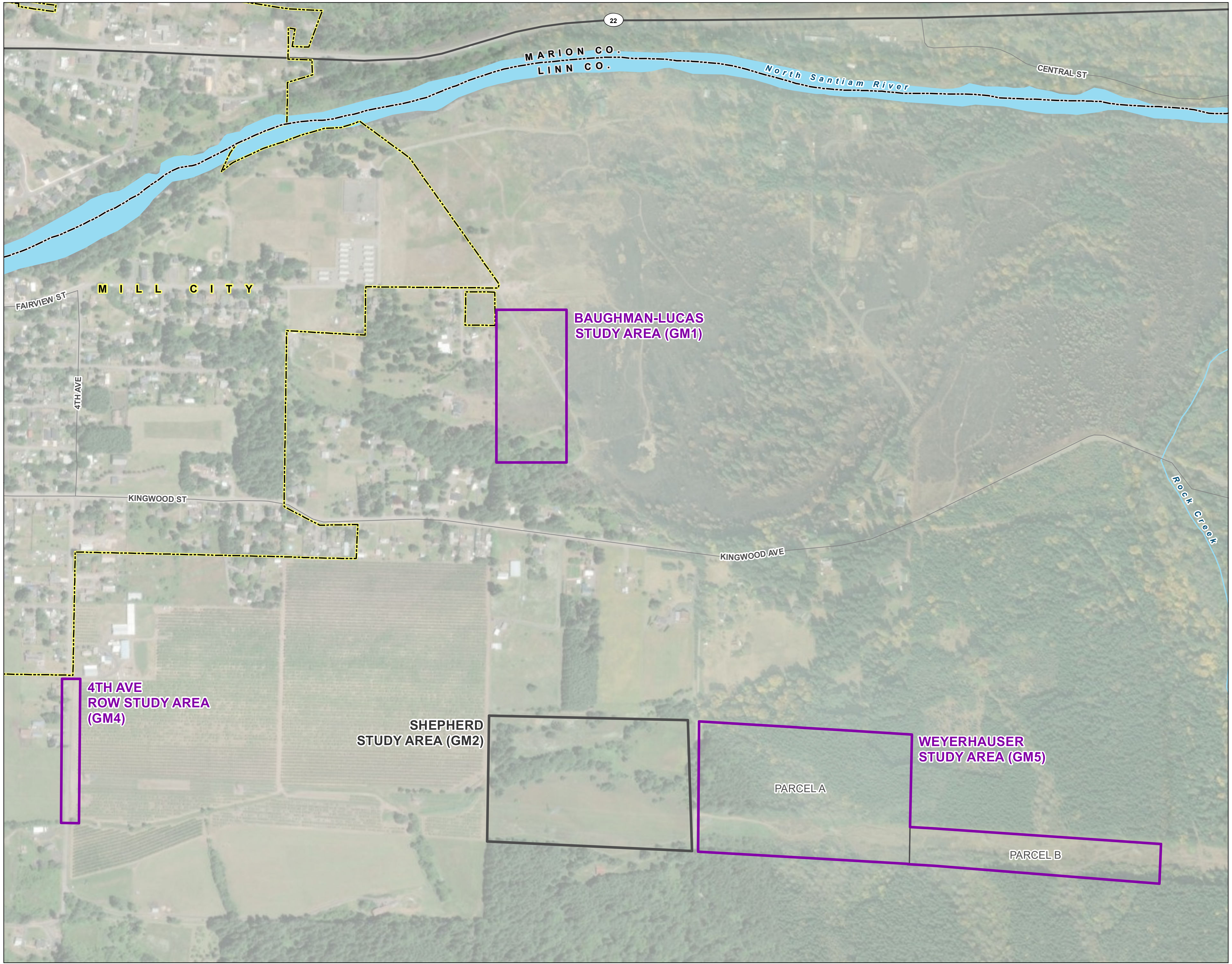

FIGURE 1

Project Location

Gates/Mill City Phase II Subsurface Characterization

LEGEND

☐ Site Parcel

Study Areas

☐ Subject of the Phase I Subsurface Characterization

☐ Subject of the Phase I and Phase II Subsurface Characterization

All Other Features

City Boundary

County Boundary

Major Road

Watercourse

Waterbody

N

0 300 600 900
Feet

Date: August 10, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

GSI Water Solutions, Inc.

Document Path: Y:\0464_Keller_Assoc\Source_Figures\020_Santiam_Canyon\Phase_II_Subsurface_Characterization\Figure1_Project_Location.mxd, abarry

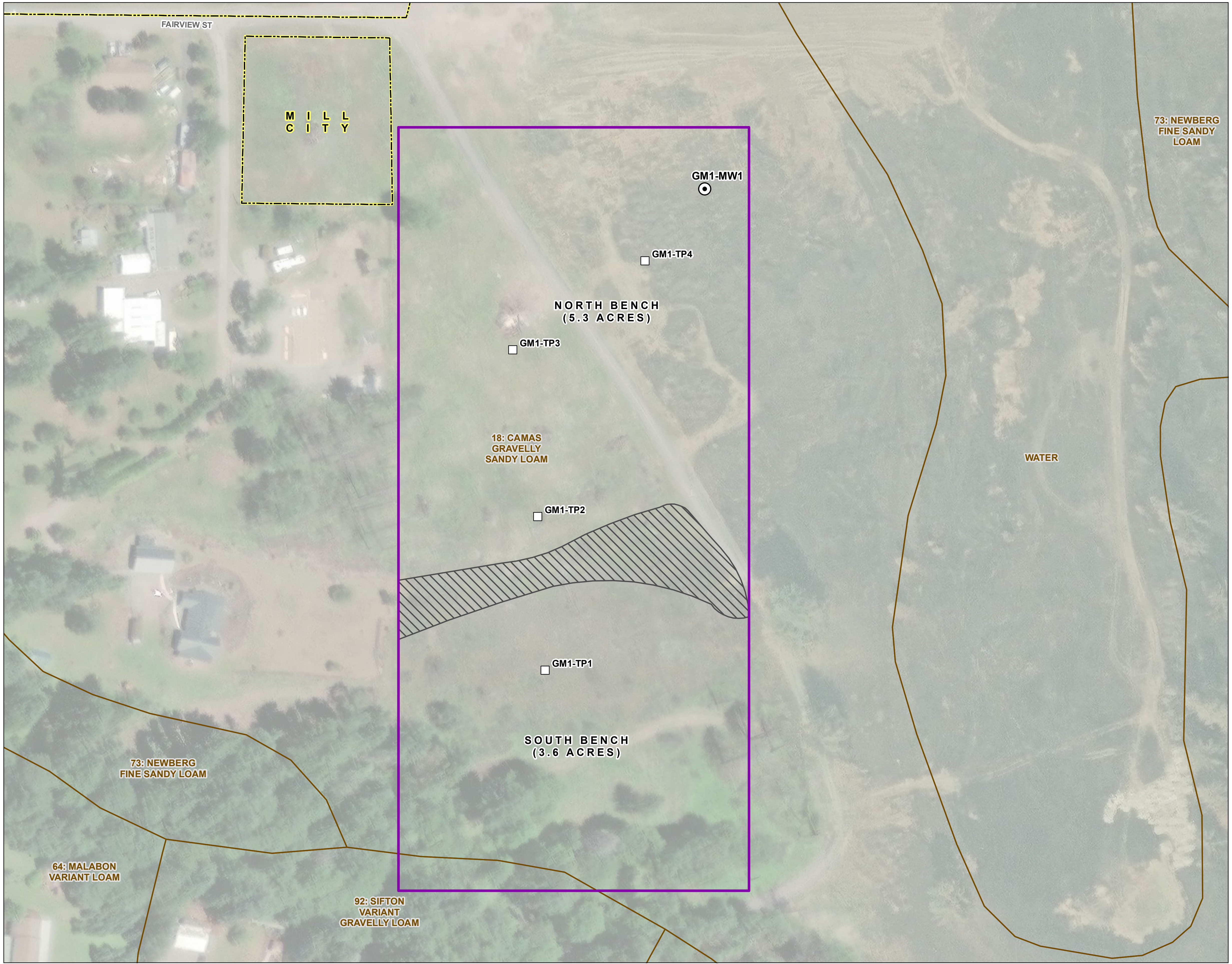

FIGURE 2a

Baughman-Lucas
Study Area (GM1)

Gates/Mill City Phase II
Subsurface Characterization

LEGEND

- ⊙ Monitoring Well
- ☐ Test Pit (Phase I)
- ☐ Study Area
- ▨ Steep Slope
- ☐ Soils

All Other Features

- ☐ City Boundary
- ╱╲ Major Road

N

0 60 120 180
Feet

Date: August 10, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

GSI
Water Solutions, Inc.

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FIGURE 2b

4th Ave ROW Study Area (GM4)

Gates/Mill City Phase II
Subsurface Characterization

LEGEND

- ⊙ Monitoring Well
- ☐ Test Pit
- ◆ Powerline Tower
- — Powerline
- ☐ Study Area
- ☐ Soils

All Other Features

- ☐ City Boundary
- ⁄\ Major Road

Date: August 10, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

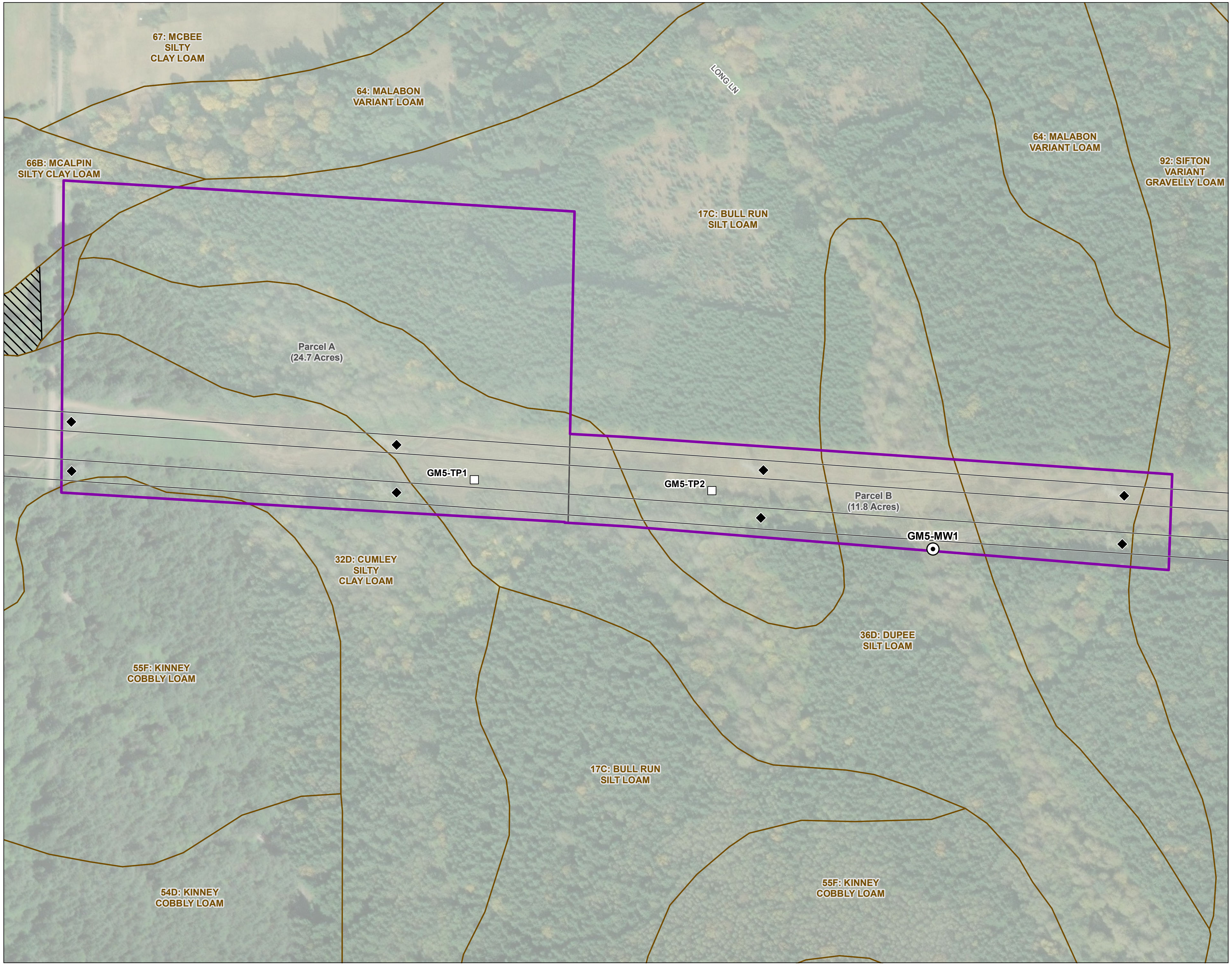
GSI Water Solutions, Inc.

Document Path: Y:\0464_Keller_Assoc\Source_Figures\020_Santiam_Canyon\Phase_II_Subsurface_Characterization\Figure2b_4th_Ave_ROW_Site_GM4.mxd, abarry

FIGURE 2c

Weyerhaeuser Study Area (GM5)

Gates/Mill City Phase II
Subsurface Characterization



LEGEND

- ⦿ Monitoring Well
- ☐ Test Pit
- ◆ Powerline Tower
- — Powerline
- ☐ Study Area
- ☐ Site Parcel
- ▨ Steep Slope
- ☐ Soils

All Other Features

- ☐ City Boundary
- ⁄\ Major Road

N

0 125 250 375
Feet

Date: August 10, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

GSI
Water Solutions, Inc.

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DRAFT TECHNICAL MEMORANDUM

Phase III Subsurface Characterization to Support an Evaluation of Treated Wastewater Infiltration in Gates and Mill City, Marion and Linn Counties, Oregon

To:	Chris Einmo, PE / Marion County
From:	Jesse Hall / GSI Water Solutions, Inc. Matt Kohlbecker, RG / GSI Water Solutions, Inc. Jason Keller, RG / GesSystems Analysis, Inc.
CC:	Peter Olsen, PE / Keller Associates, Inc. Pamela Villarreal, PE / Keller Associates, Inc. Brian Nicholas / Marion County Dave Kinney / City of Mill City Russ Foltz / City of Mill City Kari Low / Commonstreet Consulting
Date:	November 8, 2023

This Technical Memorandum (TM), prepared by GSI Water Solutions, Inc. (GSI) and GeoSystems Analysis, Inc. (GSA), summarizes the third phase of a subsurface characterization to evaluate the feasibility of treated wastewater infiltration in Gates and Mill City, Oregon.

1. Introduction

This section summarizes background information about the treated wastewater infiltration project in the Santiam Canyon, including a project overview (Section 1.1) and an overview of the Phase III Subsurface Characterization in Gates and Mill City (Section 1.2).

1.1 Project Overview

The North Santiam Sewer Authority (NSSA) is planning to dispose of treated wastewater by infiltration. Two infiltration facilities are planned—one in the Gates/Mill City area and another in the Detroit/Idanha area (Figure 1). Infiltration facilities will be comprised of rapid infiltration basins and will be authorized by Water Pollution Control Facilities (WPCF) permits from the Oregon Department of Environmental Quality (DEQ).

A phased approach is being used to evaluate infiltration feasibility in the Gates/Mill City area. The phases include:

- **Phase I.** Excavation of test pits and infiltration testing to characterize shallow soils in four study areas.

- **Phase II.** Construction of a single monitoring well and aquifer testing to characterize deep soils in the three study areas that are considered to be the most favorable for infiltration based on the results of Phase I.
- **Phase III.** Construction of two additional monitoring wells, advancement of two temporary borings within the footprint of the planned infiltration basin area, and aquifer testing in the study area that is most favorable to infiltration based on the results of Phase II.

1.2 Phase III Subsurface Characterization in the Gates/Mill City Area

Permitting and design of an infiltration basin requires characterization of soils and groundwater to evaluate whether infiltration capacity at a site is sufficient to meet the projected volume of wastewater that will be infiltrated. In March of 2023, GSI developed a work plan[1] to guide Phase I and Phase II of the subsurface characterization (GSI, 2023a). In April of 2023, an addendum was developed to guide Phase III of the characterization[2] (GSI, 2023b).

In the Gates/Mill City area, the Phase I Subsurface Characterization was completed in March of 2023. The Phase II Subsurface Characterization was completed in July of 2023 at study areas GM1, GM4, and GM5. Based on the results of the Phase II Subsurface Characterization, study area GM1 was selected for the Phase III Subsurface Characterization (GSI, 2023c).

The objective of the Phase III Subsurface Characterization was to collect data that can be used to evaluate infiltration feasibility, inform pollutant fate and transport evaluations, and update previous estimates of groundwater mounding during infiltration. This TM summarizes the: (1) collection and analysis of data during the Phase III subsurface investigation at study area GM1, and (2) updated groundwater mounding modeling to estimate the volume of wastewater that can be infiltrated at Study Area GM1.

This TM summarizes methods (Section 2) and results (Section 3) of the Gates/Mill City Phase III Subsurface Characterization. Finally, this TM provides conclusions and recommendations (Section 4).

2. Methods

This section describes methods used during the Phase III Subsurface Characterization to: (1) locate subsurface utilities (Subsection 2.1), (2) construct monitoring wells (Subsection 2.2), (3) drill temporary boreholes (Subsection 2.3), (4) classify soil physical properties (Subsection 2.4), (5) survey monitoring wells (Subsection 2.5), (6) conduct slug tests to determine aquifer hydraulic conductivity (Subsection 2.6), and (7) estimate the infiltration capacity at the site (Subsection 2.7).

2.1 Utility Locating

Oregon 411 was notified of work activities at study area GM1 and conducted a public utility locate to identify all utilities within 25-feet of the centerline of SE Fairview Street. Additionally, areas chosen for monitoring wells, which were not necessarily within 25 feet of the SE Fairview Street centerline, were located and cleared for subsurface utilities by the private locating company Pacific Northwest Locating, LLC, on August 21, 2023. No utilities were identified along the SE Fairview Street corridor or near proposed monitoring well locations.

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[1] Santiam Canyon Treated Wastewater Infiltration Evaluation Subsurface Characterization Work Plan, dated March 3, 2023

[2] Santiam Canyon Treated Wastewater Disposal – Subsurface Characterization Work Plan Addendum No. 1 (Phase III), dated August 18, 2023

2.2 Monitoring Well Construction and Development

Groundwater monitoring wells were constructed at site GM1 with the objectives of: (1) identifying potential restrictive layers at depth, (2) testing aquifer permeability, and (3) measuring shallow groundwater elevations to develop groundwater elevation contour maps and calculate horizontal hydraulic gradients. Monitoring well borings were drilled with a track-mounted Terra Sonic 150cc Compact Crawler rotosonic drilling rig operated by Holt Services of Vancouver, Washington. Monitoring well borings were advanced to approximately 20 feet below first encountered groundwater. Drilling dates, tooling types, and total monitoring well depths are provided in Table 1. Study area GM1 monitoring well locations are shown in Figure 3.

Table 1. Overview of Monitoring Well Drilling.

Well ID	Drilling Date(s) [1]	Drill Tooling	Total Depth (feet)
GM1-MW1	5/19/2023 – 5/22/2023	6-inch casing, 4-inch core barrel	40
GM1-MW2	8/23/23 – 8/24/23	6-inch casing, 4-inch core barrel	50
GM1-MW3	8/29/23	6-inch casing, 4-inch core barrel	50

Notes

(1) Does not include well completion activities.

Once monitoring well construction was completed, wells were developed using a Waterra Pump System ® with foot valve and surge block. Wells were pumped and surged until at least ten borehole volumes had been removed, turbidity levels in the well dropped below 100 nephelometric turbidity units (NTUs), and water quality parameters stabilized in accordance with Environmental Protection Agency (EPA) well development guidance (Striggow et al, 2008).

2.3 Temporary Borehole Drilling

Temporary boreholes were drilled at site GM1 with the objective of identifying potential restrictive layers at depth. Borings were drilled with a track-mounted Terra Sonic 150cc Compact Crawler rotosonic drilling rig operated by Holt Services of Vancouver, Washington. Once target depth was reached, boreholes were abandoned in accordance with Oregon Water Resources Department regulations and standards.

2.4 Soil Classification Logging

During drilling, GSI personnel continuously logged soils from each borehole in general accordance with the visual-manual method of the Unified Soil Classification System (USCS) (ASTM, 2016). Boring logs are presented in Attachment A and soil classification results are presented in subsection 3.3.

2.5 Monitoring Well Surveying

Monitoring well locations were surveyed by Forty Five North Surveying, LLC on September 5, 2023, using Global Positioning System (GPS) Real Time Kinematics (RTK) methods. Monitoring well elevations were surveyed with an accuracy of within 0.01 feet of each other.

2.6 Aquifer Testing

After monitoring wells were constructed and developed, GSI conducted three successive slug tests (including ‘slug-in’ and ‘slug-out’ tests) at each monitoring well to estimate hydraulic conductivity of the shallow aquifer (i.e., horizontal hydraulic conductivity). Slug testing involves first introducing (slug-in) a solid tapered tube, or slug, into a monitoring well to instantaneously raise the water level in the well, and then removing the slug (slug-out) from the well to instantaneously lower water levels. GSI personnel took manual water level measurements at a predetermined schedule and a pressure transducer was installed beneath the slug to monitor changes in water level every half-second during the tests. Horizontal hydraulic conductivity was calculated using the Hvorslev method for monitoring wells where the aquifer exhibited an overdamped response (Hvorslev, 1951), and the Springer-Gelhar method for monitoring wells where the aquifer exhibited an underdamped response (Springer and Gelhar, 1991).

2.7 Infiltration Capacity Modeling

GSA used the hydraulic conductivity and hydraulic gradient measured during the Phase III Subsurface Characterization to update the preliminary groundwater mounding analysis for Study Area GM1 presented in GSI (2023c). This analysis used the Zlotnik analytical solution for groundwater mounding (Zlotnik et al, 2017) as applied in MOUNDSOLV (Hydrosolv, 2023) to estimate the steady-state groundwater mound that may develop beneath potential infiltration facilities in response to recharge of treated wastewater. Model input parameters required for a steady-state simulation include recharge volume, recharge duration, infiltration area, long term infiltration rate, depth to water table, aquifer initial saturated thickness, hydraulic gradient, and groundwater flow direction. Using these parameters, the MOUNDSOLV model is able to calculate the expected rise in groundwater levels beneath the infiltration basin.

Due to the variability in horizontal saturated hydraulic conductivity (K_{sat}) between monitoring wells at Study Area GM1, three groundwater mounding scenarios were evaluated in MOUNDSOLV. K_{sat} values assigned for each scenario and the associated basis for assigning the K_{sat} values are summarized in Table 2.

Table 2. Aquifer Horizontal K_{sat} Values

Scenario	Monitoring Well	K_{sat} (ft/day)
Low	GM1-MW3	37.0
Average	Geometric Mean of All Wells	88.2
High	GM1-MW1	163.3

Groundwater mounding model parameters applied for low, mid, and high K_{sat} scenarios are summarized in Table 3.

Table 3. Input Parameters Used for Groundwater Mounding Analysis.

Hydraulic Conductivity Scenario	Low (K_{sat} = 37 ft/d)	Average (K_{sat} = 88.2 ft/d)	High (K_{sat} = 163 ft/d)
Recharge Rate [1]	0.2375 MGD	0.2375 MGD	0.2375 MGD
Recharge Duration	Continuous	Continuous	Continuous
Infiltration Area [2]	2.3 acres	2.3 acres	2.3 acres
Long-Term Infiltration Rate [3]	0.90 feet/day	0.12 feet/day	0.03 feet/day
Aquifer Hydraulic Conductivity [4]	37 feet/day	88.2 feet/day	163 feet/day
Depth to Water Table (current) [5]	15.4 feet bgs	15.4 feet bgs	15.4 feet bgs
Depth to Water Table (after basin construction) [6]	14.4 feet bgs	14.4 feet bgs	14.4 feet bgs
Initial Aquifer Saturated Thickness [7]	44.6 feet	44.6 feet	44.6 feet
Initial Horizontal Hydraulic Gradient [8]	0.0102 feet/foot	0.0102 feet/feet	0.0102 feet/foot

Notes

MGD = Million Gallons Per Day

bgs = below ground surface

(1) Projected 2045 effluent generation rate

(2) Selected to be sufficiently large to accept the 0.2375 MGD of treated wastewater
(3) 15 percent of the mean measured near-surface K_{sat} for the study area (GSI, 2023b)
(4) See Table 6 in Section 3.3.2
(5) Depth to groundwater at study area GM1 was measured on May 29, 2023 at monitoring well GM1-MW1.
(6) Assumes a basin excavation depth of 1.0 feet.
(7) Estimated from deep borehole logs. In study area GM1, the nearby 60-feet-deep domestic water well LINN 1443 shows that unconsolidated sediments are at least 60 feet thick (60 feet of unconsolidated sediments – 15.4 feet depth to water = 44.6 feet of aquifer).
(8) Horizontal hydraulic gradient determined based on a groundwater elevation contour map developed from the water levels measured by GSI at GM1-MW1, GM1-MW2, GM1-MW3 and water levels from the Oregon Water Resources Department.

Groundwater mounding simulations were based on the projected year 2045 treated wastewater effluent generation rate of 0.2375 million gallons per day (MGD). For this initial feasibility assessment, the infiltration facility was conservatively assumed to consist of one, square-shaped basin, with a 2.3 acre infiltration area. The long-term infiltration rate was assumed to be 15 percent of the mean measured near-surface K_{sat}, as measured by GSA using a single ring infiltrometer with the lateral divergence correction during the Phase I Subsurface Characterization (GSI, 2023b). A K_{sat} value of 15 percent of the mean measured K_{sat} for the site was used to account for potential surface clogging (EPA, 1984).

Groundwater mounding analysis results are presented in Section 3.6 and in the memorandum completed by GSA available in Attachment C.

3. Results

This section presents the results of Phase III Subsurface Characterization including monitoring well construction (Subsection 3.1), temporary borehole drilling (Subsection 3.2), subsurface geology (Subsection 3.3), groundwater levels, flow directions, and gradient (Subsection 3.4), saturated hydraulic conductivity (Subsection 3.5), and a groundwater mounding analysis (Subsection 3.6).

3.1 Monitoring Well Construction

Construction information for the monitoring wells installed during the Phase III Subsurface Characterization is summarized in Table 4. Monitoring well locations are shown in Figure 3. All monitoring wells were constructed using 2-inch diameter schedule 40 PVC casing and a 10-foot PVC screen with a slot size of 0.010-inches. All monitoring wells were constructed with a 10-20 silica sand filter pack. Boring logs showing well construction and soil types are provided in Attachment A. Cross-section A-A' showing Study Site GM1 geology and groundwater levels is provided in Figure 4.

Table 4. Monitoring Well Construction.

Well ID	Latitude	Longitude	Ground Surface Elevation[2] (ft amsl)	Total Boring Depth (ft bgs)	Screened Interval (ft bgs)	Static Water Level (ft amsl)
GM1-MW1[1]	44.751106°	-122.460697°	851.92	40	30 - 40	829.48
GM1-MW2	44.751044°	-122.462022°	849.77	50	40 - 50	826.78
GM1-MW3	44.749072°	-122.461128°	859.57	50	40 - 50	832.43

Notes
ft amsl = feet above mean sea level
ft bgs = feet below ground surface
(1) Monitoring well GM1-MW1 was constructed during Phase II Subsurface Investigation completed in May of 2023.
(2) Measurements of elevation were taken using the vertical datum NAVD88.

3.2 Temporary Borehole Drilling

Information obtained during drilling of temporary boreholes as part of the Phase III Subsurface Characterization is summarized in Table 5. No sitewide, continuous restrictive layers were encountered in the temporary borings. In temporary boring GM1-TB2, the bottom of the shallow aquifer was encountered at approximately 65 feet bgs, on a layer of silt approximately 20 feet thick.

Table 5. Monitoring Well Construction.

Well ID	Latitude[1]	Longitude[1]	Ground Surface Elevation[1] (ft amsl)	Total Boring Depth (ft bgs)	Depth Groundwater First Encountered (ft bgs)	Depth to Aquifer Bottom[2] (ft bgs)
GM1-TB1	44.750961°	-122.461632°	851	20	18.4	N/A
GM1-TB2	44.750025°	-122.460736°	854	90	20	65

Notes
ft amsl = feet above mean sea level
ft bgs = feet below ground surface
(1) Determined from Google Earth
(2) Aquifer bottom not encountered in GM1-TB1

3.3 Subsurface Geology

Boring logs showing subsurface geology at monitoring wells and temporary borings are provided in Attachment A. Cross-section A-A’ showing study area GM1 geology and groundwater levels is provided in Figure 4.

Observations of subsurface geology from monitoring well borings and temporary borings are summarized below:

- In the monitoring well borings completed in the lower terrace area of the site (GM1-MW1 and GM1-MW2) an approximately 1.5 feet thick surficial layer comprised of loose silty gravel was encountered overlying the Quaternary Middle Terrace deposits. The loose nature of this layer and lack of anthropologic materials (e.g., bricks) indicates it is likely a fill layer comprised of reworked native soils from past site activities.
- The surficial fill layer found at monitoring well GM1-MW3, located in the upper terrace area of the site, consisted of 6.5 feet of soft silt with no gravel or sand and contained burnt woody debris and lumber. MW3 soils contained much higher percentages of silt when compared to MW1 or MW2. No infiltration is planned to occur in this area.
- There was a significantly higher ratio of fines found in the upper 5 feet of GM1-MW2 borehole when compared to MW1. Proportions of gravel, sand, and fines between GM1-MW1 and GM1-MW2 were similar below 5 feet bgs.
- The Quaternary Middle Terrace deposits consisted of loose gravels, silty gravels, and sands with lower proportions of silt than observed in surficial layers (see boring logs in Attachment A).
- A significant layer of silt (in excess of 20 feet thick) silt was found at temporary boring GM1-TB2 from 65-feet bgs to 85-feet bgs. This silt layer represents the base of the shallow groundwater system.

3.4 Groundwater Levels, Flow Directions, and Gradient

Table 6 provides groundwater levels at site GM1, and a groundwater elevation contour map is provided in Figure 3. Generally, groundwater flows towards the northwest under a horizontal hydraulic gradient of .0102 feet per foot.

Table 6. Groundwater Levels

Well ID	Depth to Groundwater (feet bgs)	Groundwater Elevation (feet amsl)
GM1-MW1	22.42	829.48
GM1-MW2	22.99	826.78
GM1-MW3	27.14	832.43

Notes

ft amsl = feet above mean sea level ft bgs = feet below ground surface

(1) At MW1, depth to groundwater was measured on August 29, 2023. At MW2 and MW3, depth to groundwater was measured on September 4, 2023.

3.5 Saturated Hydraulic Conductivity

Saturated hydraulic conductivity is an anisotropic soil property (meaning that hydraulic conductivity may be different in the horizontal and vertical directions) indicating how easily water travels through soil. Due to geologic layering, horizontal hydraulic conductivity may be 10 to 100 times greater than vertical hydraulic conductivity. Horizontal saturated conductivity was measured in the field at GM1 monitoring wells using the slug testing method (see Attachment B for slug testing results).

Water level recovery at GM1 monitoring wells was generally rapid, ranging from less than 30 seconds at GM1-MW1 and GM1-MW2, to about 200 seconds at GM1-MW3. The relatively rapid response indicates that soils at the GM1 site are characterized by a high hydraulic conductivity. Water level response at monitoring wells GM1-MW1 and GM1-MW2 exhibited an underdamped (i.e., oscillatory) response and were analyzed using the Springer-Gelhar (1991) solution for a slug test in an unconfined aquifer. Water level response at monitoring well GM1-MW3 exhibited an overdamped (i.e., straight-line) response and was analyzed by the Hvorslev (1951) solution for a slug test in an unconfined aquifer. Plots of water level versus time during the slug tests are provided in Attachment B. Note on the plots that several tests were not analyzed due to the transducer moving during the test. Horizontal hydraulic conductivity estimates obtained from slug testing at the GM1 site are summarized in Table 7.

Table 7. Slug Test Results.

Well ID	Analysis Method	Result	Figure Reference*	Geometric Mean Horizontal K (feet/day)
GM1-MW1	Springer-Gelhar (1991) Springer-Gelhar (1991)	**Test 1 (in):** 97 feet/day **Test 3 (in):** 275 feet/day	Figure B.1(d) Figure B.1(e)	163.3
GM1-MW2	Springer-Gelhar (1991) Springer-Gelhar (1991) Springer-Gelhar (1991)	**Test 1 (in):** 111 feet/day **Test 2 (in):** 110 feet/day **Test 3 (in):** 120 feet/day	Figure B.2(d) Figure B.2(e) Figure B.2(f)	113.6
GM1-MW3	Hvorslev (1951) Hvorslev (1951) Hvorslev (1951)	**Test 1 (in):** 33.8 feet/day **Test 2 (in):** 57.5 feet/day **Test 3 (in):** 26.1 feet/day	Figure B.3(d) Figure B.3(d) Figure B.3(d)	37.0
			Overall Geometric Mean	**88.2**

* Available in Attachment B

The overall geometric mean hydraulic conductivity for soils at Study Area GM1 is 88.2 feet per day.

3.6 Groundwater Mounding Analysis

A technical memorandum summarizing the results of the groundwater mounding analysis completed by GSA is provided in Attachment C. A summary of input parameters used for the mounding analysis model is presented in Table 3. Figures showing predicted groundwater mounding in the Gates/Mill City area for each scenario are presented in Attachment C. The model-predicted steady state groundwater mounding results for each scenario is provided in Table 10. Note the depths the groundwater in Table 8 are based on the seasonal high groundwater level measured at monitoring well GM1-MW1 in May 2023 (15.4 feet below current ground surface).

Table 8. Predicted Mounding During Infiltration.

	Hydraulic Conductivity Scenario		
	Low (K_{sat}=37 ft/d)	Mid (K_{sat}=88.2 ft/d)	High (K_{sat}=163 ft/d)
Maximum Mound Height	13.8 feet above static	5.8 feet above static	3.1 feet above static
Depth to Top of Groundwater Mound (Current Ground Surface)	1.6 feet bgs	9.6 feet bgs	12.3 feet bgs
Depth to Top of Groundwater Mound (Future Ground Surface)	0.6 feet bgs	8.6 feet bgs	11.3 feet bgs

Notes
bgs = below ground surface

The following bullets summarize the results of the groundwater mounding analysis:

- Scenarios using mid and high K_{sat} values showed minimal groundwater mounding (less than 6 feet) and depth to maximum groundwater mound of greater than 8 feet.
- The low K_{sat} value scenario showed increased groundwater mounding (more than 13 feet) and depth to maximum groundwater mound of less than 1 foot under the infiltration basin.

4. Conclusions and Recommendations

The data collected during the Phase III Subsurface Characterization and subsequent mounding simulations indicate that infiltration of the 2045 wastewater effluent generation rate (0.2375 MGD) appears to be feasible at study area GM-1. As a next step, we recommend using the data collected during the Phase III Subsurface Characterization to evaluate the environmental fate of residual pollutants in treated wastewater with the objectives of informing the appropriate permitting framework for the facility (i.e., Water Pollution Control Facilities permit or National Pollutant Discharge Elimination System permit) and evaluating compliance with DEQ's groundwater protection rules and the Three Basin Rule. We also recommend conducting a pilot test as a part of basin construction to refine basin design and collect additional information on aquifer response to infiltration.

5. References—Need to Update

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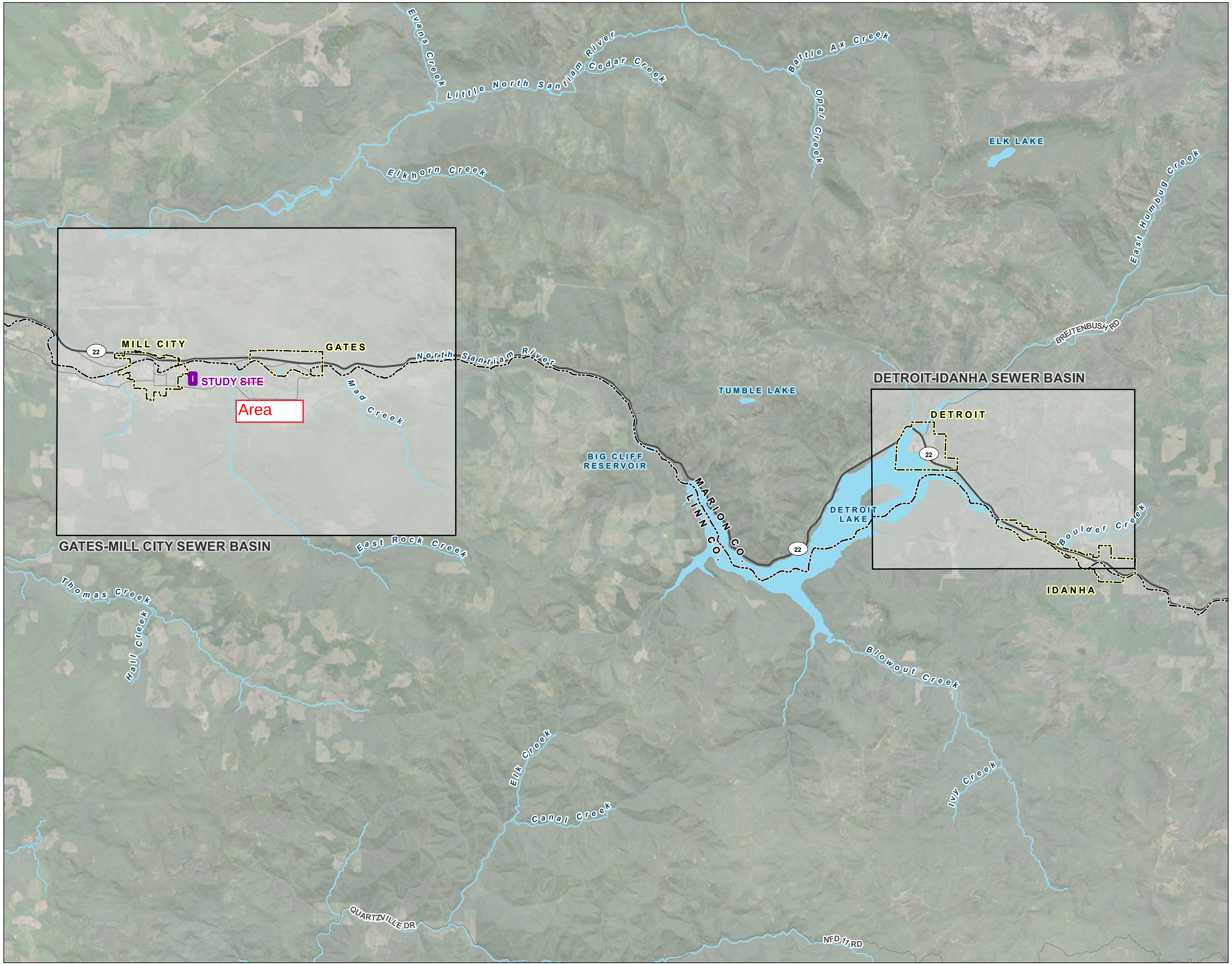
FIGURE 1

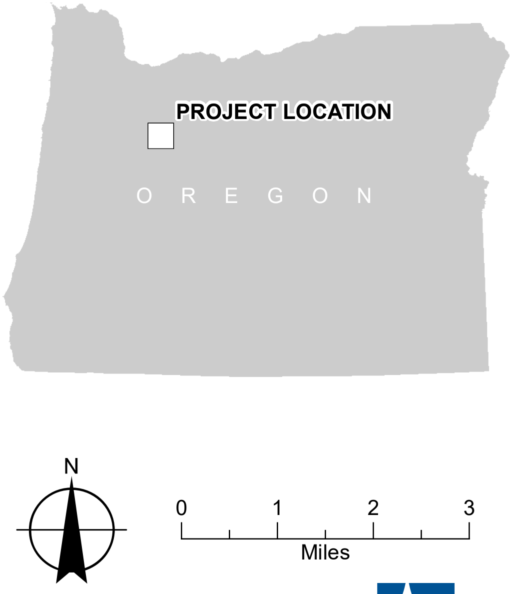
Project Location Map

Santiam Canyon Infiltration Project
Phase III



LEGEND Area

- Study ~~Site~~ GM1
- Sewer Basin
- City Boundary
- County Boundary
- Major Road
- Watercourse
- Waterbody



Date: November 6, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

GSI Water Solutions, Inc.

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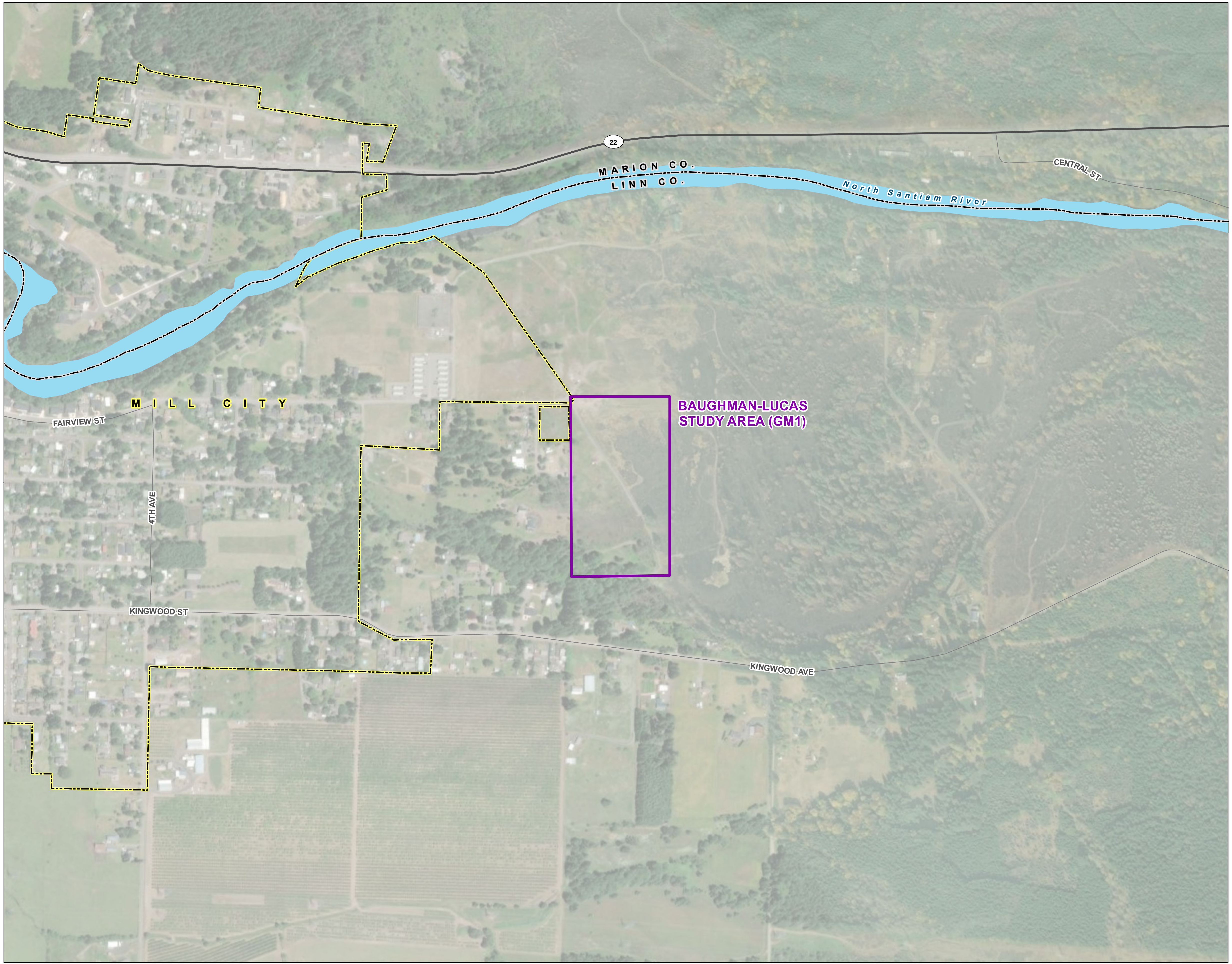

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FIGURE 2

Study ~~Site~~ GM1 Location

Santiam Canyon Infiltration Project
Phase III

Area

LEGEND

- Study Area

All Other Features

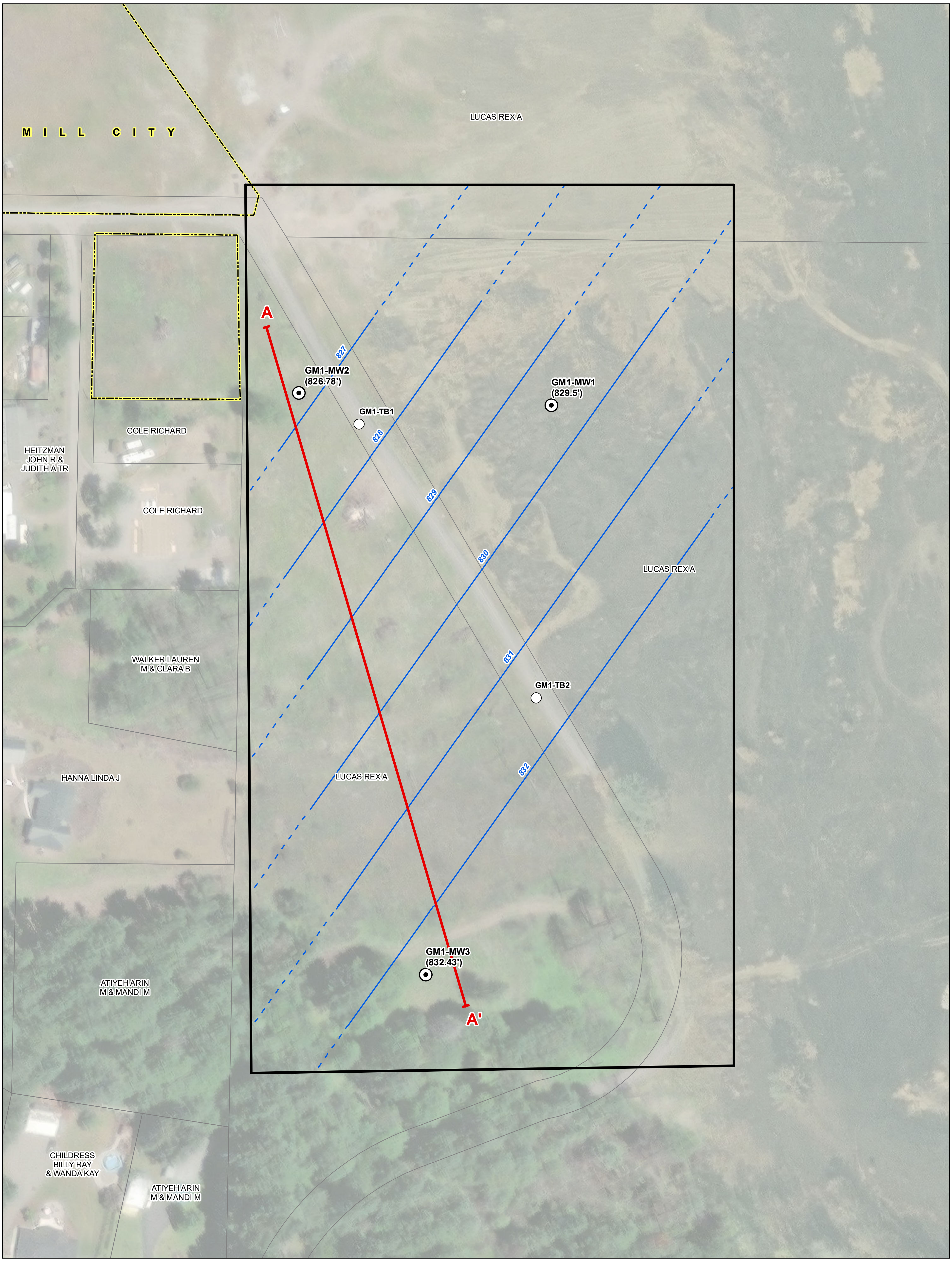
- City Boundary
- County Boundary
- Major Road
- Watercourse
- Waterbody

N

0 300 600 900
Feet

Date: November 6, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

GSI Water Solutions, Inc.



LEGEND

- ⊙ Monitoring Well (Static Water Level)
- ○ Temporary Boring Phase III
- — Groundwater Elevation Contour, feet
- ⊢ Cross Section Line
- ▭ Site

All Other Features

- ▭ Tax Lot
- ▨ City Boundary
- ╱╲ Major Road

MONITORING WELL	LATITUDE	LONGITUDE	ELEVATION
MW1 (L136274)	N44°45'03.98"	W122°27'38.51"	851.9 feet above mean sea level
MW2 (L136301)	N44°45'03.76"	W122°27'43.28"	849.8 feet above mean sea levell
MW3 (L136302)	N44°44'56.66"	W122°27'40.06"	859.6 feet above mean sea level

NOTE

Monitoring well locations surveyed by FNN Surveying on Septermber 5, 2023.

Area

FIGURE 3

Study ~~Site~~ GM1 Groundwater Elevations

Santiam Canyon Infiltration Project
Phase III

Date: November 6, 2023
Data Sources: BLM, ESRI, ODOT, USGS, Aerial Photo 2020

N

0 60 120 180
Feet

GSI Water Solutions, Inc.

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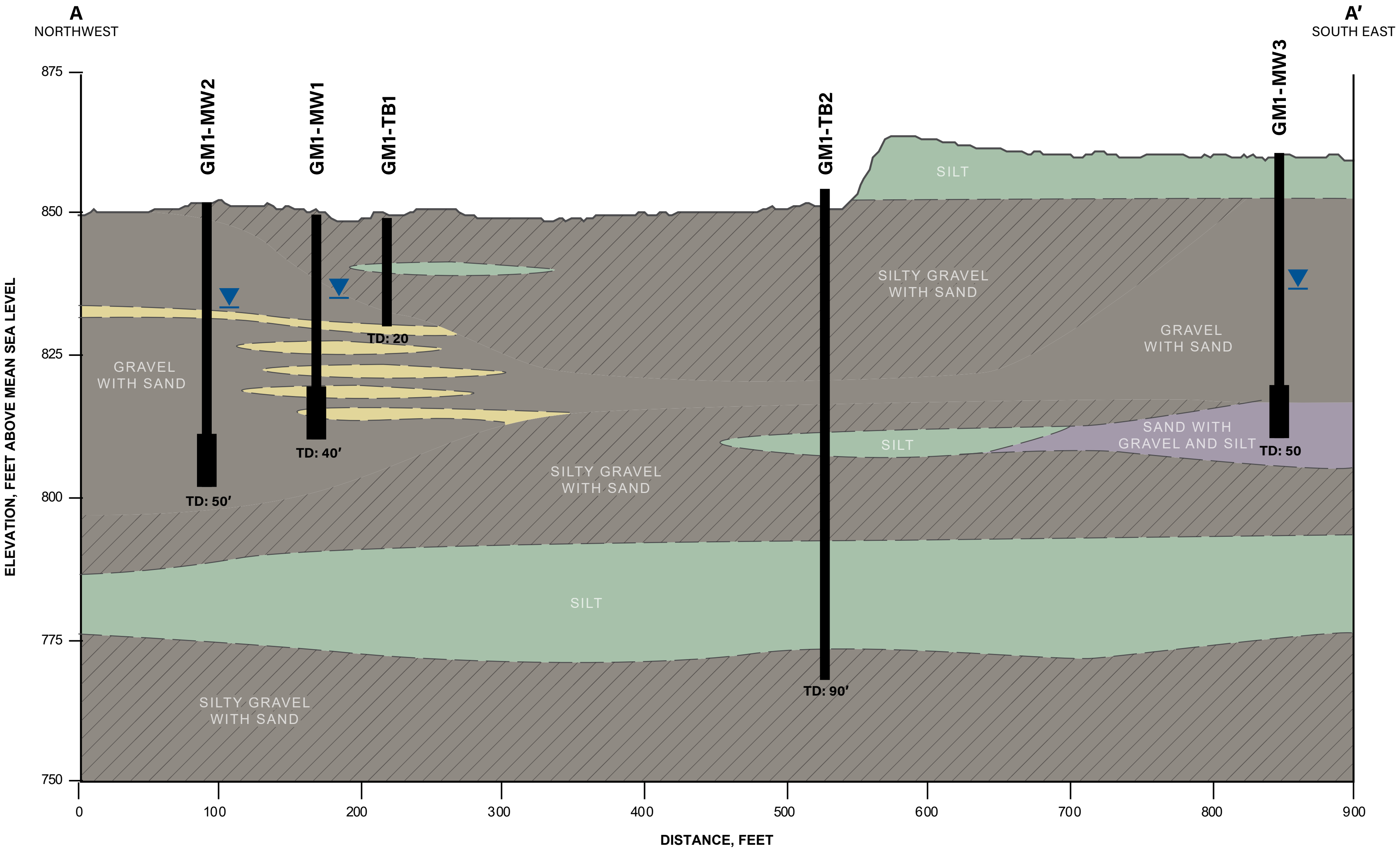


Please change patterns to standard GSI formal (gravels for gravel units and dashes for silts)

LEGEND

- ▨ GM: Silty Gravel with Sand
- ■ GW: Gravel with Sand
- 🟨 SW: Sand
- 🟩 ML: Silt
- 🟪 SW-SM: Sand with Gravel and Silt

NOTE

TD: Total Depth

Area

FIGURE 4

Study ~~Site~~ GM1 Cross-Section A-A'

Santiam Canyon Infiltration Project
Phase III

GSI Water Solutions, Inc.

Y:\0464_Keller_Assoc\Source_Figures\020_Santiam_Canyon\Phase_III_Infiltration_Project

ATTACHMENT A

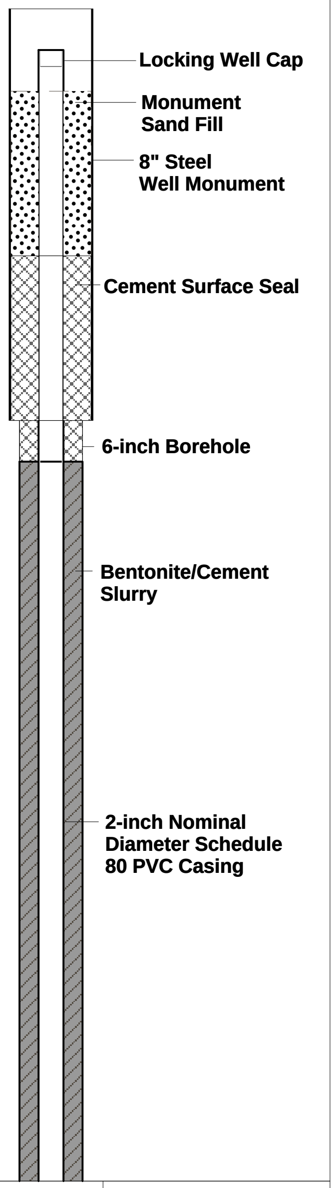
Boring Logs

LOG ID: GM1-MW1

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 851 ft NAVD88	
BORING LOCATION:	Mill City, OR	**TOTAL DEPTH (ft):** 40	**DATE STARTED:** 5/19/2023
DRILLING CONTRACTOR:	Holt	**LOGGED BY:** J. Hall	**DATE FINISHED:** 5/22/2023
SAMPLING METHOD:	Continuous Core	**DEPTH TO WATER (ft bgs)** **FIRST:** 19.5	**COMPLETED:** 14.9
DRILLING METHOD:	Sonic		

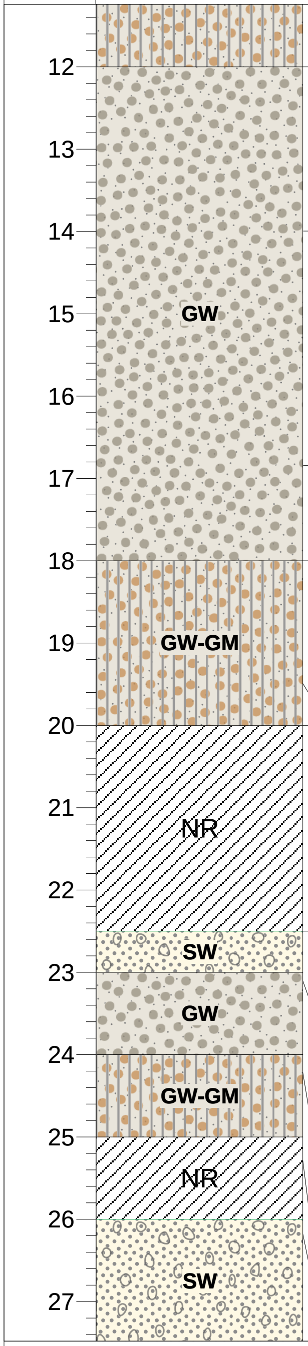
DEPTH (feet)		**SAMPLE DESCRIPTION** Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
0	**GM**	0 - 1.5 ft: Loose, dark brown, dry, silty GRAVEL with sand (GM), organics, sand is very fine to coarse, subangular to subrounded, gravel is fine to coarse, subangular to rounded [FILL]	70	<15	15
	GM	1.5 - 3.0 ft: Medium dense, dark brown, moist, silty GRAVEL (GM), organics, medium plasticity, sand is very fine to coarse, subangular to subrounded, gravel is fine to coarse, subangular to subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	50	<10	40
3	**GM**	3.0 - 4.0 ft: Loose, dark brown to black, dry to moist, silty GRAVEL with sand (GM), organics, low plasticity, sand is fine to coarse, angular to subrounded, gravel is fine to medium, subangular to subrounded, odor of charcoal [QUATERNARY MIDDLE TERRACE DEPOSITS]	40	25	35
4	**GW-GM**	4.0 - 5.0 ft; Very loose, dark grey, dry, well graded GRAVEL with silt and sand (GW-GM), low plasticity, sand is very fine to coarse, subangular to rounded, gravel is fine to medium, subangular to subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	60	30	10
5	**GW-GM**	5.0 - 12.0 ft: Very loose, brown to dark brown to grey, dry to wet, well graded GRAVEL with silt and sand (GW-GM), low plasticity, sand is very fine to coarse, subangular to rounded, gravel is fine to medium, subangular to subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	75	15	10
		Gray, dry, increase in coarse gravel/cobbles at 6.5 ft			
11		Increase in moisture (moist to wet) at 11 ft			

AS-BUILT WELL CONSTRUCTION



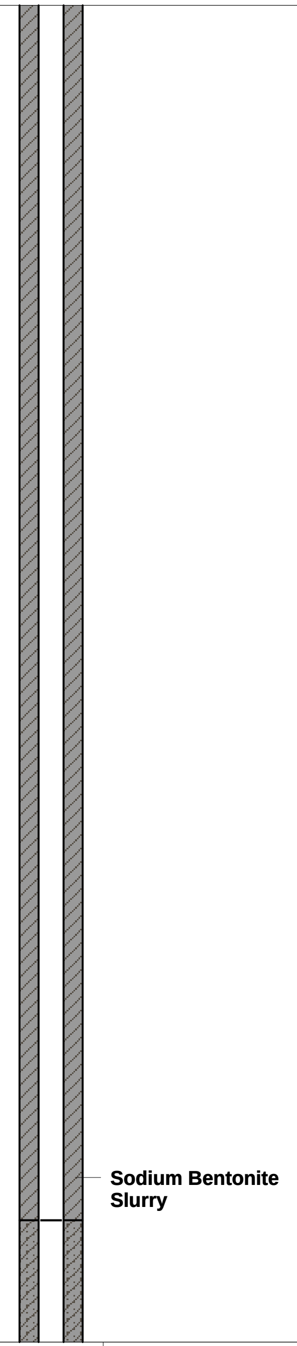
LOG ID: GM1-MW1

PROJECT: Santiam Canyon Infiltration Evaluation
BORING LOCATION: Mill City, OR
DRILLING CONTRACTOR: Holt
SAMPLING METHOD: Continuous Core
DRILLING METHOD: Sonic
GROUND SURFACE ELEVATION AND DATUM: 851 ft NAVD88
TOTAL DEPTH (ft): 40
DATE STARTED: 5/19/2023
LOGGED BY: J. Hall
DATE FINISHED: 5/22/2023
DEPTH TO WATER (ft bgs) **FIRST:** 19.5 **COMPLETED:** 14.9



DEPTH (feet)	SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
14	Wet at 14.0 ft			
12–18	12.0 - 18.0 ft: Very loose, dark brown, moist, well graded GRAVEL with sand (GW), low plasticity, sand is very fine to very coarse, subangular to rounded, gravel is fine to coarse, subangular to rounded, cobbles (< 6 inches), subrounded to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	80	15	<5
17	No return from 15 to 20 ft. Recovered with clean-out.			
18–20	18.0 - 20.0 ft: Very loose, dark brown, moist, well graded GRAVEL with silt and sand (GW-GM), low plasticity, sand is very fine to coarse, subangular to rounded, gravel is fine to medium, subangular to subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	70	20	10
19.5	Wet at 19.5 ft			
20–22.5	20.0 - 22.5 ft: NO RETURN			
22.5–23	22.5 - 23.0 ft: Very loose, dark brown, wet, well graded SAND (SW), low plasticity, sand is very fine to very coarse, subangular to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	0	100	<5
23–24	23.0 - 24.0 ft: Very loose, dark brown, moist, well graded GRAVEL with sand (GW), low plasticity, sand is very fine to very coarse, subangular to rounded, gravel is very fine to very coarse, subangular to rounded, cobbles (< 6 inches), subrounded to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	50	<50	<5
24–25	24.0 - 25.0 ft: Very loose, dark brown, wet, well graded GRAVEL with silt and sand (GW-GM), low plasticity, gravel is very fine to very coarse, subangular to rounded, cobbles <6 in, subrounded to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	70	20	10
25–26	25.0 - 26.0 ft: NO RETURN			
26–27.5	26.0 - 27.5 ft: Very loose, dark brown, wet, well graded	0	100	<5

AS-BUILT WELL CONSTRUCTION

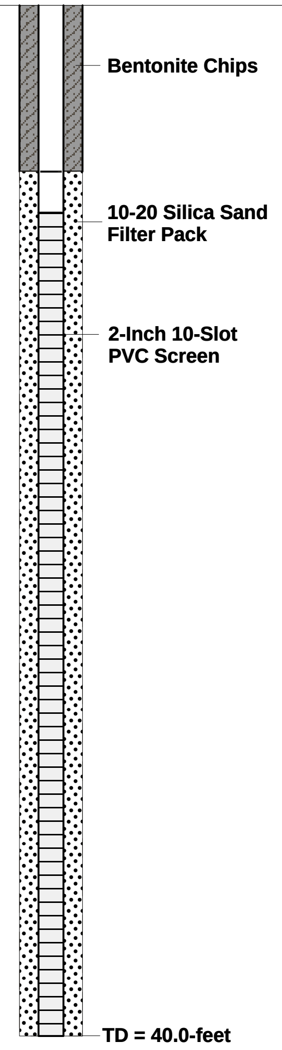


LOG ID: GM1-MW1

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 851 ft NAVD88	
BORING LOCATION:	Mill City, OR	**TOTAL DEPTH (ft):** 40	**DATE STARTED:** 5/19/2023
DRILLING CONTRACTOR:	Holt	**LOGGED BY:** J. Hall	**DATE FINISHED:** 5/22/2023
SAMPLING METHOD:	Continuous Core	**DEPTH TO WATER (ft bgs)** **FIRST:** 19.5	**COMPLETED:** 14.9
DRILLING METHOD:	Sonic		

DEPTH (feet)		**SAMPLE DESCRIPTION** Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
28		SAND (SW), low plasticity, sand is very fine to coarse, subangular to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]			
29	GW	27.5 - 30.0 ft: Very loose, dark brown, wet, well graded GRAVEL (GW), low plasticity, sand is very fine to very coarse, subangular to rounded, gravel is fine to coarse, subangular to rounded, cobbles (< 8 inches), subrounded to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	100	0	<5
30 31	SW	30.0 - 31.5 ft: Very loose, dark brown, wet, well graded SAND (SW), low plasticity, sand is very fine to coarse, subangular to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	0	100	<5
32 33 34	GW	Increase in silt/decrease in gravel at 33.0 ft 31.5 - 35.0 ft: Loose, dark brown, wet, well graded GRAVEL with sand (GW), low plasticity, sand is fine to coarse, subangular to subrounded, gravel is fine to coarse, subangular to rounded, cobbles (< 8 inches), subrounded to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	60	40	<5
35	SW-SM	35.0 - 36.0 ft: Very loose, dark brown to dark gray, wet, well graded SAND with silt (SW-SM), sand is very fine to coarse, subangular to subrounded, gravel is fine to coarse, subrounded to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	10	80	10
36	GW	36.0 - 37.0 ft: Loose, brown to gray, wet, well graded GRAVEL (GW), gravel is fine to coarse, subrounded to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	90	<5	<5
37 38 39	GW	Increase in cobbles at 38.0 ft 37.0 - 40.0 ft: Loose, dark brown, wet, well graded GRAVEL with sand (GW), low plasticity, sand is fine to coarse, subangular to subrounded, gravel is fine to coarse, subangular to rounded, cobbles (< 8 inches), subrounded to rounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	60	40	<5
40		Total Depth = 40.0 ft			
41					
42					
43					

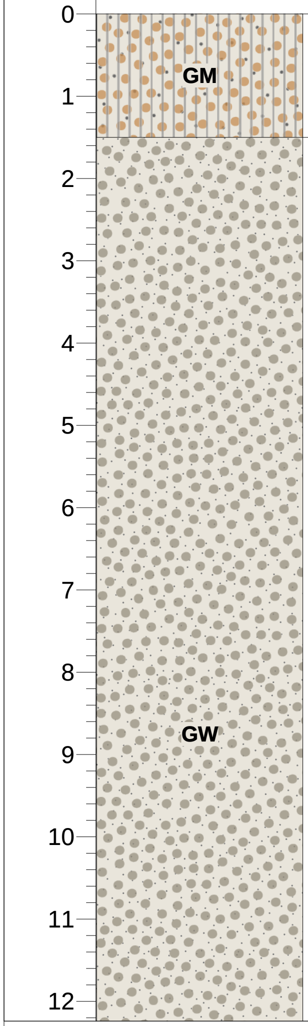
AS-BUILT WELL CONSTRUCTION



GSI Water Solutions, Inc.

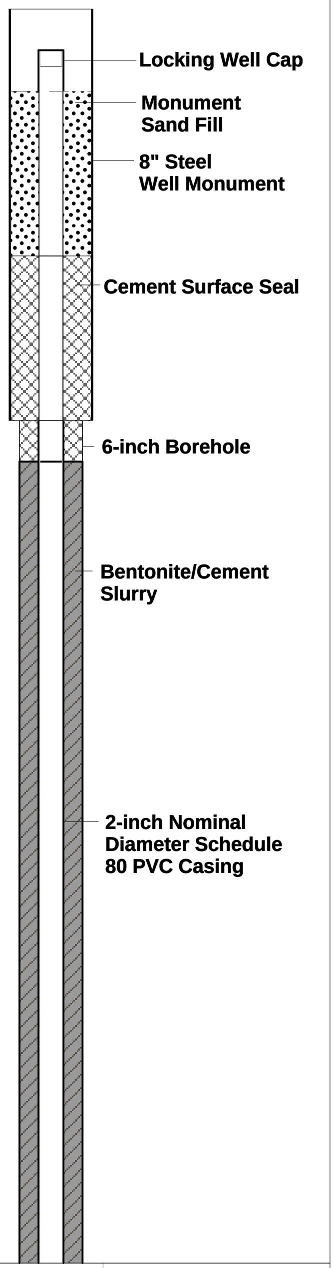
LOG ID: GM1-MW2

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 849.8 ft NAVD88	
BORING LOCATION:	Mill City, OR	**TOTAL DEPTH (ft):** 50	**DATE STARTED:** 8/23/2023
DRILLING CONTRACTOR:	Holt	**LOGGED BY:** M. Harrison	**DATE FINISHED:** 8/23/2023
SAMPLING METHOD:	Continuous Core	**DEPTH TO WATER (ft bgs)** **FIRST:** 17.58	**COMPLETED:** 20.98
DRILLING METHOD:	Sonic		



SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
0.0 - 1.5 ft: Very loose, brown, dry, silty GRAVEL with sand (GM), nonplastic, sand is very fine to coarse, gravel is fine to medium, rounded to subrounded, organics, rootlets [FILL]	60	15	25
Few Cobbles (<5 in) from 5 - 15ft			
1.5 - 16.0 ft: Very loose, gray, dry, well graded GRAVEL with sand (GW), sand is fine to coarse, gravel is fine to medium, subrounded to angular [QUATERNARY MIDDLE TERRACE DEPOSITS]	80	15	<5

AS-BUILT WELL CONSTRUCTION



LOG ID: GM1-MW2

PROJECT: Santiam Canyon Infiltration Evaluation

BORING LOCATION: Mill City, OR

DRILLING CONTRACTOR: Holt

SAMPLING METHOD: Continuous Core

DRILLING METHOD: Sonic

GROUND SURFACE ELEVATION AND DATUM: 849.8 ft NAVD88

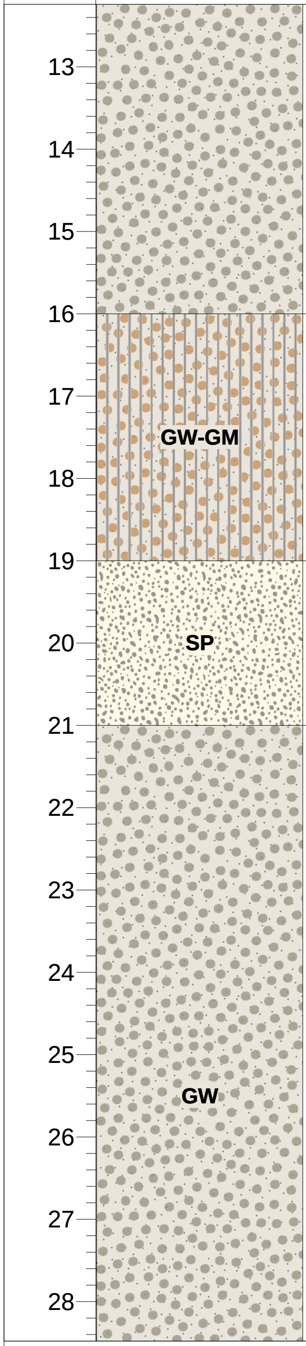
TOTAL DEPTH (ft): 50

DATE STARTED: 8/23/2023

LOGGED BY: M. Harrison

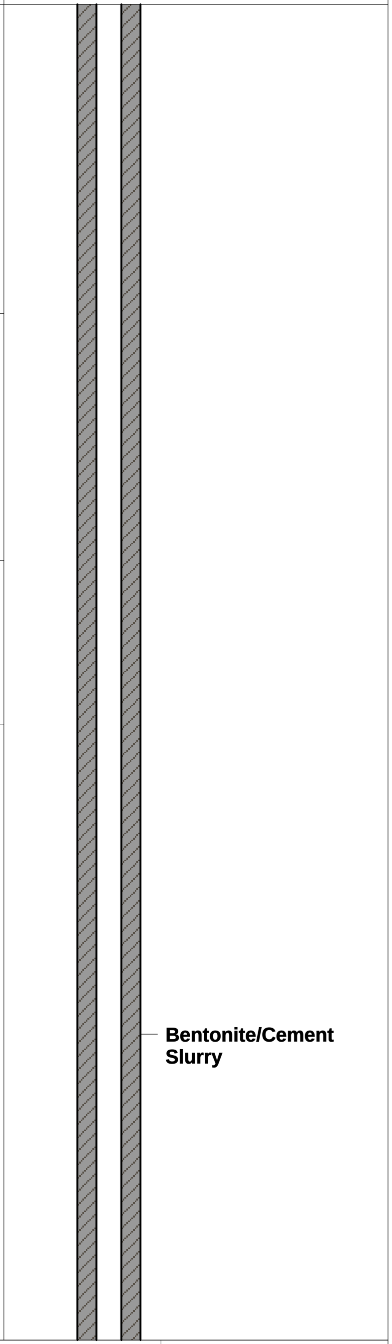
DATE FINISHED: 8/23/2023

DEPTH TO WATER (ft bgs) **FIRST:** 17.58 **COMPLETED:** 20.98



SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
Dry to moist at 13.0 ft and 15.0 ft Wet at 16.0 ft			
16.0 - 19.0 ft: Loose, dark brown, moist to wet, well graded GRAVEL with silt and sand (GW-GM), sand is fine to medium, gravel is fine to coarse, rounded to subrounded, some cobbles (<5 inches) [QUATERNARY MIDDLE TERRACE DEPOSITS]	60	30	<10
19.0 - 21 ft: Loose, dark brown, wet, poorly graded SAND (SP), sand is fine to medium, gravel is fine to medium, subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS] Gravel size increases from 20.0 - 21.0 ft	10	80	<5
21.0 - 30.0 Loose, dark brown to gray, wet, well graded GRAVEL with sand (GW), sand is fine to medium, gravel is fine to coarse, subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS] Wet from 25.0 - 30.0 ft	60	35	<5

AS-BUILT WELL CONSTRUCTION



LOG ID: GM1-MW2

PROJECT:	Santiam Canyon Infiltration Evaluation
BORING LOCATION:	Mill City, OR
DRILLING CONTRACTOR:	Holt
SAMPLING METHOD:	Continuous Core
DRILLING METHOD:	Sonic

GROUND SURFACE ELEVATION AND DATUM: 849.8 ft NAVD88

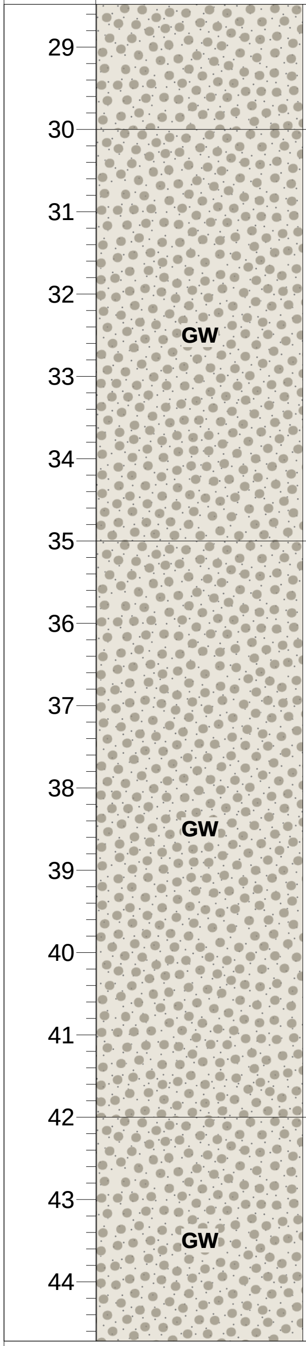
TOTAL DEPTH (ft): 50

DATE STARTED: 8/23/2023

LOGGED BY: M. Harrison

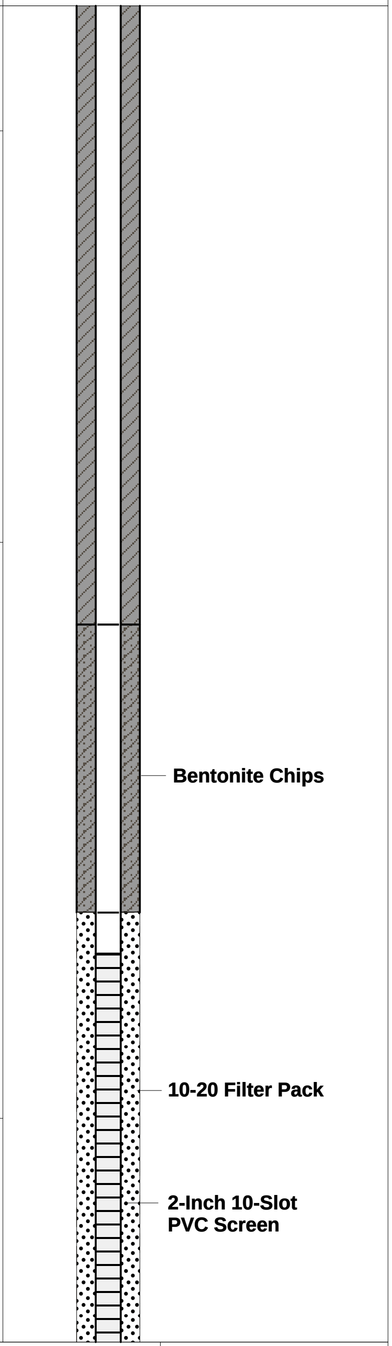
DATE FINISHED: 8/23/2023

DEPTH TO WATER (ft bgs) **FIRST:** 17.58 **COMPLETED:** 20.98



SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
30.0 - 35 ft: Loose, dark brown to gray, wet, well graded GRAVEL with sand (GW), sand is fine to medum, gravel is fine to coarse, subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	80	15	<5
Coarse sand from 37.0 - 38.0 ft 35.0 - 42.0 ft: Loose, gray brown, wet, well graded GRAVEL with sand (GW), sand is fine to coarse, gravel is fine to coarse, subrounded, some cobbles (<4 in) [QUATERNARY MIDDLE TERRACE DEPOSITS]	73	25	<5
42.0 - 45.0 ft: Loose, dark brown, wet, well graded GRAVEL with sand (GW), sand is fine to medium, gravel is fine to medium, subangular [QUATERNARY MIDDLE TERRACE DEPOSITS]	77	18	<5

AS-BUILT WELL CONSTRUCTION



GSI Water Solutions, Inc.

LOG ID: GM1-MW2

PROJECT: Santiam Canyon Infiltration Evaluation

BORING LOCATION: Mill City, OR

DRILLING CONTRACTOR: Holt

SAMPLING METHOD: Continuous Core

DRILLING METHOD: Sonic

GROUND SURFACE ELEVATION AND DATUM: 849.8 ft NAVD88

TOTAL DEPTH (ft): 50

DATE STARTED: 8/23/2023

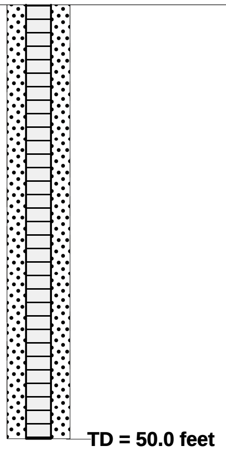
LOGGED BY: M. Harrison

DATE FINISHED: 8/23/2023

DEPTH TO WATER (ft bgs) **FIRST:** 17.58 **COMPLETED:** 20.98

DEPTH (feet)		SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
45–48	GW	45.0 - 48.0 ft: Loose, dark brown to gray, wet, well graded GRAVEL with sand (GW), sand is fine to coarse, gravel is fine to coarse, subangular [QUATERNARY MIDDLE TERRACE DEPOSITS]	70	27	<5
48–49	GW	48.0 - 49.0 ft: Loose, dark brown to gray, wet, well graded GRAVEL with sand (GW), sand is fine to coarse, gravel is fine to medium, subangular to angular [QUATERNARY MIDDLE TERRACE DEPOSITS]	54	46	<5
50		Total Depth = 50.0 ft			

AS-BUILT WELL CONSTRUCTION



GSI Water Solutions, Inc.

LOG ID: GM1-MW3

PROJECT: Santiam Canyon Infiltration Evaluation

GROUND SURFACE ELEVATION AND DATUM: 859.6 ft NAVD88

BORING LOCATION: Mill City, OR

TOTAL DEPTH (ft): 50

DATE STARTED: 8/29/2023

DRILLING CONTRACTOR: Holt

LOGGED BY: M.Harrison, J. Cain

DATE FINISHED: 8/29/2023

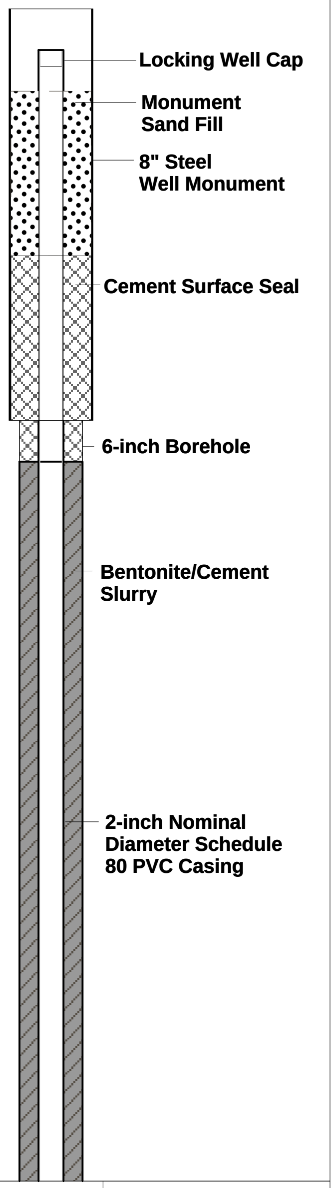
SAMPLING METHOD: Continuous Core

DEPTH TO WATER (ft bgs) **FIRST:** 32.17 **COMPLETED:** 23.17

DRILLING METHOD: Sonic

DEPTH (feet)		SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
0 1 2 3 4 5 6	ML	0.0 - 6.5 ft: Soft, brown, dry, SILT (ML), few rootlets [FILL]	0	0	100
7 8 9 10 11	GW	Coarse gravel/cobbles (<4 inches) at 6.5 ft 6.5 - 12.5 ft: Loose, gray to brown, dry, well graded GRAVEL (GW), sand is fine to coarse, subangular, gravel is fine to coarse, subrounded to subanglar [QUATERNARY MIDDLE TERRACE DEPOSITS]	84	13	<5

AS-BUILT WELL CONSTRUCTION



GSI Water Solutions, Inc.

LOG ID: GM1-MW3

PROJECT: Santiam Canyon Infiltration Evaluation

GROUND SURFACE ELEVATION AND DATUM: 859.6 ft NAVD88

BORING LOCATION: Mill City, OR

TOTAL DEPTH (ft): 50

DATE STARTED: 8/29/2023

DRILLING CONTRACTOR: Holt

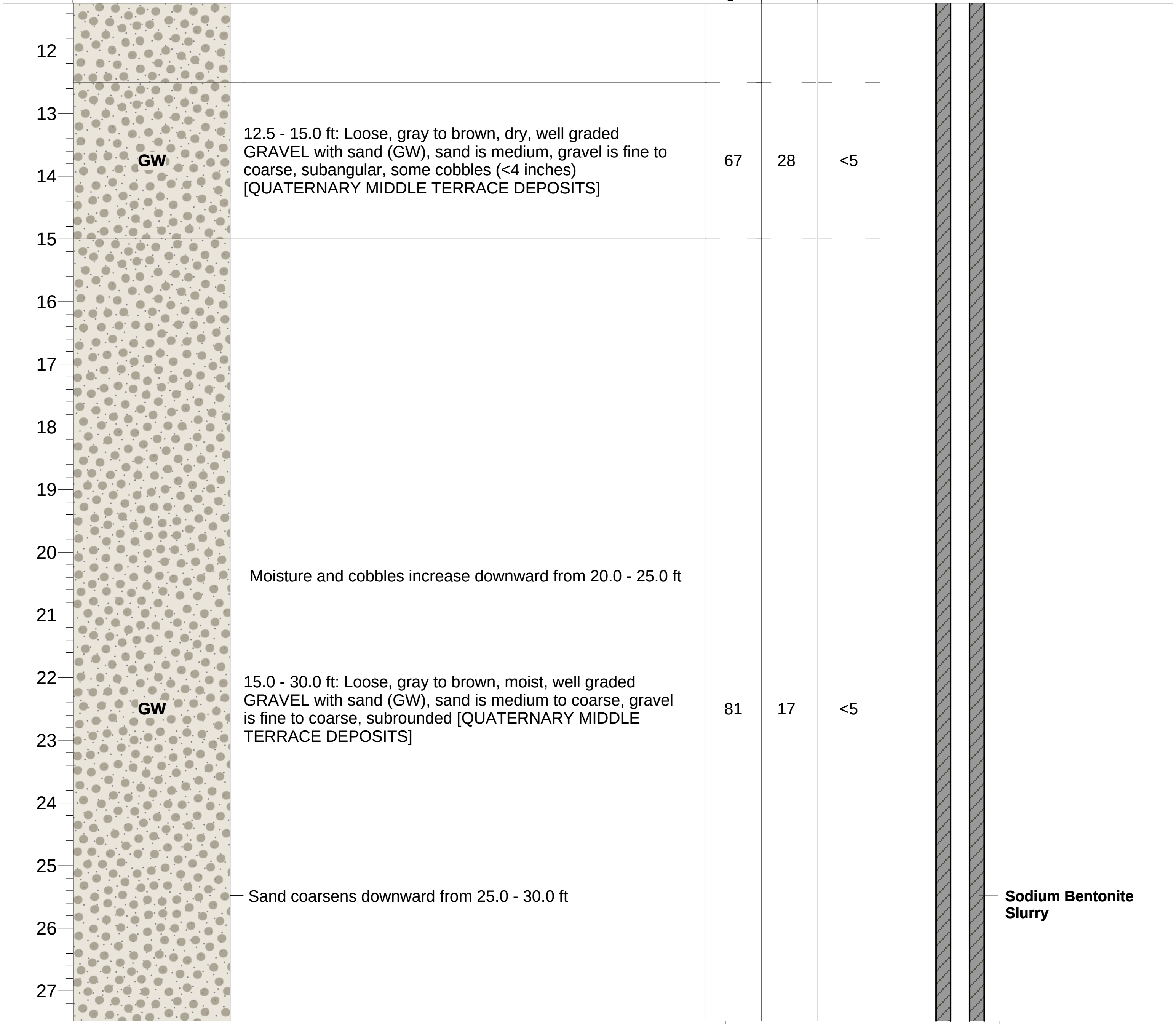
LOGGED BY: M.Harrison, J. Cain

DATE FINISHED: 8/29/2023

SAMPLING METHOD: Continuous Core

DEPTH TO WATER (ft bgs) **FIRST:** 32.17 **COMPLETED:** 23.17

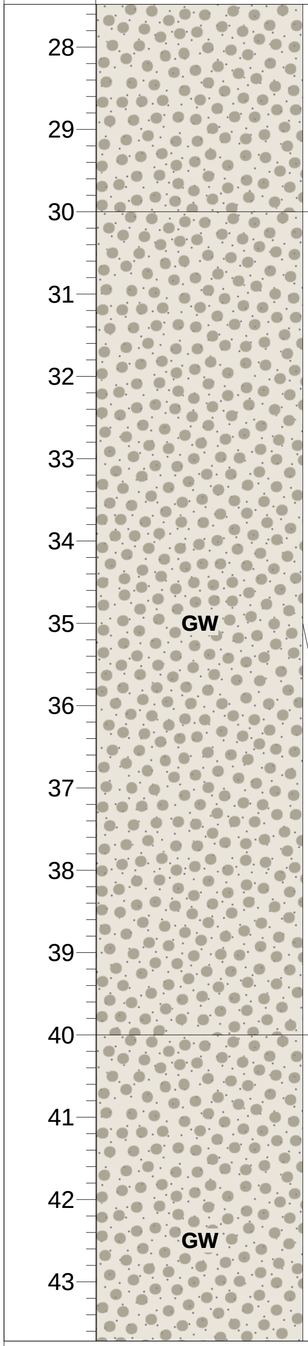
DRILLING METHOD: Sonic



SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
12.5 - 15.0 ft: Loose, gray to brown, dry, well graded GRAVEL with sand (GW), sand is medium, gravel is fine to coarse, subangular, some cobbles (<4 inches) [QUATERNARY MIDDLE TERRACE DEPOSITS]	67	28	<5
Moisture and cobbles increase downward from 20.0 - 25.0 ft			
15.0 - 30.0 ft: Loose, gray to brown, moist, well graded GRAVEL with sand (GW), sand is medium to coarse, gravel is fine to coarse, subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	81	17	<5
Sand coarsens downward from 25.0 - 30.0 ft			

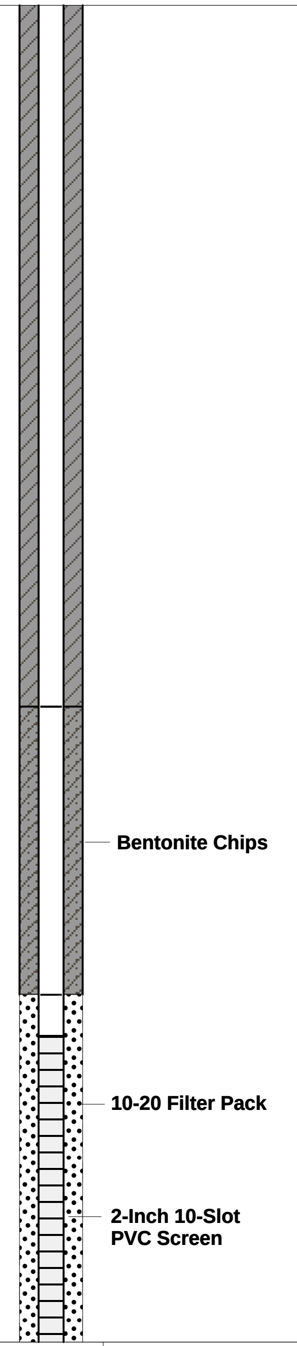
LOG ID: GM1-MW3

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 859.6 ft NAVD88	
BORING LOCATION:	Mill City, OR	**TOTAL DEPTH (ft):** 50	**DATE STARTED:** 8/29/2023
DRILLING CONTRACTOR:	Holt	**LOGGED BY:** M.Harrison, J. Cain	**DATE FINISHED:** 8/29/2023
SAMPLING METHOD:	Continuous Core	**DEPTH TO WATER (ft bgs)** **FIRST:** 32.17	**COMPLETED:** 23.17
DRILLING METHOD:	Sonic		



SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
30.0 - 40.0 ft: Loose, gray, wet, well graded GRAVEL with sand (GW), sand is medium, gravel is fine to coarse, subrounded, some cobbles (<4 inches) [QUATERNARY MIDDLE TERRACE DEPOSITS] Increase in sand at 35.0 ft	70	25	<5
40.0 - 45.0 ft: Loose, gray to brown, wet, well graded GRAVEL with sand (GW), sand is fine to medium, gravel is fine to coarse, subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	60	32	8

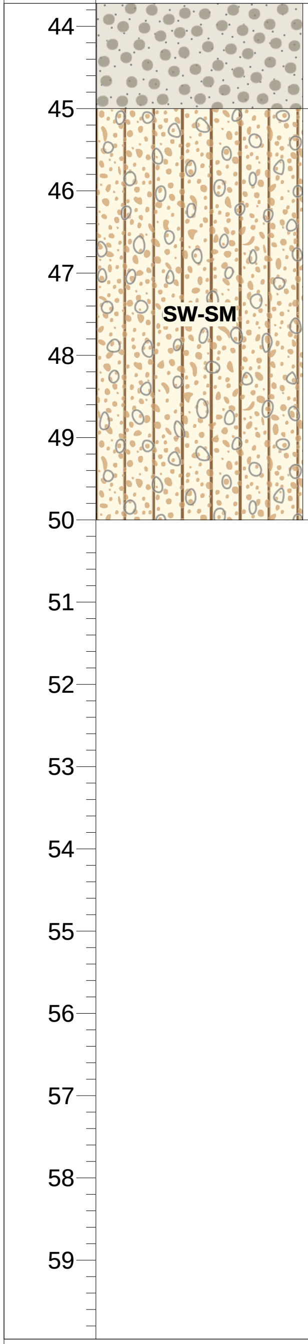
AS-BUILT WELL CONSTRUCTION



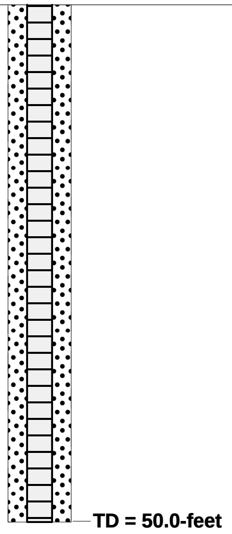
LOG ID: GM1-MW3

PROJECT:	Santiam Canyon Infiltration Evaluation	**GROUND SURFACE ELEVATION AND DATUM:** 859.6 ft NAVD88	
BORING LOCATION:	Mill City, OR	**TOTAL DEPTH (ft):** 50	**DATE STARTED:** 8/29/2023
DRILLING CONTRACTOR:	Holt	**LOGGED BY:** M.Harrison, J. Cain	**DATE FINISHED:** 8/29/2023
SAMPLING METHOD:	Continuous Core	**DEPTH TO WATER (ft bgs)** **FIRST:** 32.17	**COMPLETED:** 23.17
DRILLING METHOD:	Sonic		

DEPTH (feet)	**SAMPLE DESCRIPTION** Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**	**AS-BUILT WELL CONSTRUCTION**
44–45					
45–50	45.0 - 50.0 ft: loose to medium dense, gray to brown, wet, well graded SAND with silt and gravel (SW-SM), sand is fine to medium, gravel is fine to coarse, subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	29	61	10	



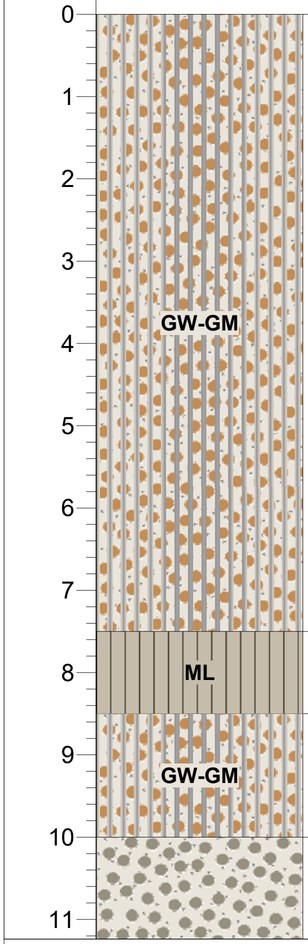
Total Depth = 50.0 ft



GSI Water Solutions, Inc.

LOG ID: GM1-TB1

PROJECT:	Santiam Canyon Infiltration Evaluation	**TOTAL DEPTH (ft):** 20	**DATE STARTED:** 8/21/2023
BORING LOCATION:	Mill City, OR	**LOGGED BY:** M. Harrison, C. Kambur	**DATE FINISHED:** 8/21/2023
DRILLING CONTRACTOR:	Holt	**DEPTH TO WATER (ft bgs)** **FIRST:** 18.4	**COMPLETED:** N/A
SAMPLING METHOD:	Continuous Core		
DRILLING METHOD:	Sonic		



DEPTH (feet)	**SAMPLE DESCRIPTION** Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
0 – 7.5	0.0 - 7.5 ft: Loose, light brown to gray, dry to moist, well graded GRAVEL with silt and sand (GW-GM), sand is fine to medium, few cobbles (<4 inches) [QUATERNARY MIDDLE TERRACE DEPOSITS]	82	18	13
7.5 – 8.5	7.5 - 8.5 ft: Soft, dark brown, dry to moist, SILT (ML) [QUATERNARY MIDDLE TERRACE DEPOSITS]	<5	<5	97
8.5 – 10	8.5 - 10.0 ft: Loose, gray, dry, well graded GRAVEL with silt and sand (GM), sand is fine to medium, gravel is fine to coarse, subangular, some cobbles (<4 inches) [QUATERNARY MIDDLE TERRACE DEPOSITS]	70	15	15
10 – 11				

LOG ID: GM1-TB1

PROJECT: Santiam Canyon Infiltration Evaluation

TOTAL DEPTH (ft): 20

DATE STARTED: 8/21/2023

BORING LOCATION: Mill City, OR

LOGGED BY: M. Harrison, C. Kambur

DATE FINISHED: 8/21/2023

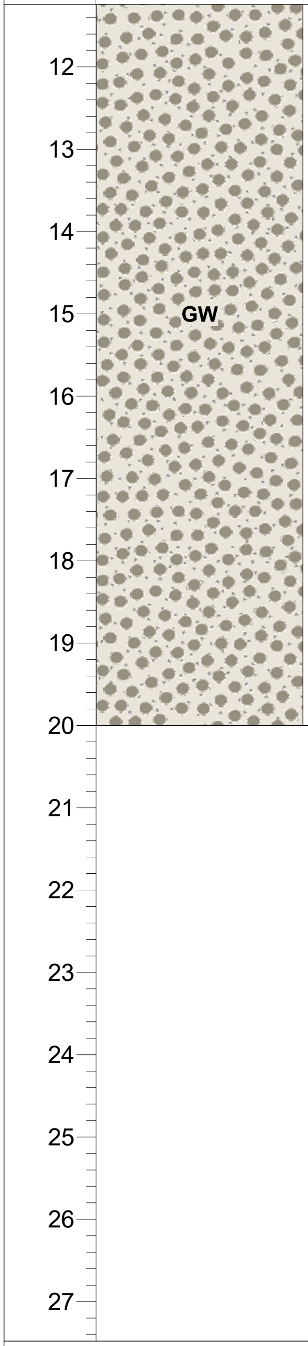
DRILLING CONTRACTOR: Holt

DEPTH TO WATER (ft bgs) **FIRST:** 18.4 **COMPLETED:** N/A

SAMPLING METHOD: Continuous Core

DRILLING METHOD: Sonic

DEPTH (feet)	SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
	10.0 - 20.0 ft: Loose, gray, dry, well graded GRAVEL with sand (GM), sand is fine to medium, gravel is fine to medium, subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	73	22	<5



Total Depth = 20.0 ft

LOG ID: GM1-TB2

PROJECT: Santiam Canyon Infiltration Evaluation

BORING LOCATION: Mill City, OR

DRILLING CONTRACTOR: Holt

SAMPLING METHOD: Continuous Core

DRILLING METHOD: Sonic

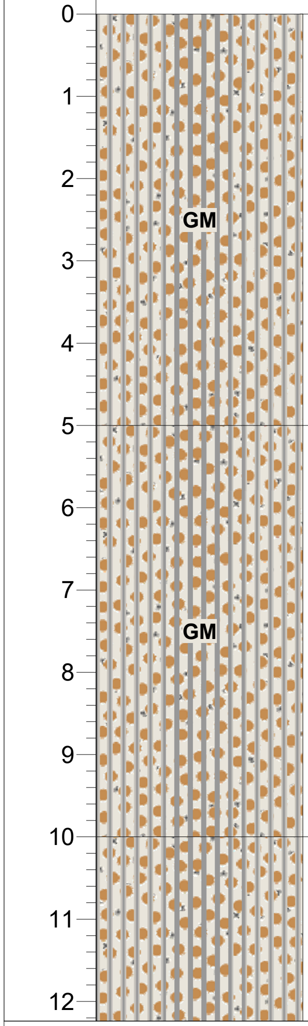
TOTAL DEPTH (ft): 90

DATE STARTED: 8/21/2023

LOGGED BY: M. Harrison, C. Kambur

DATE FINISHED: 8/22/2023

DEPTH TO WATER (ft bgs) **FIRST:** 20 **COMPLETED:** N/A



SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
0.0 - 5.0 ft: Loose, gray to brown, silty GRAVEL with sand (GM), sand is fine to medium, gravel is subangular, cobbles are subangular, topsoil contains rootlets [QUATERNARY MIDDLE TERRACE DEPOSITS]	65	20	15
5.0 - 10.0 ft: Loose, light gray, dry, silty GRAVEL with sand (GM), sand is fine to medium, subrounded, cobbles are fist-shaped [QUATERNARY MIDDLE TERRACE DEPOSITS]	70	15	15

LOG ID: GM1-TB2

PROJECT: Santiam Canyon Infiltration Evaluation

BORING LOCATION: Mill City, OR

DRILLING CONTRACTOR: Holt

SAMPLING METHOD: Continuous Core

DRILLING METHOD: Sonic

TOTAL DEPTH (ft): 90

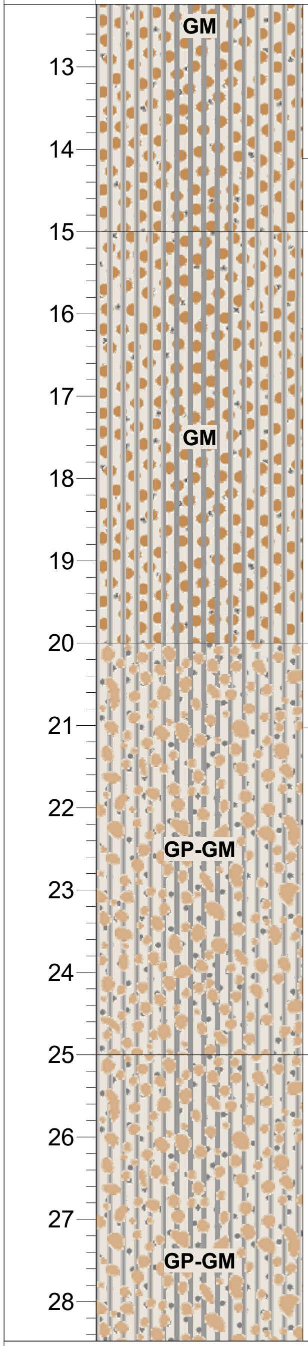
DATE STARTED: 8/21/2023

LOGGED BY: M. Harrison, C. Kambur

DATE FINISHED: 8/22/2023

DEPTH TO WATER (ft bgs) **FIRST:** 20 **COMPLETED:** N/A

DEPTH (feet)



SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
10.0 - 15.0 ft: Loose, gray to brown, wet, silty GRAVEL with sand (GM), sand is fine to medium, gravel is subangular, cobbles are subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	76	14	10
Sands appear to fine downwards from 10.0 - 15.0 ft			
15.0 - 20.0 ft: Loose, gray to brown, wet, silty GRAVEL with sand (GM), sand is fine to medium, gravel is subangular, cobbles are subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	80	10	10
Sands appear to slightly fine downwards from 20.0 - 25.0 ft			
20.0 - 25.0 ft: Loose, gray to dark gray, wet, poorly graded GRAVEL with silt (GP-GM), sand is medium to fine, gravel is fine to coarse, gravel is subangular to subrounded, cobbles are subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	88	<5	10
25.0 - 30.0 ft: Loose, gray to dark gray, wet, poorly graded GRAVEL with silt (GP-GM), sand is medium to fine, gravel is fine to coarse, gravel is subangular to subrounded, cobbles are subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	78	10	12

GSI Water Solutions, Inc.

LOG ID: GM1-TB2

PROJECT:	Santiam Canyon Infiltration Evaluation	**TOTAL DEPTH (ft):** 90		**DATE STARTED:** 8/21/2023	
BORING LOCATION:	Mill City, OR	**LOGGED BY:** M. Harrison, C. Kambur		**DATE FINISHED:** 8/22/2023	
DRILLING CONTRACTOR:	Holt	**DEPTH TO WATER (ft bgs)**	**FIRST:** 20	**COMPLETED:** N/A	
SAMPLING METHOD:	Continuous Core				
DRILLING METHOD:	Sonic				

DEPTH (feet)		**SAMPLE DESCRIPTION** Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
29		Matrix fines downwards from 25.0 - 30.0 ft			
30 31 32 33 34	GP-GM	30.0 - 35.0 ft: Loose, gray to dark gray, wet, poorly graded GRAVEL with silt (GP-GM), sand is medium to fine, gravel is fine to coarse, gravel is subangular to subrounded, cobbles are subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS] Sand content increases downwards from 30.0 - 35.0 ft	85	8	7
35 36 37 38 39	GP-GM	35.0 - 40.0 ft: Loose, gray to dark gray, wet, poorly graded GRAVEL with silt and sand (GP-GM), gravel is fine to coarse, gravel is fine to coarse, subrounded, cobbles are subangular, less cohesive than 30-35 ft sample [QUATERNARY MIDDLE TERRACE DEPOSITS]	90	5	5
40 41 42 43 44	GP-GM	40.0 - 45.0 ft: Loose, gray to dark gray, wet, poorly graded GRAVEL with silt (GP-GM), sand is fine to medium, gravel is fine to coarse, subrounded, cobbles are subrounded, sandy matrix, silty matrix fines downward [QUATERNARY MIDDLE TERRACE DEPOSITS]	63	12	25

LOG ID: GM1-TB2

PROJECT: Santiam Canyon Infiltration Evaluation

BORING LOCATION: Mill City, OR

DRILLING CONTRACTOR: Holt

SAMPLING METHOD: Continuous Core

DRILLING METHOD: Sonic

TOTAL DEPTH (ft): 90

DATE STARTED: 8/21/2023

LOGGED BY: M. Harrison, C. Kambur

DATE FINISHED: 8/22/2023

DEPTH TO WATER (ft bgs) **FIRST:** 20 **COMPLETED:** N/A

DEPTH (feet)	USCS	SAMPLE DESCRIPTION Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	% GRAVEL	% SAND	% FINES
45 – 50	ML	45.0 - 50.0 ft: Medium hard to hard, gray-olive, moist, gravelly SILT (ML), gravel is subrounded, few cobbles, subangular, some clay [QUATERNARY MIDDLE TERRACE DEPOSITS]	35	10	55
50 – 60	ML	55.0 - 60.0 ft: Medium hard to hard, light gray to gray-olive, moist, gravelly SILT (ML), gravel is subrounded, cobbles are subangular, more clay than 45.0 - 50.0 ft [QUATERNARY MIDDLE TERRACE DEPOSITS] Matrix coarsens downwards from 55.0 - 60.0 ft Gravel is more abundant from 55.0 - 60.0 ft	50	10	40

LOG ID: GM1-TB2

PROJECT: Santiam Canyon Infiltration Evaluation
TOTAL DEPTH (ft): 90
DATE STARTED: 8/21/2023
BORING LOCATION: Mill City, OR
LOGGED BY: M. Harrison, C. Kambur
DATE FINISHED: 8/22/2023
DRILLING CONTRACTOR: Holt
DEPTH TO WATER (ft bgs) **FIRST:** 20 **COMPLETED:** N/A
SAMPLING METHOD: Continuous Core
DRILLING METHOD: Sonic

DEPTH (feet)		**SAMPLE DESCRIPTION** Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
61					
62	**ML**	60.0 - 65.0 ft: Medium hard, olive-gray, moist, silty GRAVEL with sand (GM), sand is fine to medium, gravel is fine to medium, subrounded [QUATERNARY MIDDLE TERRACE DEPOSITS]	65	15	20
63					
64		3.0 - 4.0 in clasts and weathered mafic material at 65.0 ft			
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75	**ML**	65.0 - 85.0 ft: hard, brown, moist, SILT (ML) [QUATERNARY MIDDLE TERRACE DEPOSITS]	<5	<5	100
76					
77					

GSI Water Solutions, Inc.

LOG ID: GM1-TB2

PROJECT: Santiam Canyon Infiltration Evaluation

BORING LOCATION: Mill City, OR

DRILLING CONTRACTOR: Holt

SAMPLING METHOD: Continuous Core

DRILLING METHOD: Sonic

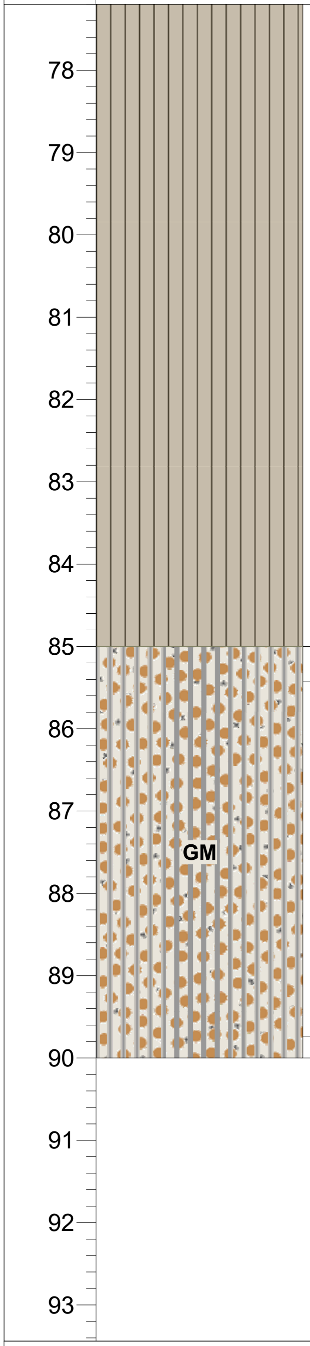
TOTAL DEPTH (ft): 90

DATE STARTED: 8/21/2023

LOGGED BY: M. Harrison, C. Kambur

DATE FINISHED: 8/22/2023

DEPTH TO WATER (ft bgs) **FIRST:** 20 **COMPLETED:** N/A



DEPTH (feet)	**SAMPLE DESCRIPTION** Flow, color, weathering, grain size, vesicles primary and secondary minerals, alterations	**% GRAVEL**	**% SAND**	**% FINES**
85	Coarsens downward from 85.0 - 90.0 ft			
85 - 90	85.0 - 90.0 ft: Loose to medium dense, dark brown to gray-olive, slightly moist to moist, silty GRAVEL with sand (GM), gravel is subangular, cobbles are subangular [QUATERNARY MIDDLE TERRACE DEPOSITS]	51	15	34
90	Cobbles present at 90.0 ft			

Total Depth = 90.0 ft

ATTACHMENT B

Slug Testing Memo

TECHNICAL MEMORANDUM

Aquifer Permeability Estimates in Study Area GM1, Gates/Mill City Sewer Basin, Linn County, Oregon

To:	File
From:	Matthew Kohlbecker, RG / GSI Water Solutions, Inc.
Date:	September 20, 2023

1. Introduction

GSI Water Solutions, Inc., (GSI) conducted slug testing at three monitoring wells in Study Area GM1, which is a candidate for infiltration of treated wastewater in Mill City, Oregon. The purpose of the slug testing was to estimate the hydraulic conductivity of saturated soils in the study area. Hydraulic conductivity is a property of soils that describes the ease at which a fluid moves through the pore space. The estimates of hydraulic conductivity will be used to: (1) predict the groundwater mounding that occurs during the infiltration of treated wastewater at proposed Rapid Infiltration Basins (RIBs) using an analytical model, and (2) run contaminant fate and transport models to evaluate the fate and transport of residual constituents in the treated wastewater.

The monitoring wells were installed in Study Area GM1 as part of a subsurface characterization in August 2023. The monitoring wells are completed in a shallow, unconfined aquifer. In addition, the monitoring well screens remained saturated for the duration of the slug tests. Boring logs and well construction diagrams for the monitoring wells are provided in the main text of this report.

This technical memorandum provides methods and results of slug testing conducted at monitoring wells GM1-MW1, GM1-MW2, and GM1-MW3 in Study Area GM1. Note that slug tests at monitoring well GM1-MW1 were previously analyzed in GSI (2023). This technical memorandum presents a re-analysis of the slug tests at GM1-MW1 based on a clearer understanding of aquifer response to slug testing gained from the GM1-MW2 and GM1-MW3 slug tests.

2. Methods

A slug test involves: (1) introducing or removing a solid cylinder into a monitoring well to instantaneously raise or lower the water level in the monitoring well, and (2) monitoring the recovery of the water level to the static (pre-test) condition. Slug tests were conducted in general accordance with the *Santiam Canyon Treated Wastewater Disposal – Subsurface Characterization Work Plan*, dated March 3, 2023, and the *Santiam Canyon Treated wastewater Disposal – Subsurface Characterization Work Plan Addendum No. 1 (Phase III)*, dated August 18, 2023.

For each slug test, water level recovery was recorded every 0.5 seconds with a non-vented Solinst pressure transducer and datalogger. Although non-vented transducers record both water pressure and barometric pressure, it was not necessary to subtract out barometric pressure effects due to the rapid recovery of water levels to the static level.

Each slug test consisted of monitoring water level response due to raising the water level (“Slug-In Test”) and lowering the water level (“Slug-Out Test”). Three tests were conducted at each well. Water level responses exhibiting an underdamped (i.e., oscillatory) response were analyzed with the Springer-Gelhar (1991) solution for a slug test in an unconfined aquifer. Water level responses exhibiting an overdamped (i.e., straight-line) response were analyzed by the Hvorslev (1951) solution for a slug test in an unconfined aquifer.

3. Results

Plots of water level versus time during the slug tests are provided in Figures B.1(a) and B.1(b) for GM1-MW1, Figures B.2(a) through B.2(c) for GM1-MW2, and Figures B.3(a) through B.3(c) for GM1-MW3. Water level recovery was generally rapid, ranging from less than 30 seconds in monitoring wells GM1-MW1 and GM1-MW2, to about 200 seconds at GM1-MW3. The relatively rapid response indicates that soils at Study Area GM-1 are characterized by a high hydraulic conductivity. Note on the plots that several tests were not analyzed due to the transducer moving during the test.

Water level response at monitoring wells GM1-MW1 and GM1-MW2 exhibited an underdamped (i.e., oscillatory) response and were analyzed using the Springer-Gelhar (1991) solution for a slug test in an unconfined aquifer. Water level response at monitoring well GM1-MW3 exhibited an overdamped (i.e., straight-line) response and was analyzed by the Hvorslev (1951) solution for a slug test in an unconfined aquifer. Hydraulic conductivity estimates from the slug tests are summarized in Table 1.

Table 1. Slug Test Results.

Well ID	Analysis Method	Result	Figure Reference	Geometric Mean Horizontal K (feet/day)
GM1-MW1	Springer-Gelhar (1991) Springer-Gelhar (1991)	**Test 1 (in):** 97 feet/day **Test 3 (in):** 275 feet/day	Figure B.1(d) Figure B.1(e)	163.3
GM1-MW2	Springer-Gelhar (1991) Springer-Gelhar (1991) Springer-Gelhar (1991)	**Test 1 (in):** 111 feet/day **Test 2 (in):** 110 feet/day **Test 3 (in):** 120 feet/day	Figure B.2(d) Figure B.2(e) Figure B.2(f)	113.6
GM1-MW3	Hvorslev (1951) Hvorslev (1951) Hvorslev (1951)	**Test 1 (in):** 33.8 feet/day **Test 2 (in):** 57.5 feet/day **Test 3 (in):** 26.1 feet/day	Figure B.3(d) Figure B.3(d) Figure B.3(d)	37.0
			Overall Geometric Mean	**88.2**

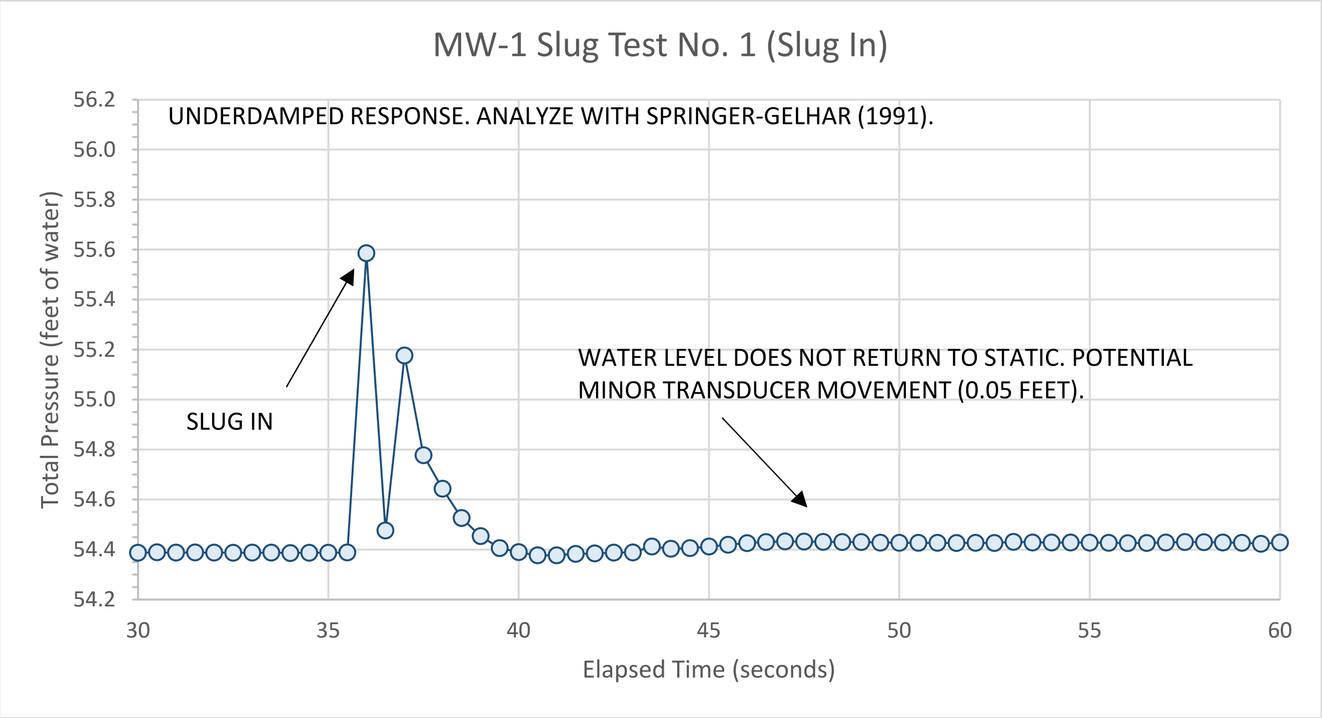
The hydraulic conductivity of the aquifer at Study Area GM1 ranges from 37 feet per day to 163 feet per day, with a geometric mean of 88.2 feet per day. Note that hydraulic conductivity in the area where treated wastewater is to be infiltrated (i.e., in the lower-elevation area around GM1-MW1 and GM1-MW2) is higher, ranging from about 114 feet per day to 163 feet per day. This trend in hydraulic conductivity is consistent with coarser, higher conductivity sediments being deposited close to a river.

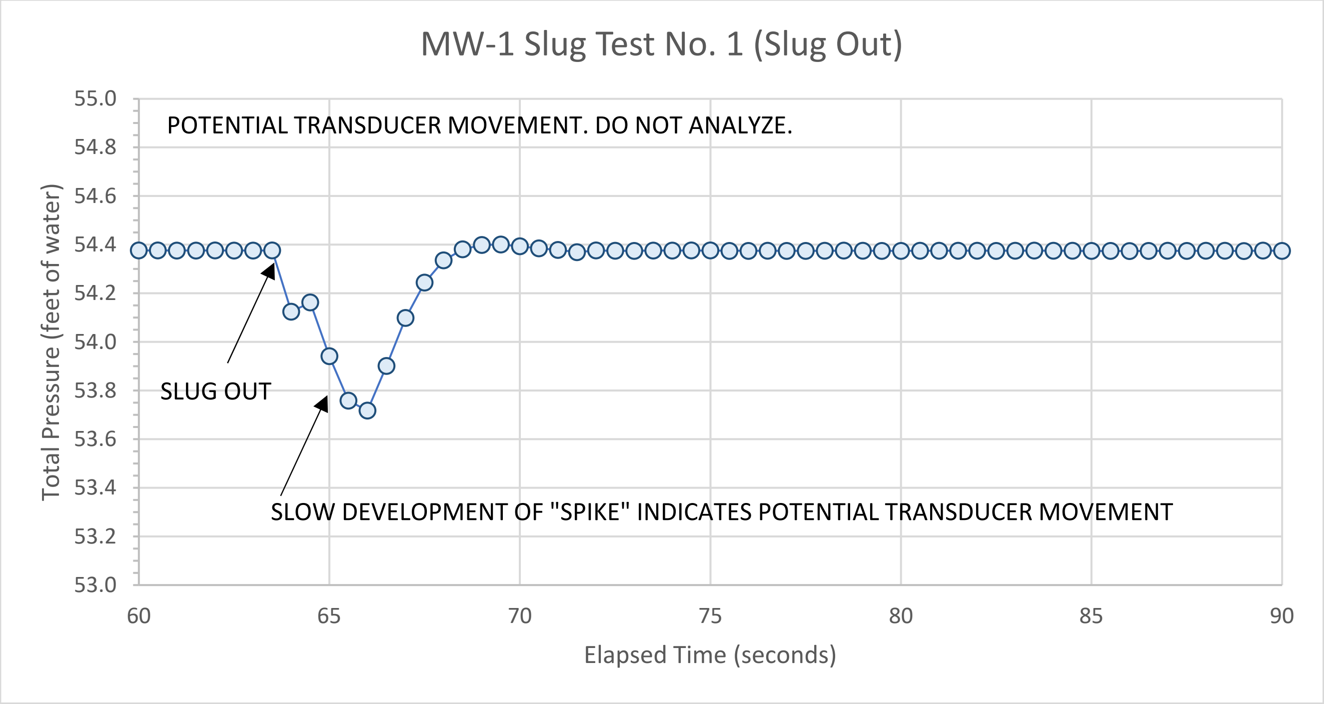
4. References

GSI. 2023. Phase II Subsurface Characterization to Support an Evaluation of Treated Wastewater Infiltration in Gates and Mill City, Marion and Linn Counties, Oregon.

Hvorslev, M. J. 1951. Time lag and soil permeability in ground-water observations. Bulletin No. 36, Waterways Exper. Sta. Corps of Engineers, U.S. Army, Vicksburg, Mississippi, pp. 1-50.

Springer, R. K. and L. W. Gehlar. 1991. Characterization of large-scale aquifer heterogeneity in glacial outwash by analysis of slug tests with oscillatory response, Cape Cod, Massachusetts. U.S. Geological Survey Water Resources Investigations 91-4034, pp. 36-40.





Notes:

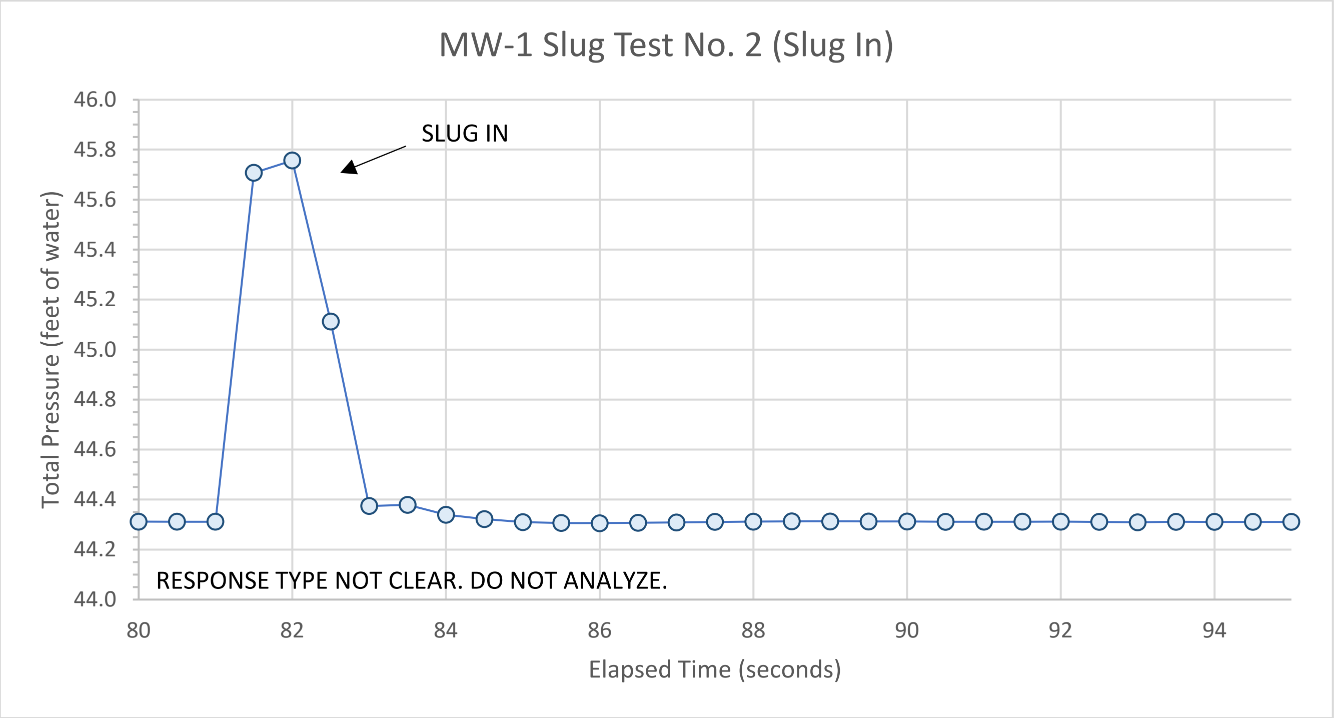
(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

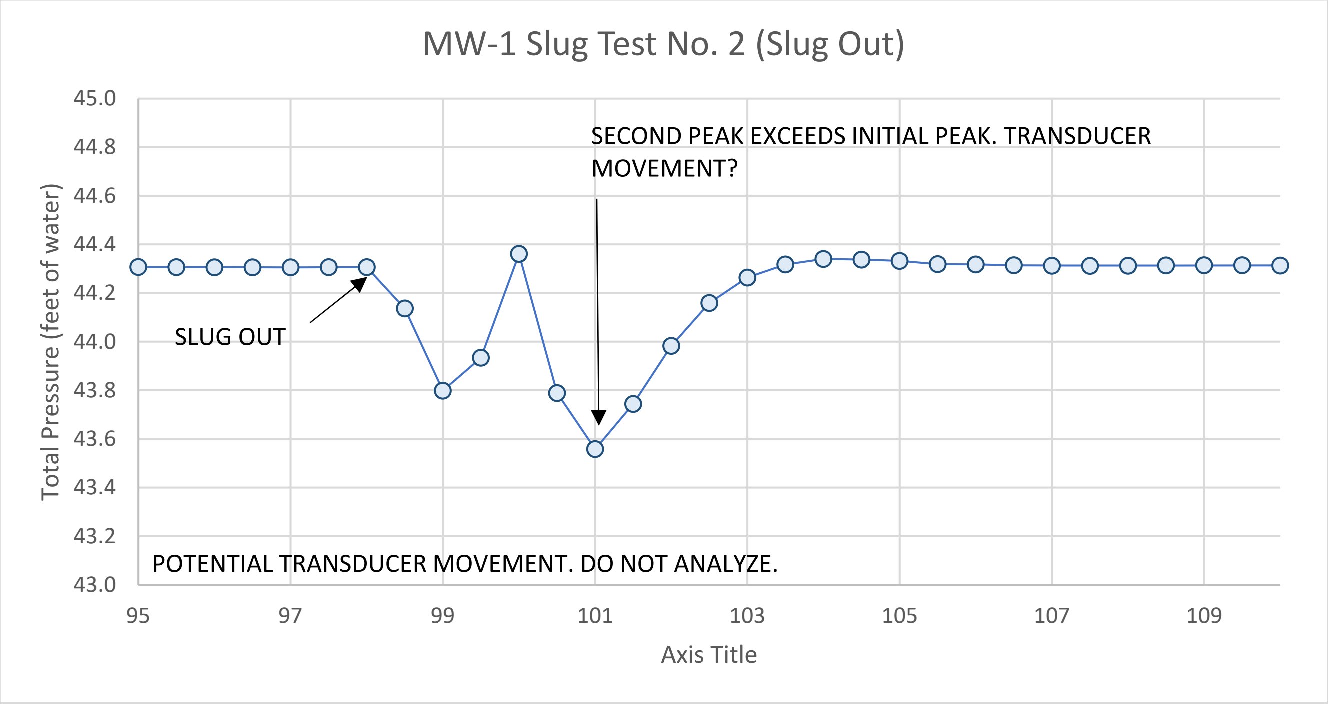
GSI Water Solutions, Inc.

Figure B.1(a)

GM1-MW1 Slug Test 1

Gates/Mill City Phase II Subsurface Characterization





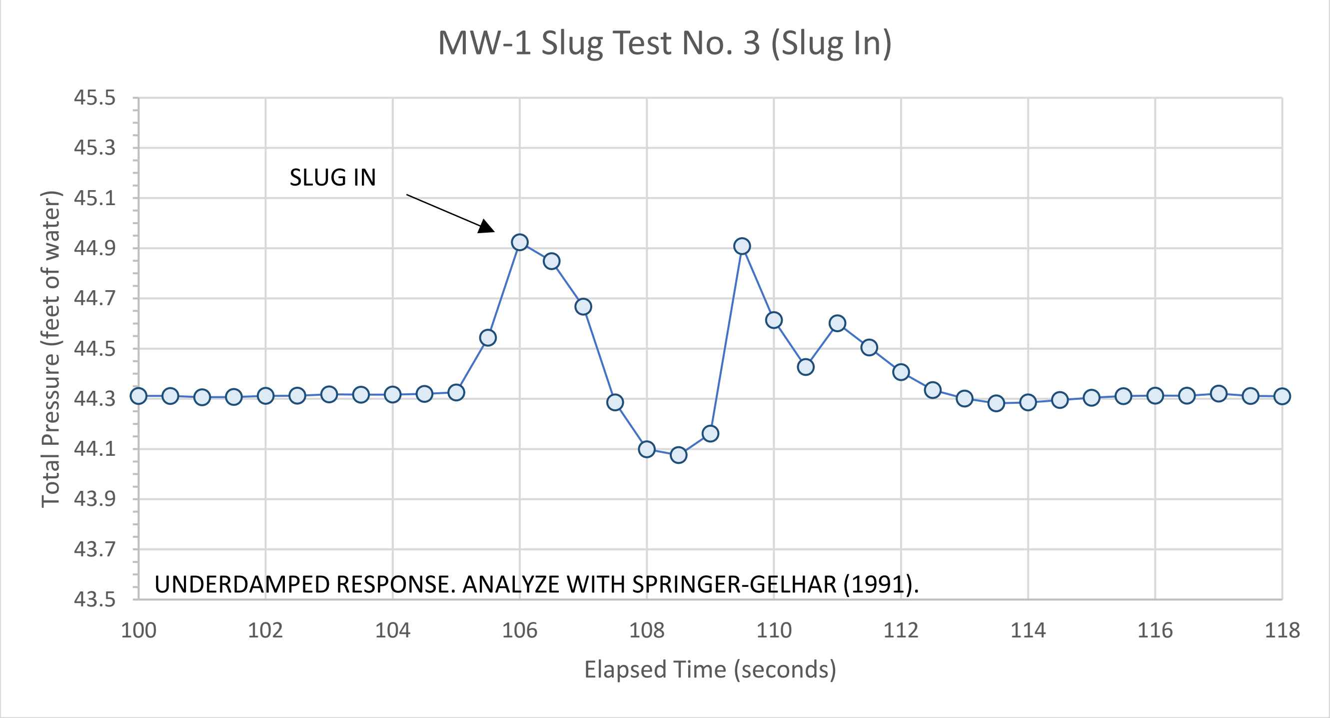
Notes:

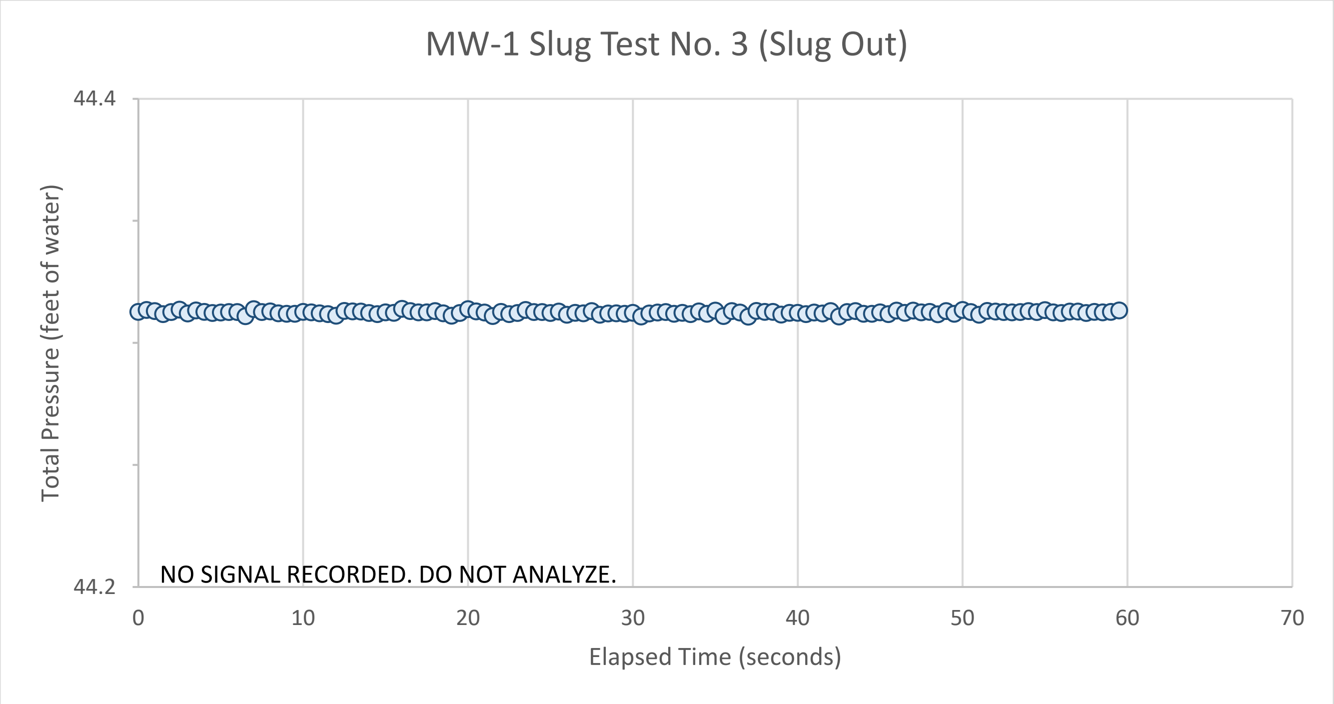
(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

Figure B.1(b)

GM1-MW1 Slug Test 2

Gates/Mill City Phase II Subsurface Characterization





Notes:

(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

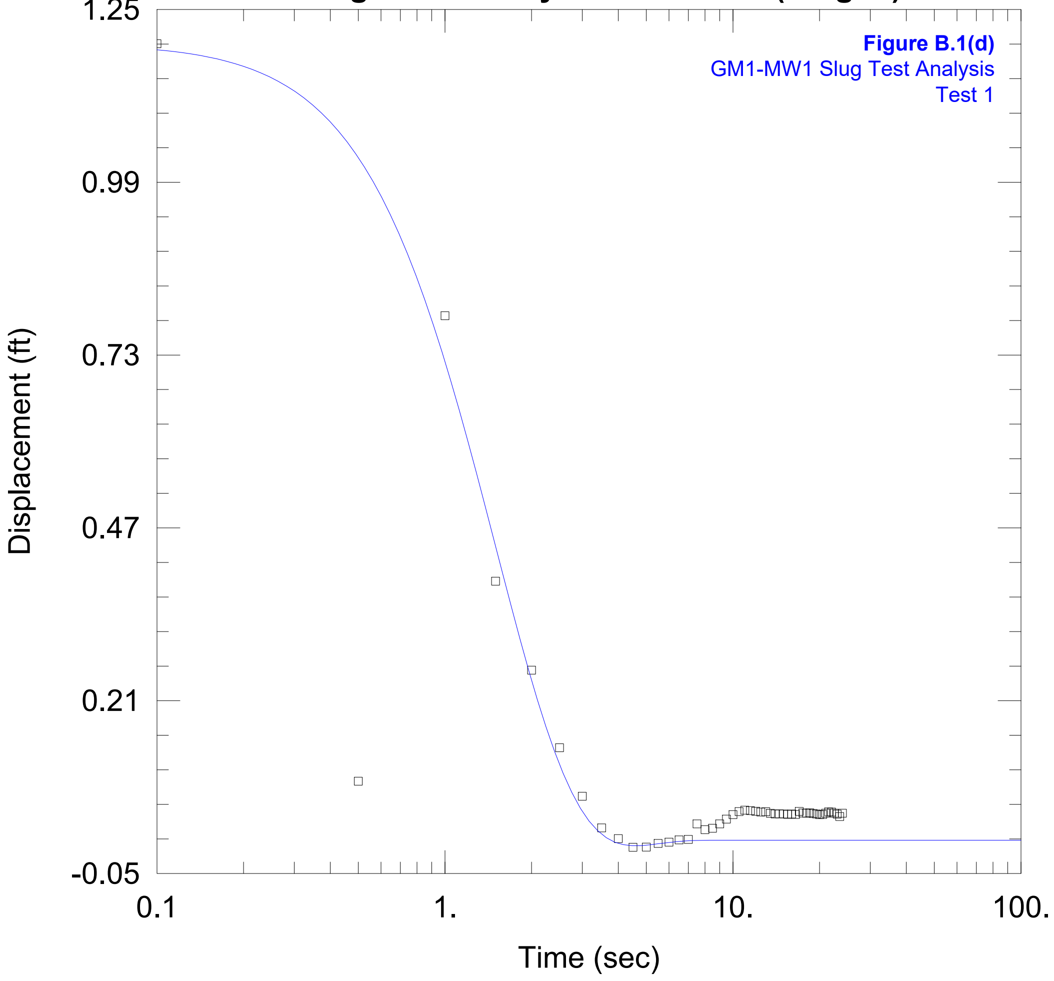
GSI Water Solutions, Inc.

Figure B.1(c)

GM1-MW1 Slug Test 3

Gates/Mill City Phase II Subsurface Characterization

Slug Tests Analysis GM1-MW1 (Slug In)



WELL TEST ANALYSIS

Data Set: P:\...\GM1-MW1-ST1-INa.aqt
Date: 09/18/23 Time: 12:35:07

PROJECT INFORMATION

Company: Gates Mill City Infiltration
Client: Keller Associates
Project: 464.020
Location: Mill City, Oregon
Test Well: MW-1
Test Date: 6/8/2023

AQUIFER DATA

Saturated Thickness: 24.6 ft Anisotropy Ratio (Kz/Kr): 1.

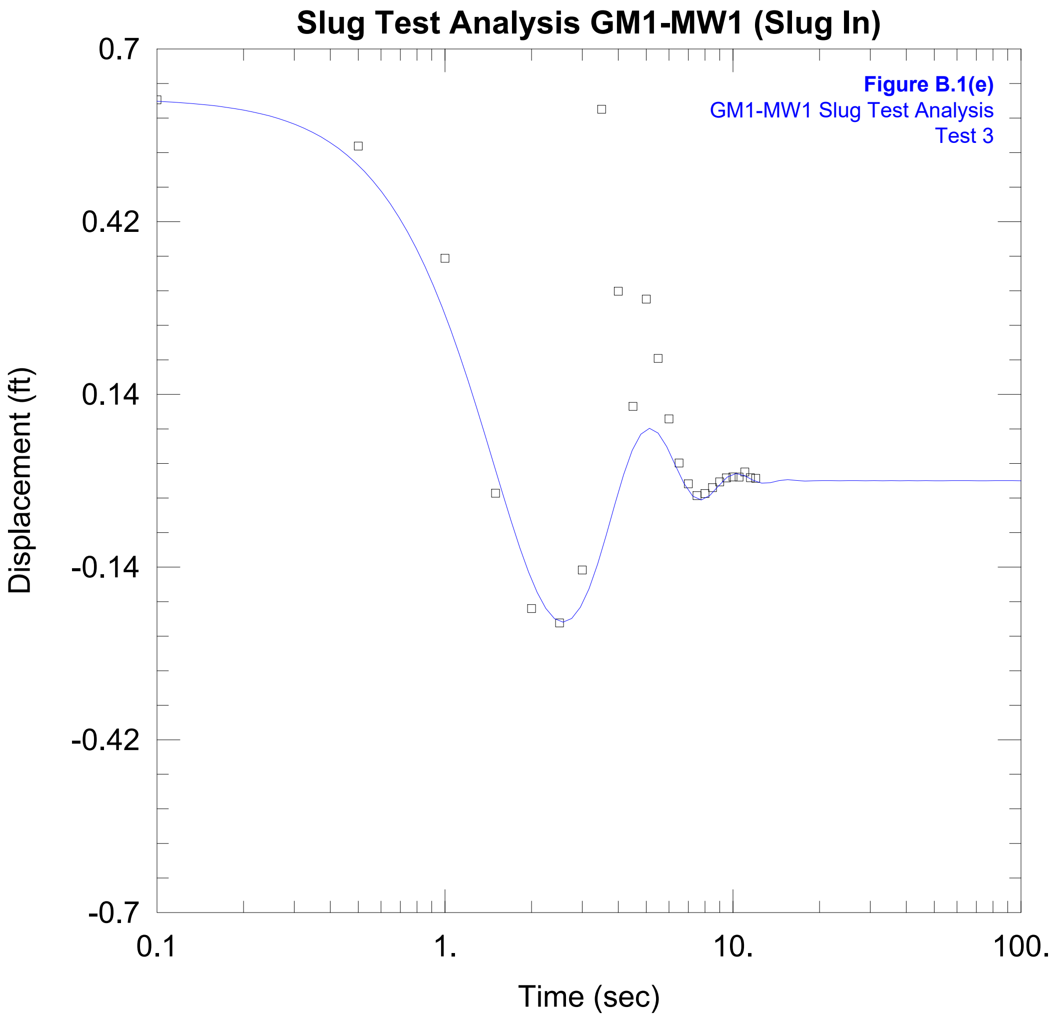
WELL DATA (MW-1)

Initial Displacement: 1.198 ft Static Water Column Height: 24.6 ft
Total Well Penetration Depth: 24.6 ft Screen Length: 10. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Springer-Gelhar

K = 97. ft/day Le = 19.6 ft



WELL TEST ANALYSIS

Data Set: P:\...\GM1-MW1-ST3-INa.aqt
Date: 09/18/23 Time: 13:54:04

PROJECT INFORMATION

Company: Gates Mill City Infiltration
Client: Keller Associates
Project: 464.020
Location: Mill City, Oregon
Test Well: MW-1
Test Date: 6/8/2023

AQUIFER DATA

Saturated Thickness: 24.6 ft
Anisotropy Ratio (Kz/Kr): 1.

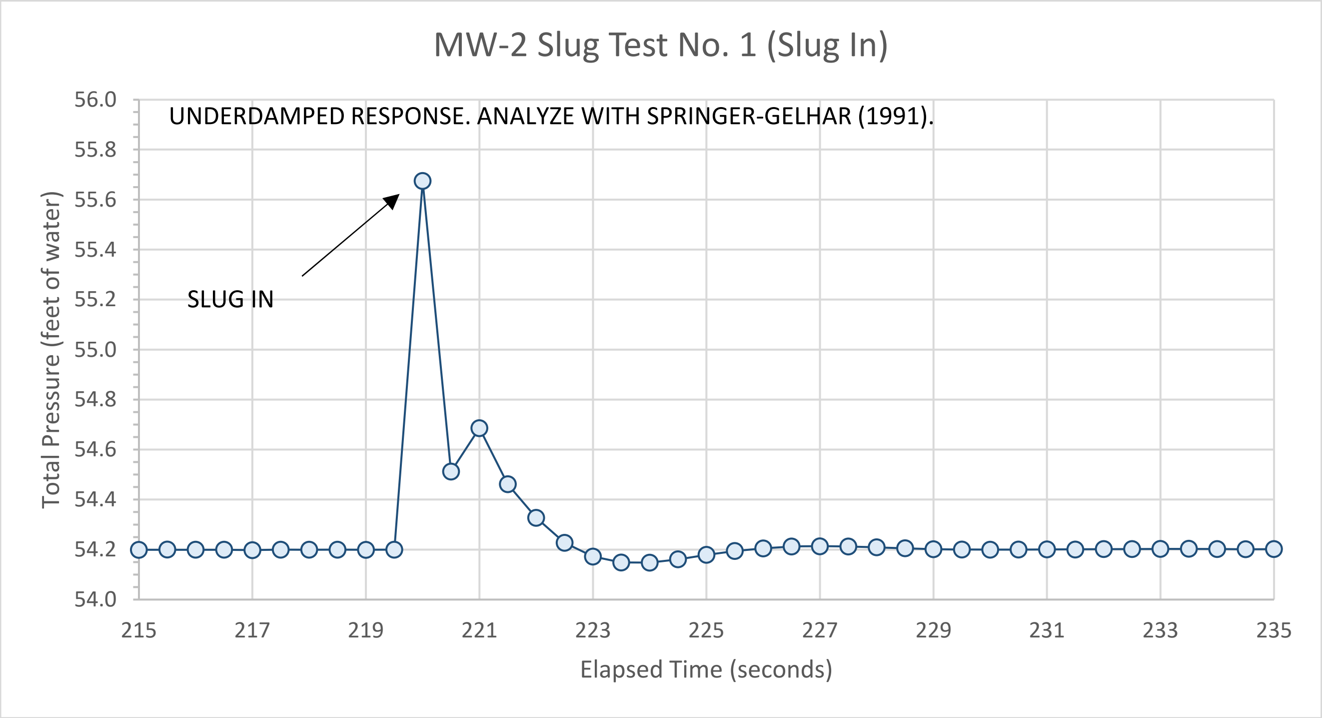
WELL DATA (MW-1)

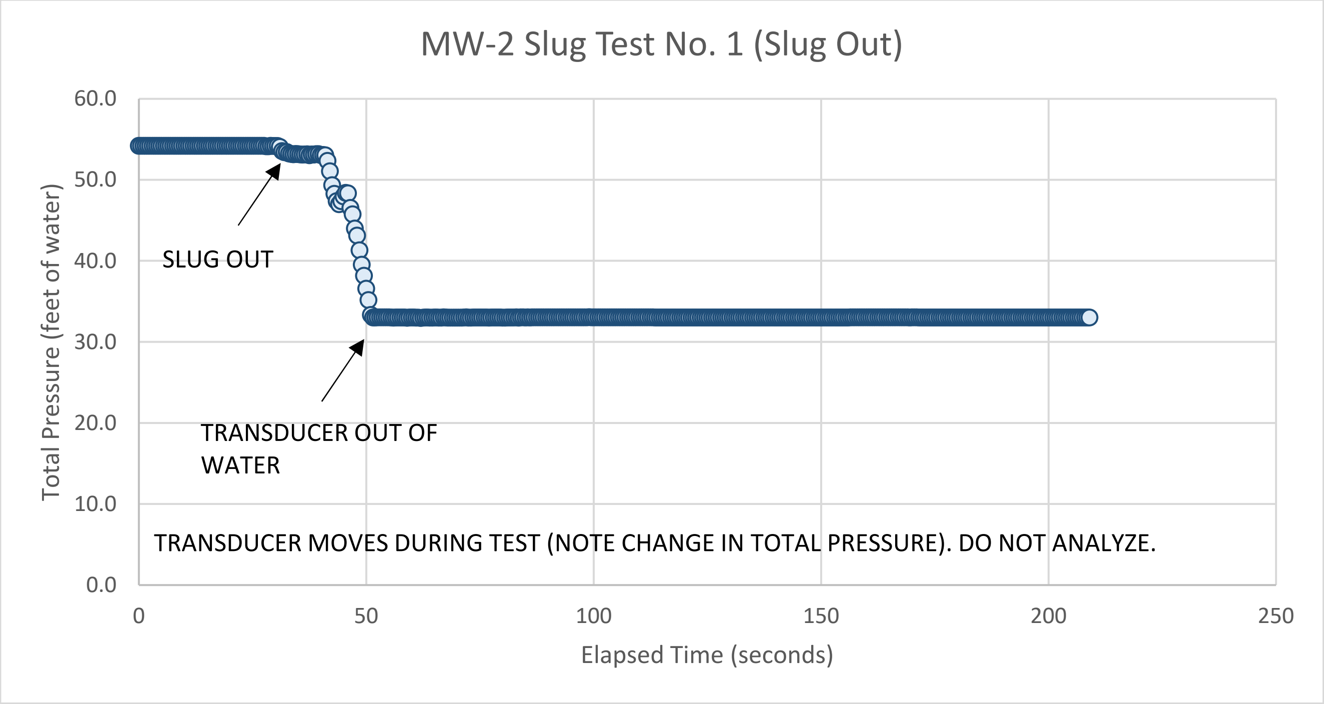
Initial Displacement: 0.62 ft
Total Well Penetration Depth: 24.6 ft
Casing Radius: 0.083 ft
Static Water Column Height: 24.6 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 275. ft/day
Le = 19.6 ft





Notes:

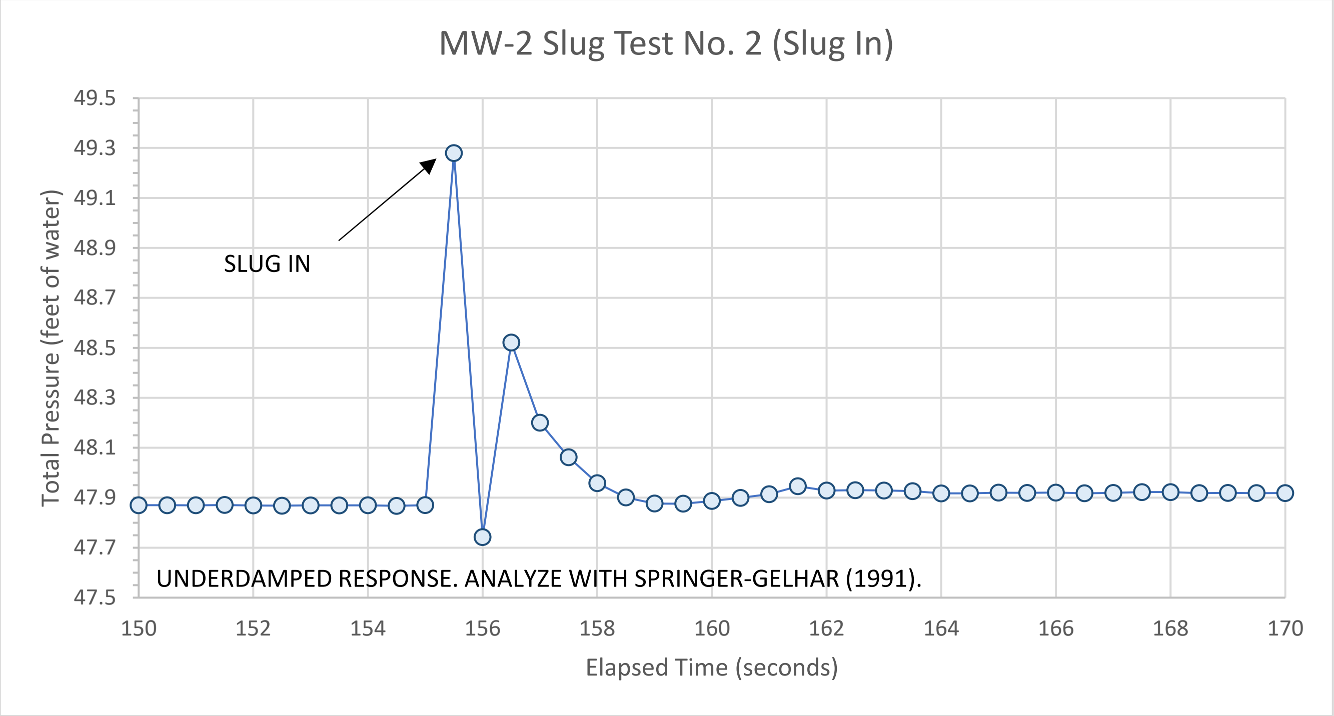
(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

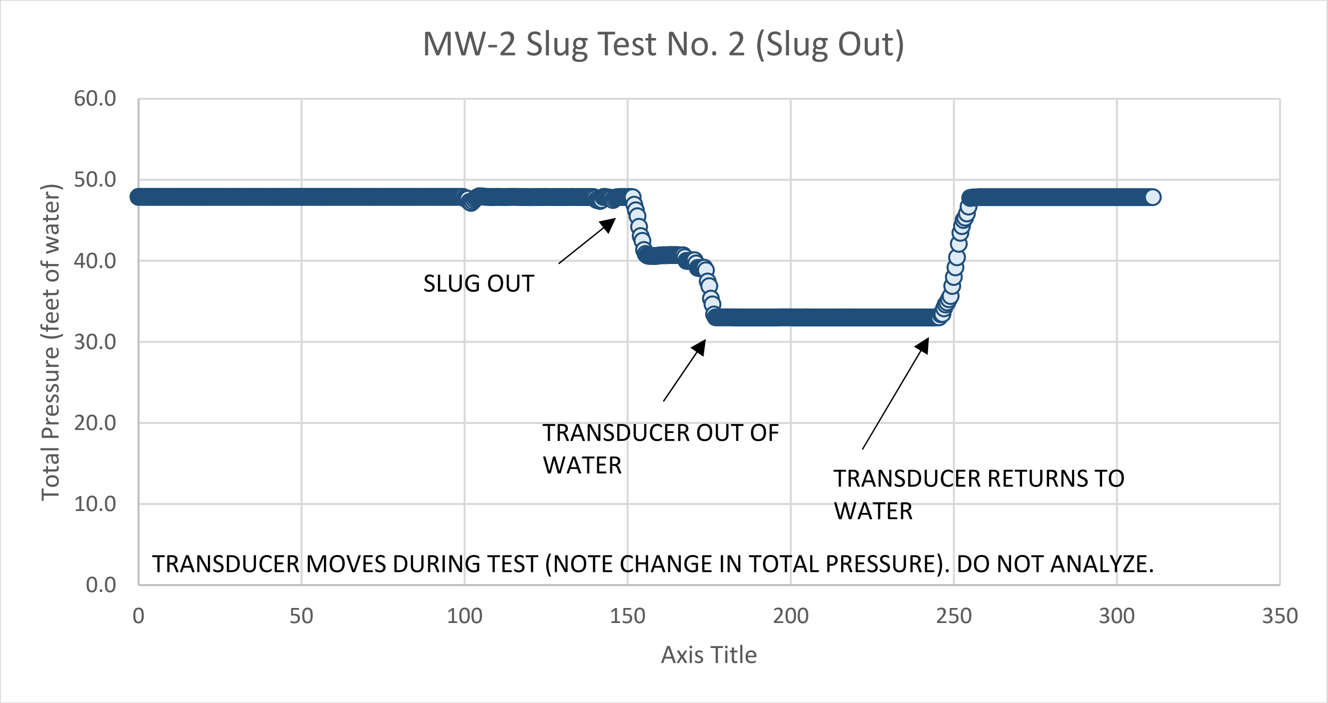
GSI Water Solutions, Inc.

Figure B.2(a)

GM1-MW2 Slug Test 1

Gates/Mill City Phase II Subsurface Characterization





Notes:

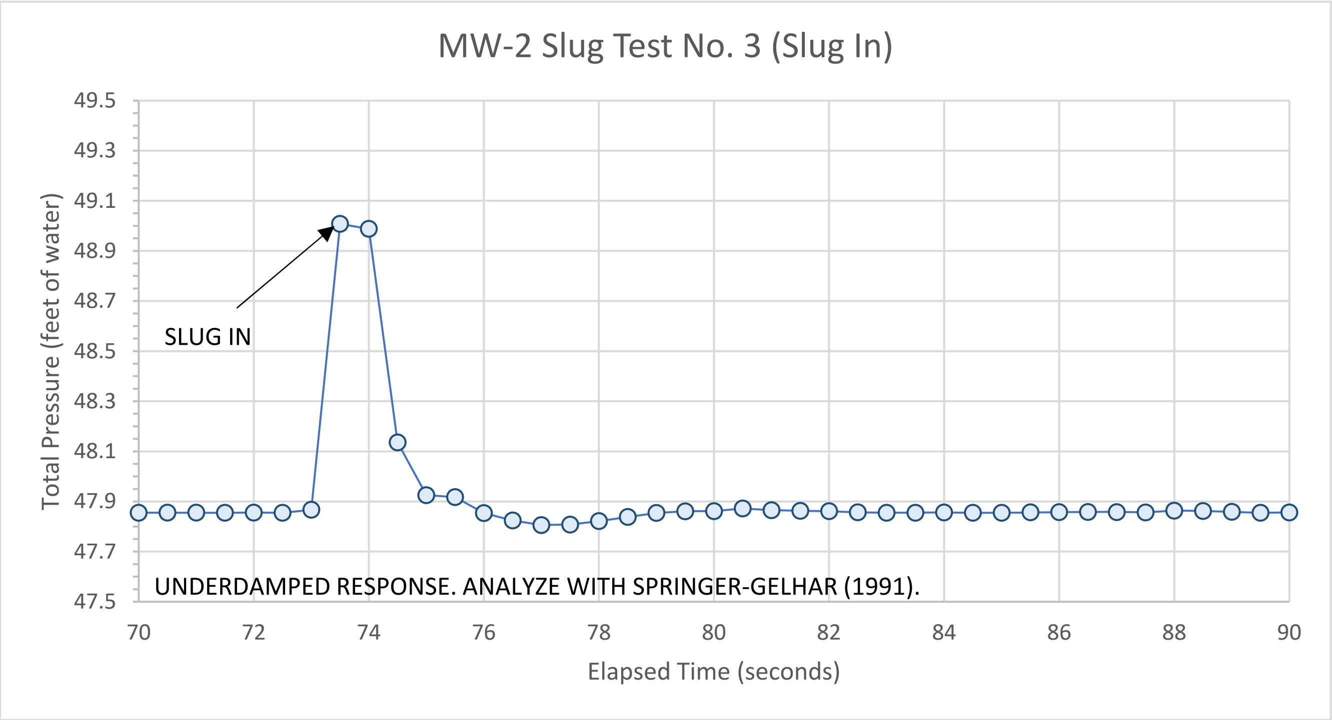
(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

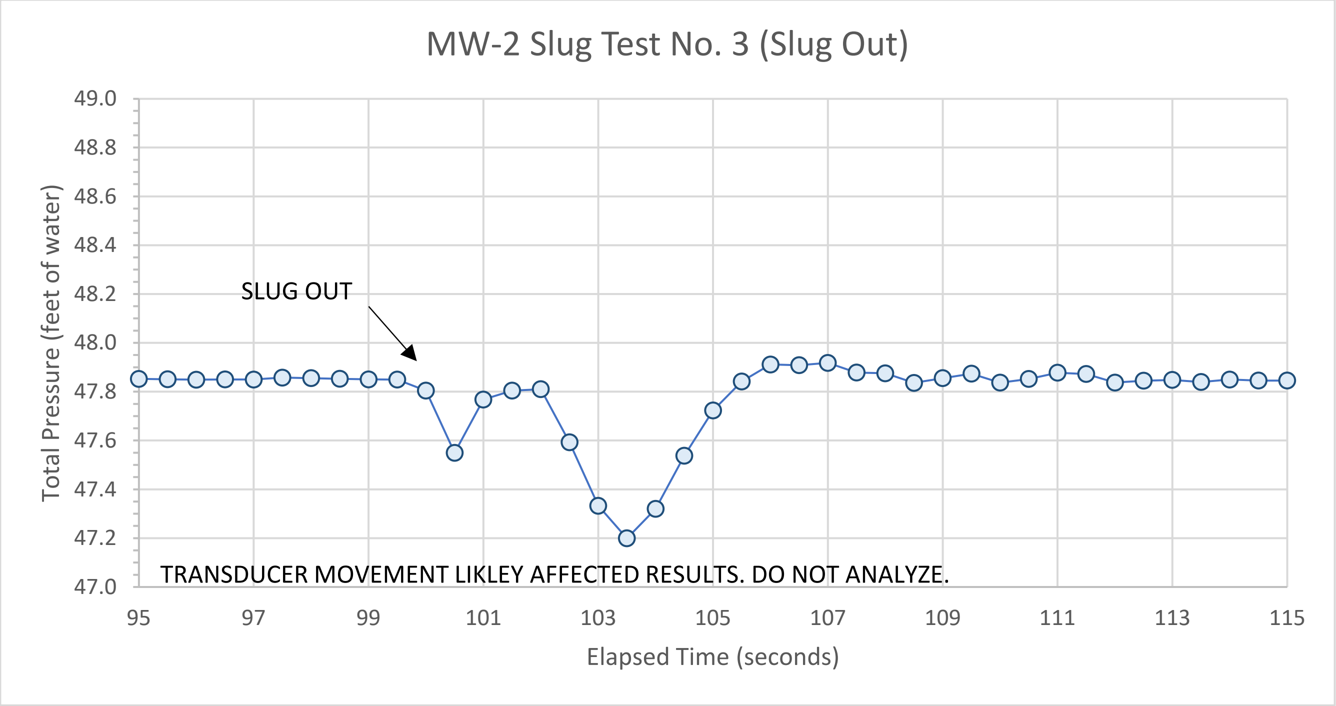
GSI Water Solutions, Inc.

Figure B.2(b)

GM1-MW2 Slug Test 2

Gates/Mill City Phase II Subsurface Characterization





Notes:

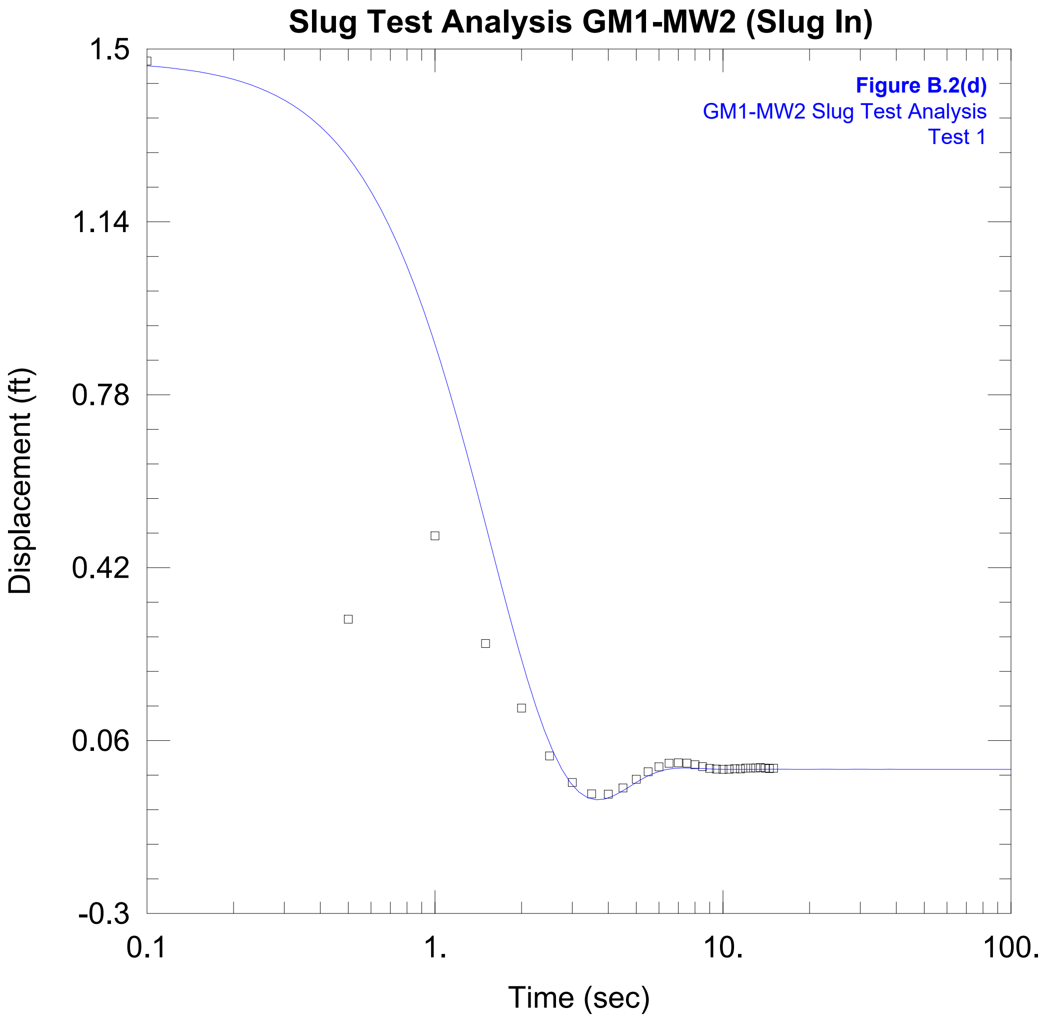
(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

GSI Water Solutions, Inc.

Figure B.2(c)

GM1-MW2 Slug Test 3

Gates/Mill City Phase II Subsurface Characterization



WELL TEST ANALYSIS

Data Set: P:\...\GM1-MW1-ST1-INa.aqt
Date: 09/15/23
Time: 16:26:36

PROJECT INFORMATION

Company: Gates Mill City Infiltration
Client: Keller Associates
Project: 464.020
Location: Mill City, Oregon
Test Well: MW-2
Test Date: 9/4/2023

AQUIFER DATA

Saturated Thickness: 27.01 ft
Anisotropy Ratio (Kz/Kr): 1.

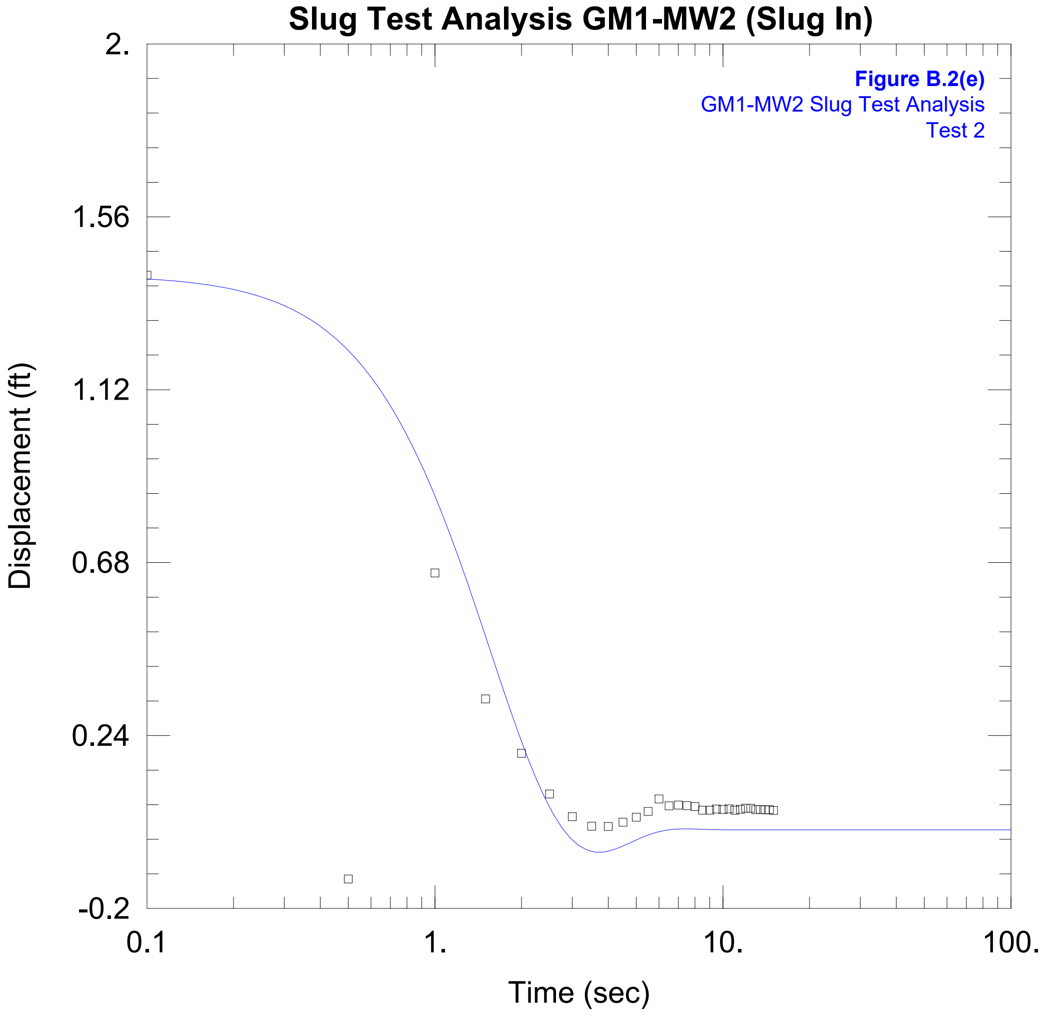
WELL DATA (GM1-MW2)

Initial Displacement: 1.475 ft
Total Well Penetration Depth: 27.01 ft
Casing Radius: 0.083 ft
Static Water Column Height: 27.01 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 111. ft/day
Le = 22.01 ft



WELL TEST ANALYSIS

Data Set: P:\...\GM1-MW2-ST1-INa.aqt
Date: 09/15/23 Time: 16:40:44

PROJECT INFORMATION

Company: Gates Mill City Infiltration
Client: Keller Associates
Project: 464.020
Location: Mill City, Oregon
Test Well: MW-2
Test Date: 9/4/2023

AQUIFER DATA

Saturated Thickness: 27.01 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-2)

Initial Displacement: 1.412 ft
Total Well Penetration Depth: 27.01 ft
Casing Radius: 0.083 ft
Static Water Column Height: 27.01 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 110. ft/day
Le = 22.01 ft

Slug Test Analysis GM1-MW2 (Slug In)

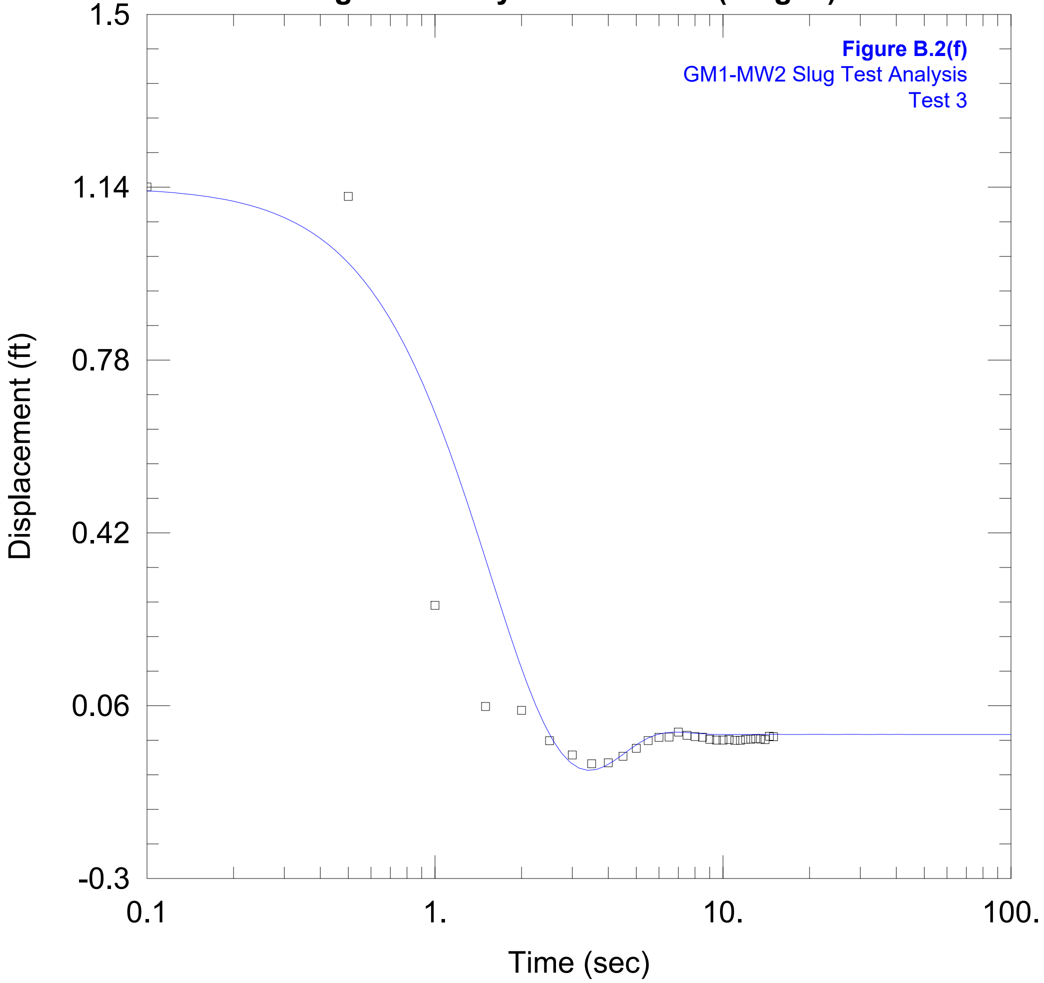


Figure B.2(f)
GM1-MW2 Slug Test Analysis
Test 3

WELL TEST ANALYSIS

Data Set: P:\...\GM1-MW2-ST3-INa.aqt
Date: 09/15/23 Time: 16:56:38

PROJECT INFORMATION

Company: Gates Mill City Infiltration
Client: Keller Associates
Project: 464.020
Location: Mill City, Oregon
Test Well: MW-2
Test Date: 9/4/2023

AQUIFER DATA

Saturated Thickness: 27.01 ft
Anisotropy Ratio (Kz/Kr): 1.

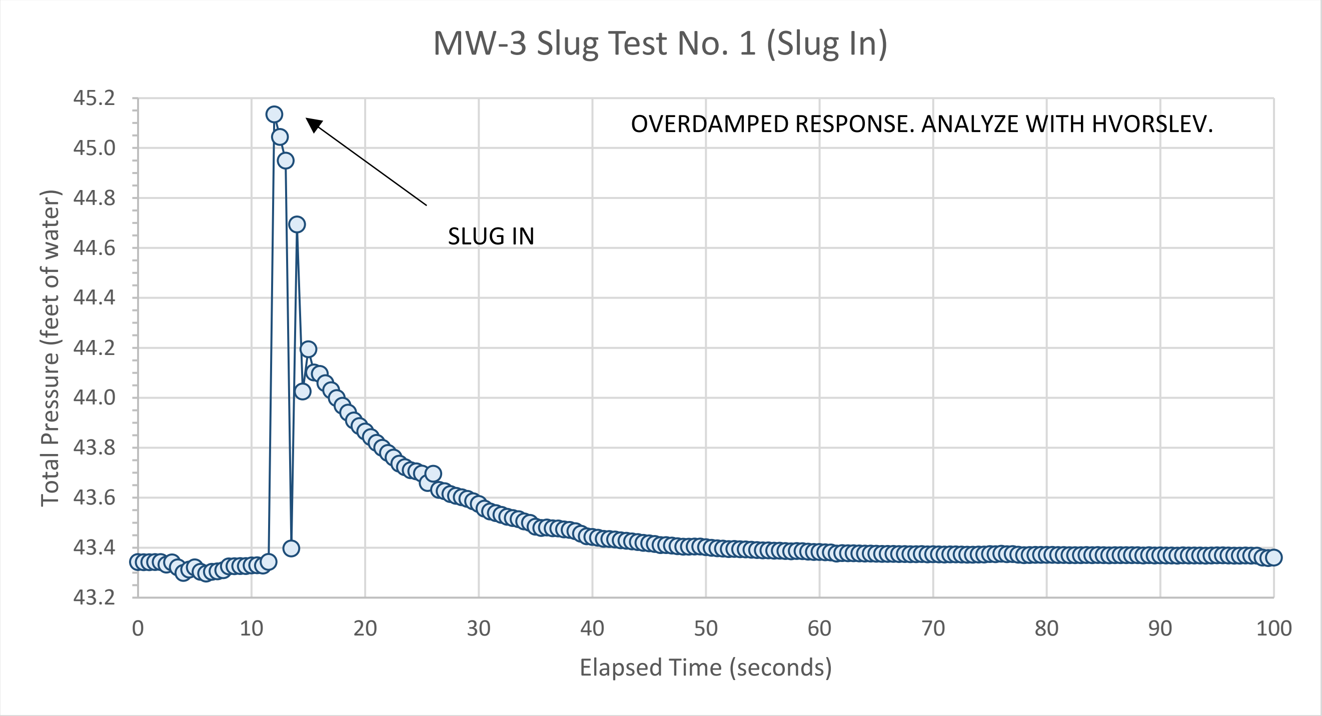
WELL DATA (MW-2)

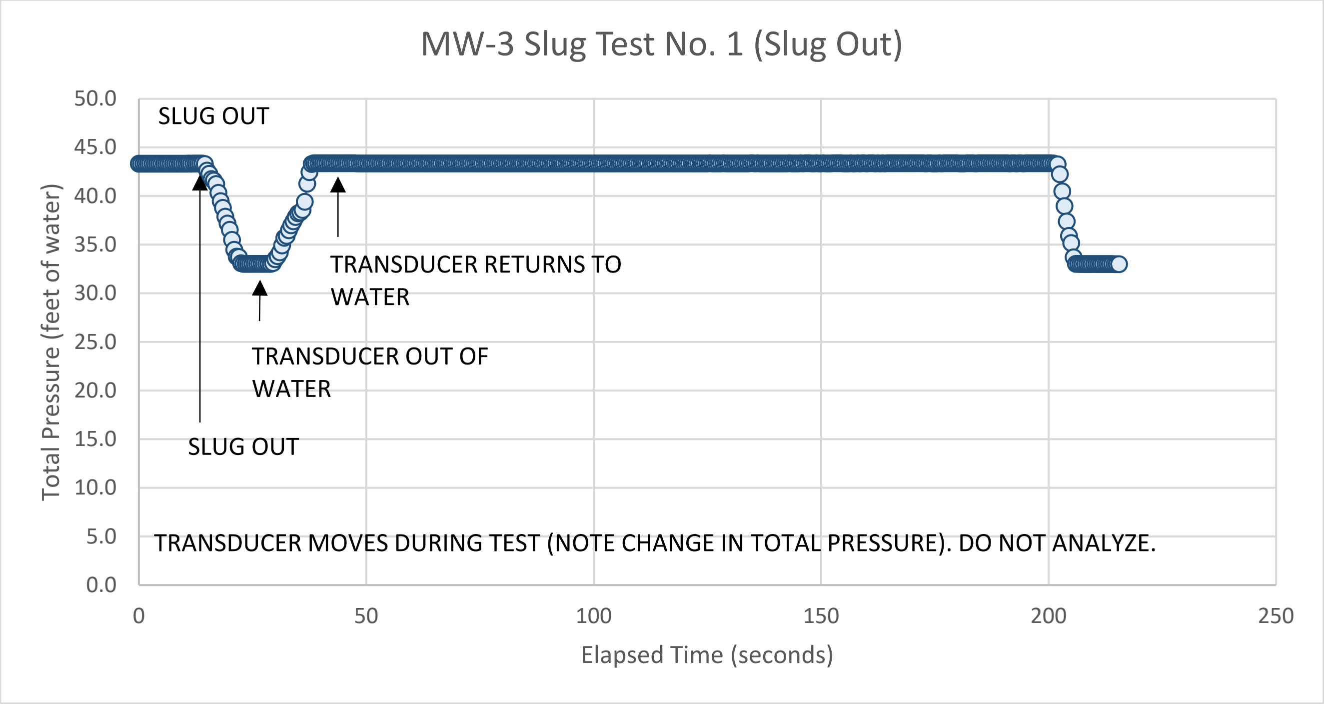
Initial Displacement: 1.141 ft
Total Well Penetration Depth: 27.01 ft
Casing Radius: 0.083 ft
Static Water Column Height: 27.01 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 120. ft/day
Le = 22.01 ft





Notes:

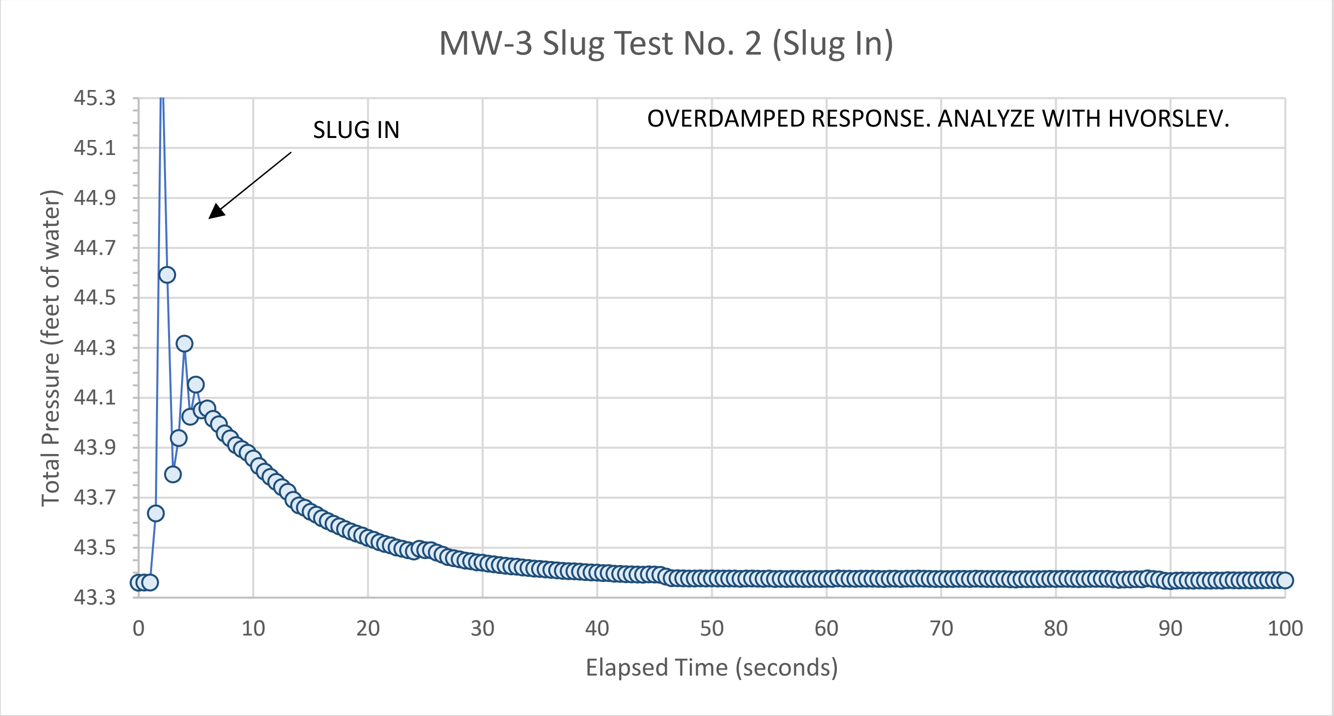
(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

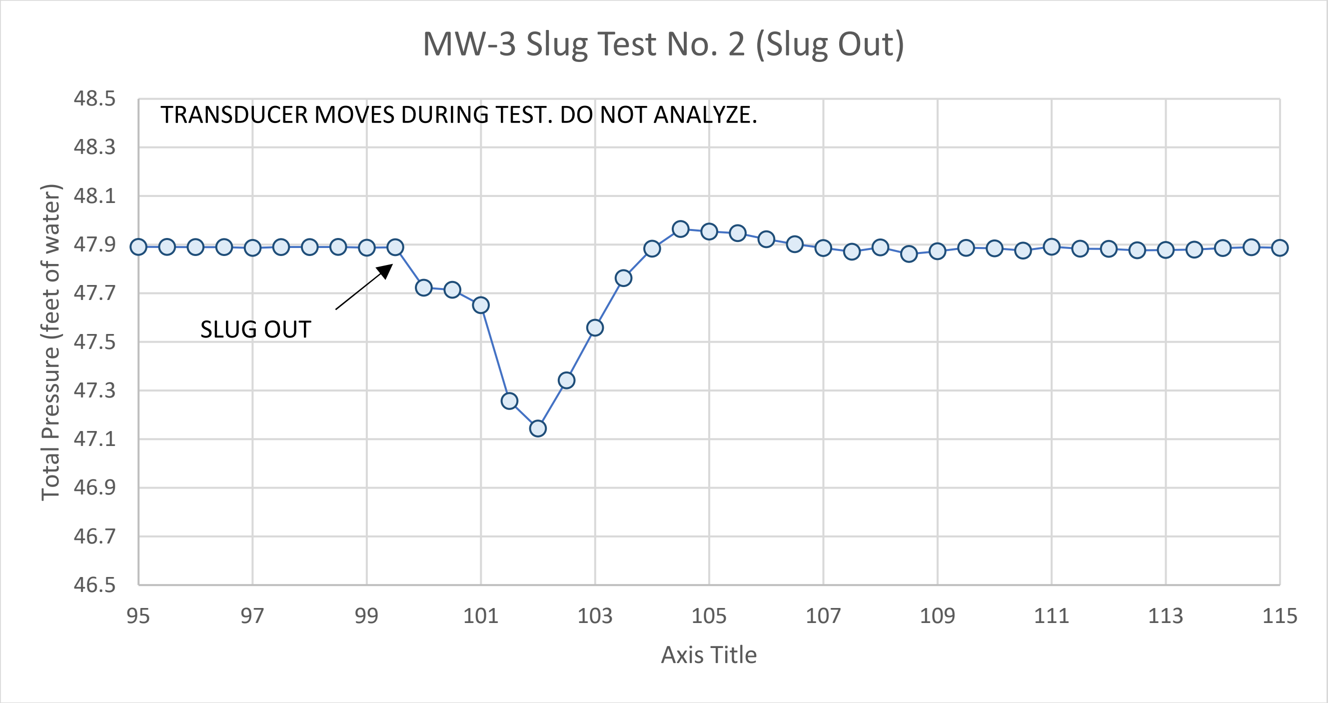
GSI Water Solutions, Inc.

Figure B.3(a)

GM1-MW3 Slug Test 1

Gates/Mill City Phase II Subsurface Characterization





Notes:

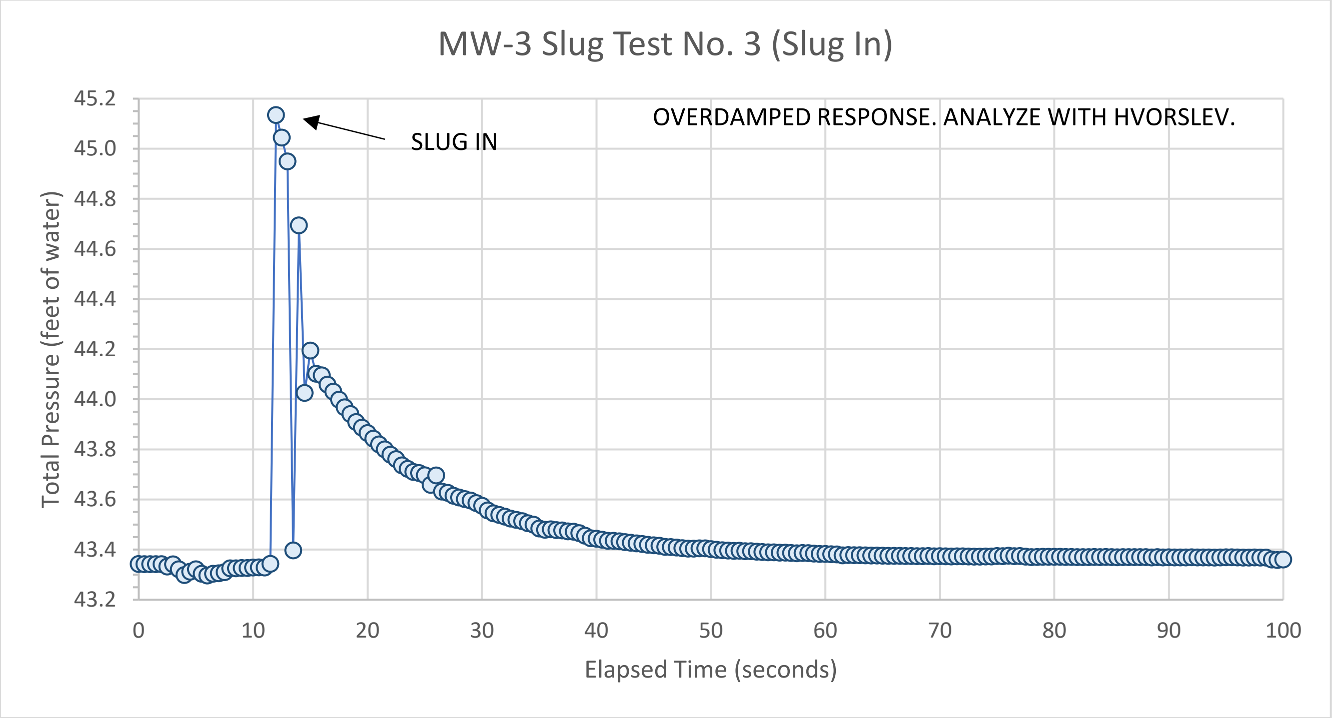
(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

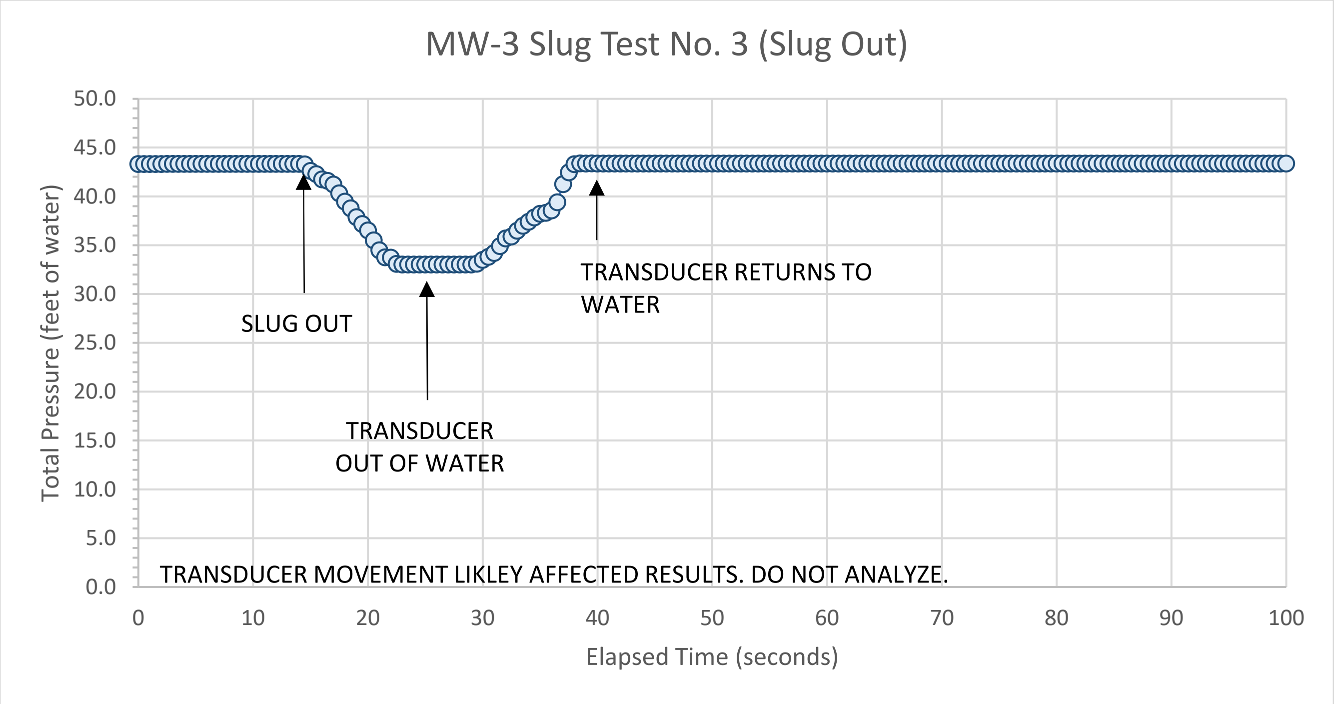
GSI Water Solutions, Inc.

Figure B.3(b)

GM1-MW3 Slug Test 2

Gates/Mill City Phase II Subsurface Characterization





Notes:

(1) "Total Pressure" includes water pressure above transducer and barometric pressure.

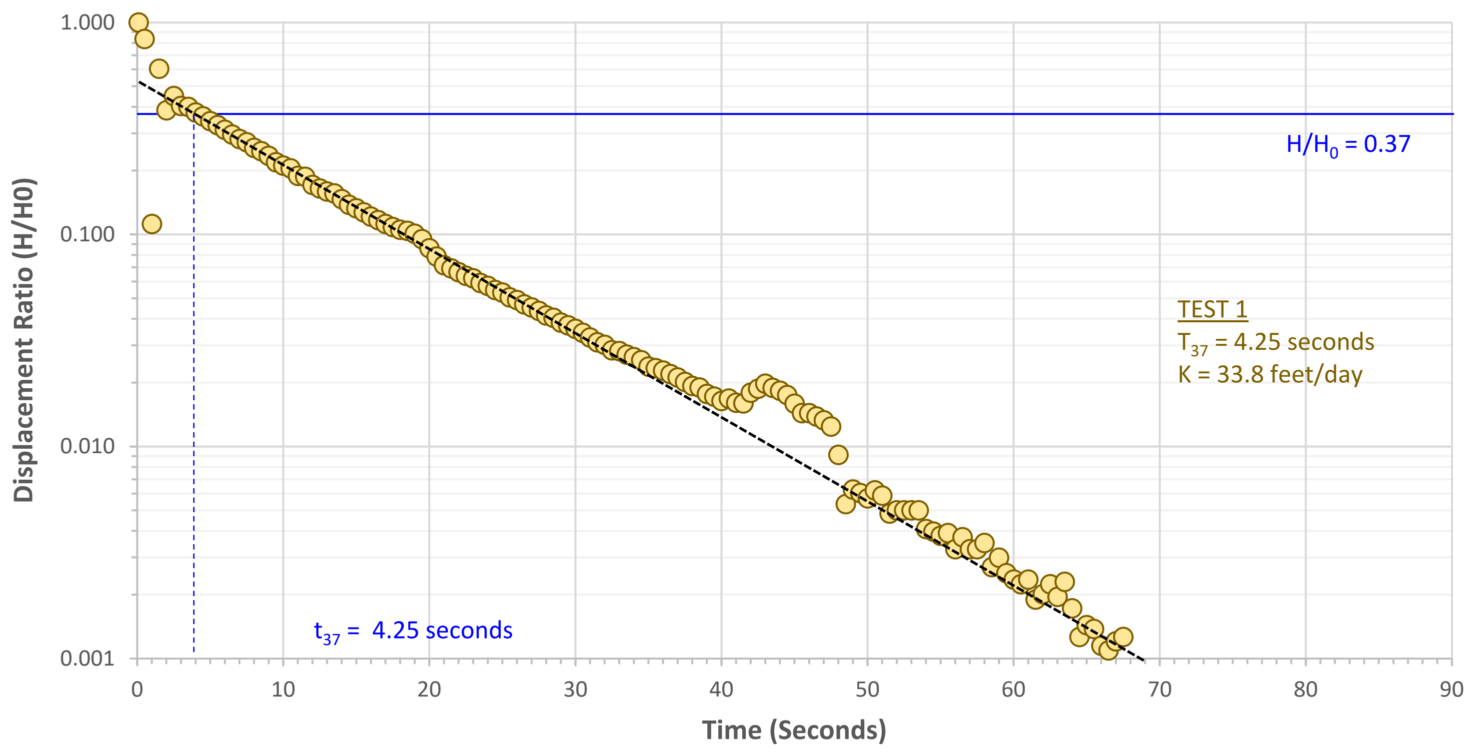
GSI Water Solutions, Inc.

Figure B.3(c)

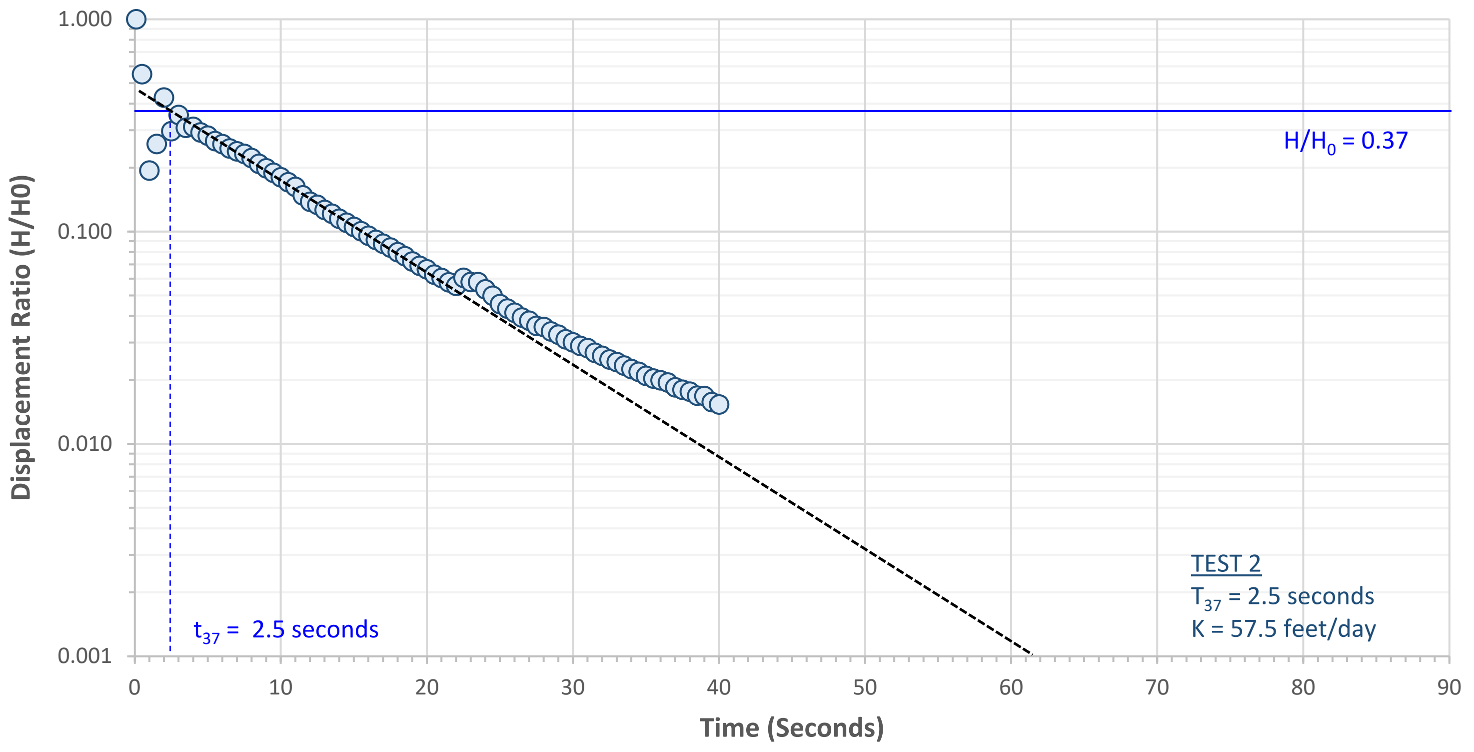
GM1-MW3 Slug Test 3

Gates/Mill City Phase II Subsurface Characterization

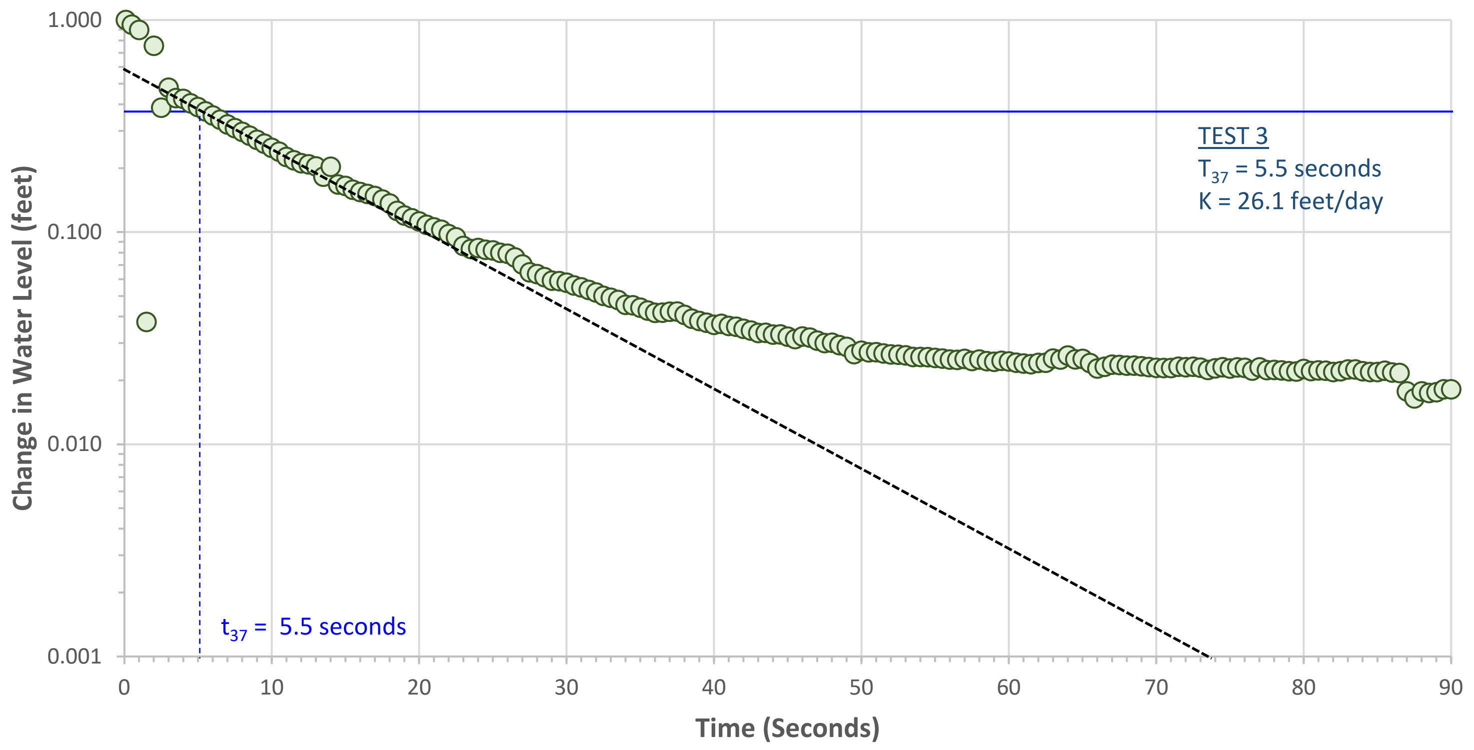
Slug-In Test No. 1



Slug-In Test No. 2



Slug-In Test No. 3



GSI Water Solutions, Inc.

Figure B.3(d)
GM1-MW3 Slug-In Test Analyses
Santiam Canyon Treated Wastewater Infiltration Evaluation

ATTACHMENT C

Groundwater Mounding Analysis

GeoSystems Analysis, Inc.
Innovations in Hydrology

MEMORANDUM

November 3, 2023

TO: Matt Kohlbecker, GSI Water Solutions, Inc.

FROM: Jason Keller, GeoSystems Analysis, Inc.

CC: Scott Waibel, GeoSystems Analysis, Inc.

RE: Gates – Mill City Site GM1 Groundwater Mounding Analysis

INTRODUCTION

Geosystems Analysis, Inc. (GSA) conducted a groundwater mounding analysis for the alluvial aquifer beneath Gates and Mill City, Oregon in support of the treated wastewater infiltration feasibility assessment being completed by GSI Water Solutions and Keller and Associates. Groundwater mounding beneath a potential infiltration basin location at site GM1 (Figure 1) was simulated for three measured horizontal saturated hydraulic conductivity (K_{sat-h}) scenarios.

A subsurface characterization program was completed by GSI and GSA, consisting of shallow (i.e., test pit) and deep (i.e., borehole) soil texture characterization, depth to groundwater measurements, soil saturated hydraulic conductivity (K_{sat}) measurements, and aquifer horizontal saturated hydraulic conductivity (K_{sat-h}) measurements (GSI/GSA, 2023; GSI, 2023). Information collected from the subsurface characterization program was applied in the groundwater mounding analysis presented herein.

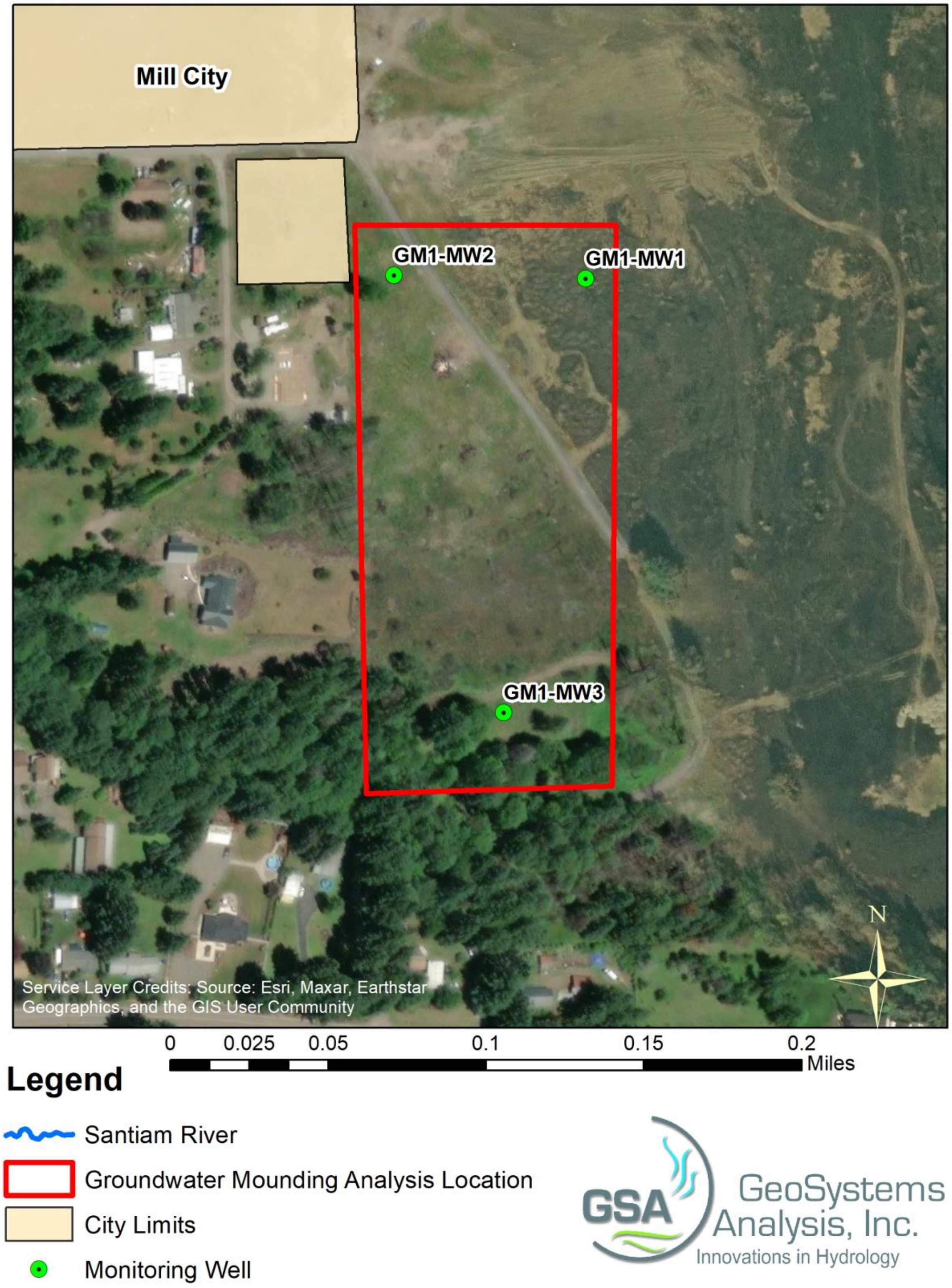


Figure 1. Potential infiltration basin location at GM-1

METHODS

The Zlotnik (2017) analytical solution for groundwater mounding as applied in MOUNDSOLV (Hydrosolve, 2023) was used to estimate the steady-state groundwater mound that may develop beneath the potential infiltration facility at site GM1 in response to recharge of treated wastewater. The Zlotnik analytical solution considers both horizontal and dipping aquifers that are assumed to be of infinite extent, homogenous, and isotropic. Required steady-state model parameters include:

- Recharge rate and duration.
- Recharge basin infiltration area and orientation.
- Aquifer horizontal saturated hydraulic conductivity (K_{sat-h})
- Aquifer initial saturated thickness
- Aquifer gradient (dip and flow direction)

The recharge rate was set equal to the projected year 2045 effluent generation rate of 0.2375 million gallons per day (MGD) (M. Kohlbecker, personal communication, April 12, 2023) and was assumed to be continuous in time. For this initial feasibility assessment, the infiltration facility was assumed to consist of one, square shaped basin with a 2.3-acre infiltration area (K. Stewart, personal communication, October 9, 2023). Preliminary basin designs consist of six independently operated, and adjacent smaller basins with a total infiltration area of 2.3 acres. The basins are proposed to operate on a two-day wastewater application rotation between basins. The proposed short rotation cycle and proximity of the basins to each other is hydraulically similar to infiltrating over one 2.3-acre basin. The 2.3-acre infiltration area is sufficient to infiltrate 0.2375 MGD assuming a long-term infiltration rate equal to 15 percent of the mean measured near surface K_{sat} for the site (GSA, 2023) to account for potential surface clogging.

Aquifer K_{sat-h} values were assigned from aquifer slug test measurements performed by GSI (GSI, 2023). A range of aquifer K_{sat-h} values were simulated to represent measurement uncertainty and spatial heterogeneity in K_{sat-h}. Initial (pre-infiltration) depth to groundwater and aquifer saturated thickness was estimated from observed depth to groundwater measured by GSI on May 29, 2023 and GSI observed depth of a thick, fine textured hydrostratigraphic unit during monitoring well installation that may act as the lower boundary of the alluvial aquifer system. The regional aquifer gradient and direction was calculated by GSI from static groundwater levels measured on August 29 and September 4, 2023 at the three on-site monitoring wells. The depth to groundwater used the earlier May 29th measurement to conservatively assess when groundwater conditions will be shallower, relative to the late summer measurements. Groundwater mounding model parameters that are the same for each scenario (static parameters) are summarized in Table 1. The K_{sat-h} value assigned for each scenario is shown in Table 2.

Table 1. Groundwater mounding model parameters applied for all scenarios

Static Model Parameter	Value
Recharge Volume	0.2375 MGD
Recharge Duration	Continuous
Infiltration Area	2.3 acres
Long Term Infiltration Rate	0.32 ft/day
Depth to Water Table[1]	14.4 ft
Aquifer Initial Saturated Thickness	44.6 ft
Aquifer Gradient	0.01
Aquifer Flow Direction	N 53° W

[1] Measured depth to groundwater was 15.5 ft, assumes constructed basin floor will be 1 foot below original ground surface

Table 2. Aquifer horizontal saturated hydraulic conductivity values

Scenario	Monitoring Well	K_{sat-h} (ft/day)
Low	MW3	37.0
Mid	Geometric Mean MW1, MW2, MW3	88.2
High	MW1	163.3

RESULTS

Site GM1 model predicted steady-state maximum mound height above the pre-infiltration water table and depth to the mound below the assumed 1-foot deep infiltration basin floor are presented in Table 3 for all three K_{sat-h} scenarios. Model predicted steady-state mounding extent for the scenarios is provided in Figure 2 through Figure 4. Using the lowest K_{sat-h} value of 37.0 ft/day (Low Scenario) produced a predicted steady-state maximum mound height of 13.8 ft above the pre-infiltration water table, equivalent to 0.6 ft below the basin floor. A K_{sat-h} value of 88.2 ft/day (Mid Scenario) produced a predicted steady-state maximum mound height of 5.8 ft above the pre-infiltration water table, which is 8.6 ft below the basin floor. A K_{sat-h} value of 163.3 ft/day (High Scenario) produced a predicted steady-state maximum mound height of 3.1 ft, which is 11.3 ft below the basin floor.

Table 3. Site GM1 model predicted steady-state maximum mound height and depth below surface

Scenario	**K_{sat-h} (ft/day)**	**Maximum Mounding Height (ft above pre-infiltration water table)**	**Depth to Maximum Groundwater Mound (ft bgs)**
Low	37.0	13.8	0.6
Mid	88.2	5.8	8.6
High	163.3	3.1	11.3

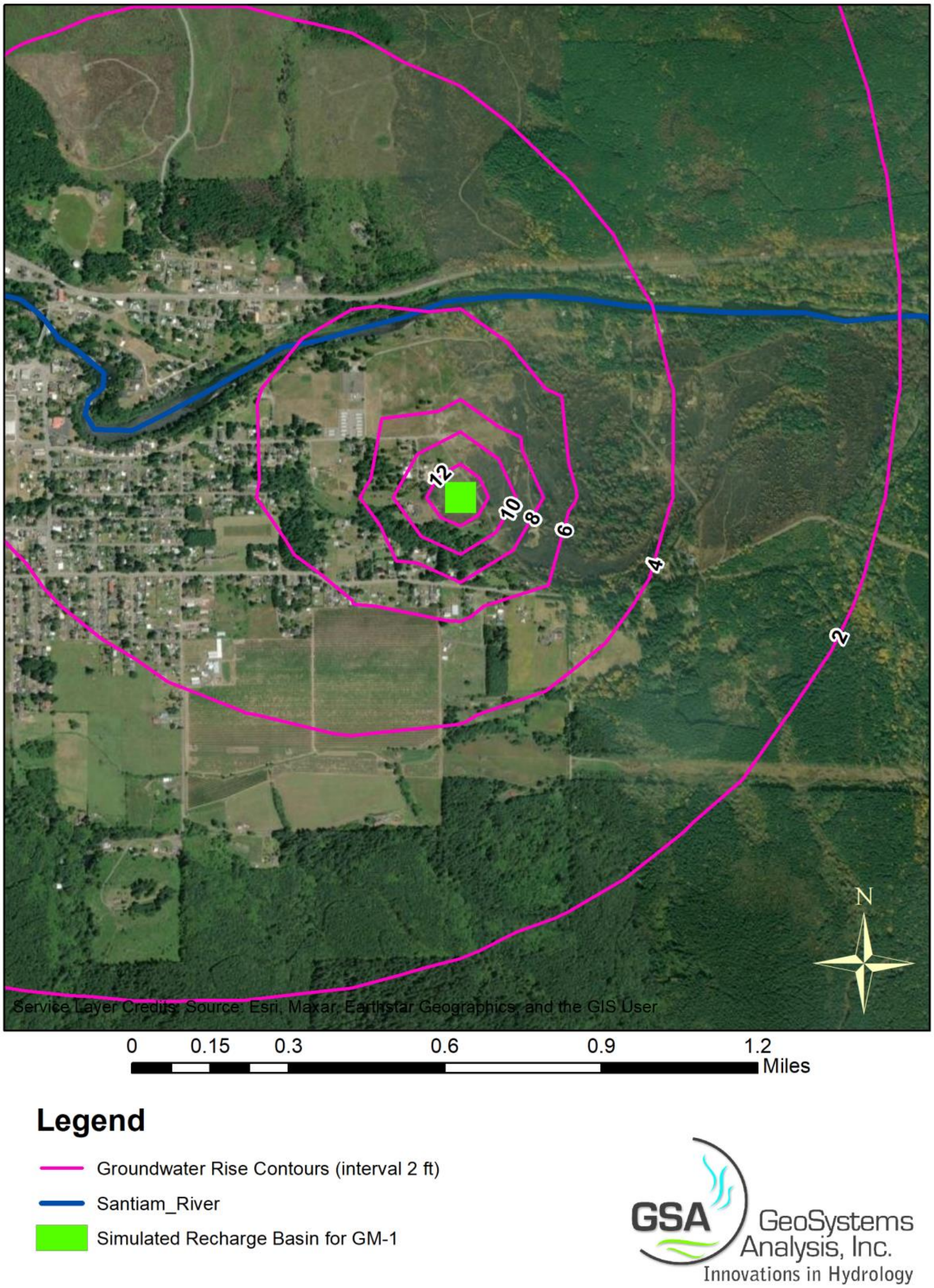


Figure 2. Predicted steady-state groundwater mounding extent for K_{sat-h} = 37.0 ft/day

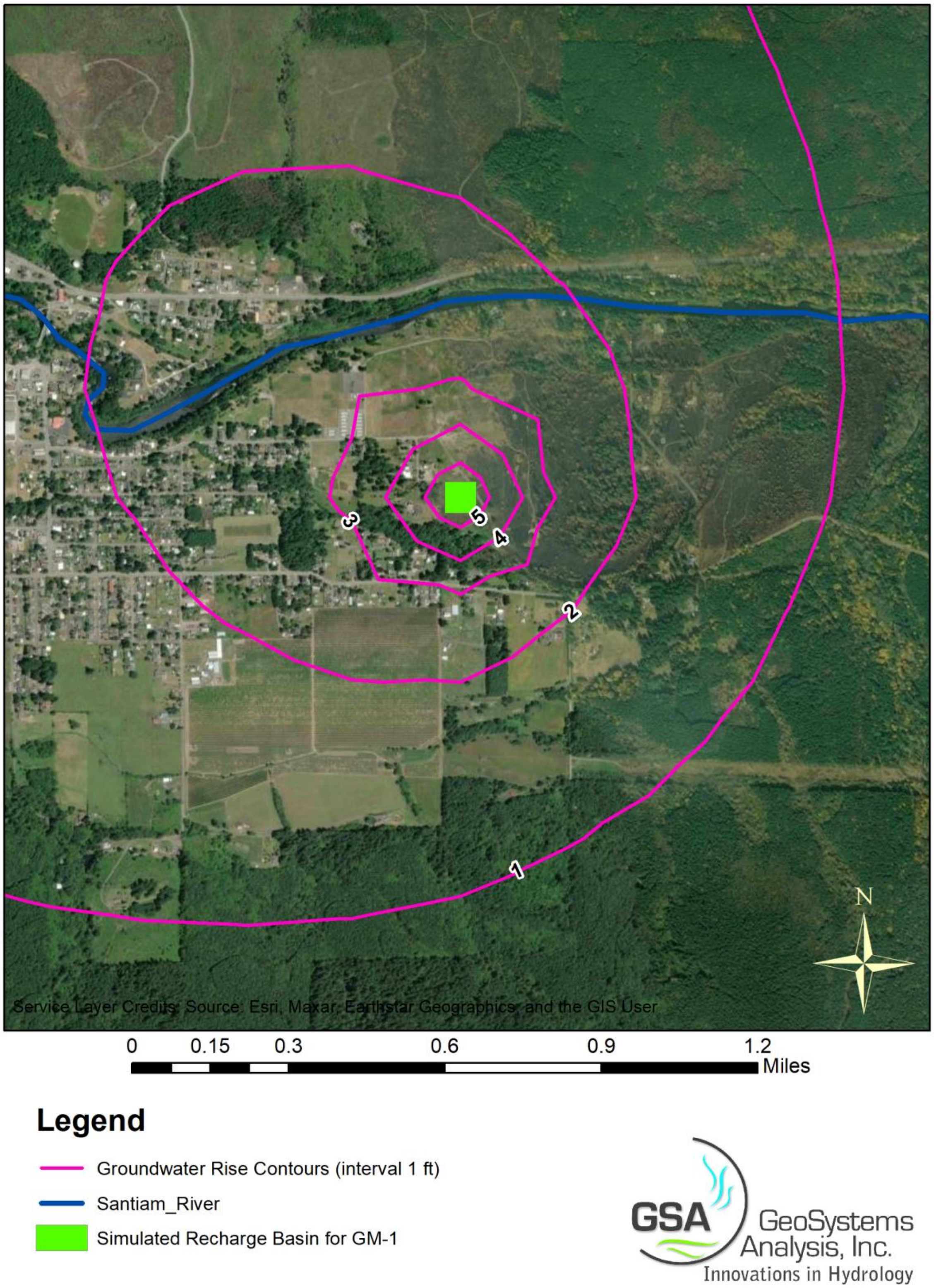
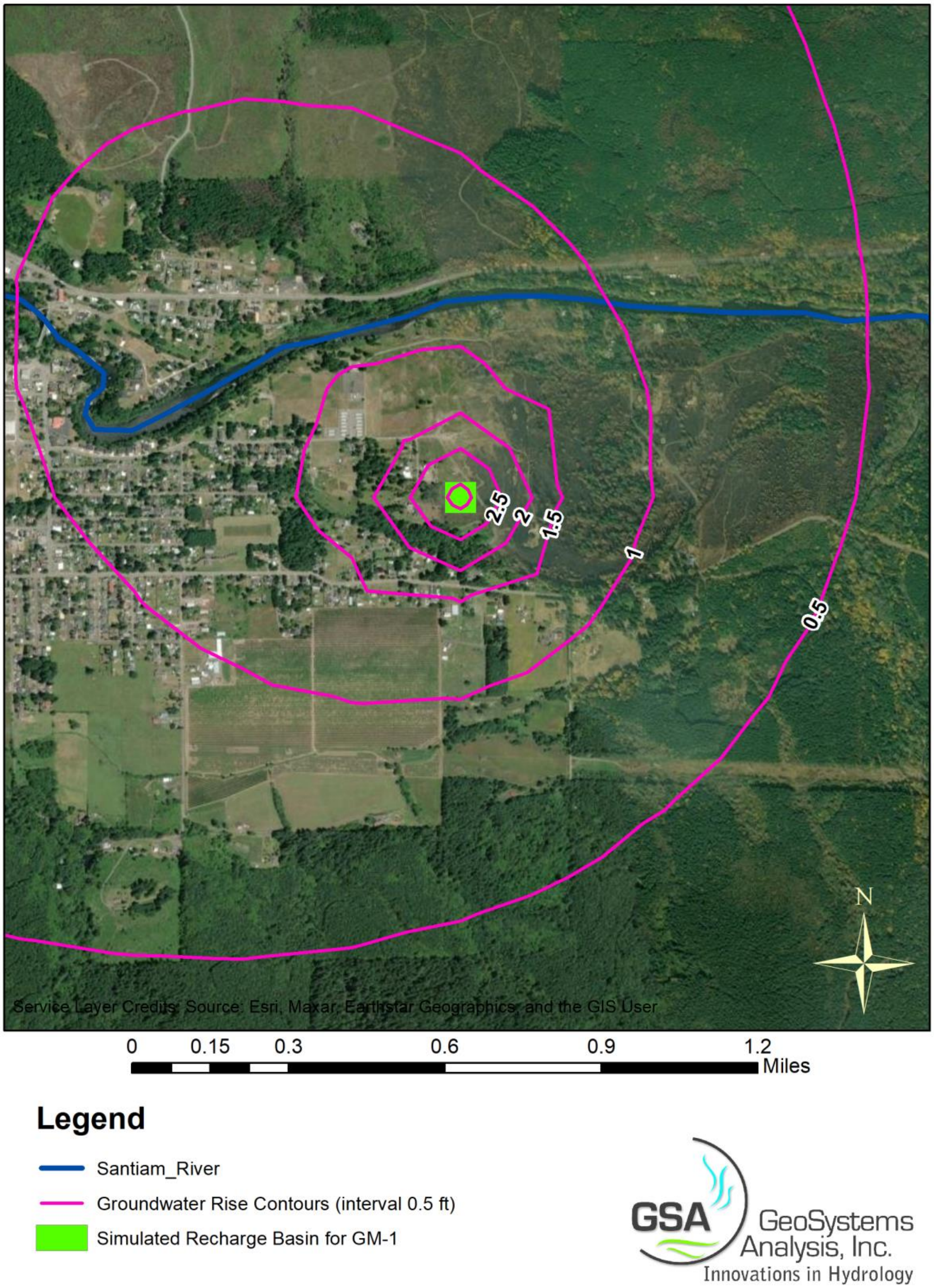


Figure 3. Predicted steady-state groundwater mounding extent for K_{sat-h} = 88.2 ft/day



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User

Figure 4. Predicted steady-state groundwater mounding extent for K_{sat-h} = 163.3 ft/day

CONCLUSIONS

A steady-state mounding analysis was performed for site GM1 applying low, mid, and high K_{sat-h} values representing the range of measured K_{sat-h}. The mounding analysis assumed a 2.3-acre recharge basin infiltration area and a recharge volume of 0.2375 MGD. Model predicted steady-state groundwater mounding was 3.1 ft to 13.8 ft above the pre-infiltration water table, with mounding height increasing with decreased K_{sat-h}. Assuming a 14.4 ft depth from the basin floor to the pre-infiltration water table, the predicted depth to the groundwater mounding was 11.3 ft to 0.6 ft bgs. Due to the predicted potential for shallow mounding beneath the basin, which may reduce basin infiltration rates, GSA recommends additional aquifer characterization be performed to resolve uncertainty in aquifer Ksat-h or a long-term infiltration pilot test be completed to assess aquifer mounding response.

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GSI, see GSI Water Solutions, Inc.

GSI/GSA, see GSI Water Solutions, Inc. and GeoSystems Analysis, Inc.

GSI Water Solutions, Inc. and GeoSystems Analysis, Inc., 2023. Gates/Mill City Shallow Soil Characterization and Infiltration Testing Results, Marion and Linn Counties, Oregon. Technical Memorandum to Chris Einmo, Marion County, dated June 23, 2023

GSI Water Solutions, Inc., 2023. Aquifer Permeability Estimates in Study Area GM1, Gates/Mill Sewer Basin, Linn County, Oregon. Technical Memorandum, dated September 20, 2023

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GSI
Water Solutions, Inc.

TECHNICAL MEMORANDUM

Evaluation of the Environmental Fate of Residual Pollutants from an Advance (Class A) Treated Wastewater Infiltration System, Mill City, Oregon

To: Chris Einmo, PE / Marion County

From: Matt Kohlbecker, RG / GSI Water Solutions, Inc.
Ailco Wolf, PG, CHG / GSI Water Solutions, Inc.
Katie O'Malley / GSI Water Solutions, Inc.

CC: Dallin Stephens, PE / Keller Associates
Kevin Stewart, EI / Keller Associates
Peter Olsen, PE / Keller Associates, Inc.
Pamela Villarreal, PE / Keller Associates, Inc.
Brian Nicholas / Marion County
Dave Kinney / City of Mill City
Russ Foltz / City of Mill City
Kari Low / Commonstreet Consulting
Tamisha Schrunk / Commonstreet Consulting
Mary Camarata / Department of Environmental Quality

Date: November 16, 2023

EXP: 5/2024

This technical memorandum (TM), prepared by GSI Water Solutions, Inc., (GSI), summarizes an evaluation of the environmental fate of residual pollutants in discharges from a proposed advance (Class A) treated wastewater infiltration system in Mill City, Oregon. The purpose of the evaluation is to inform the permitting framework for the proposed system.

1. Background

This section presents the project background (Section 1.1), site selection activities (Section 1.2), permitting framework (Section 1.3), conceptual model for treated wastewater infiltration (Section 1.4), purpose and objectives of the fate and transport evaluation (Section 1.5), and TM organization (Section 1.6).

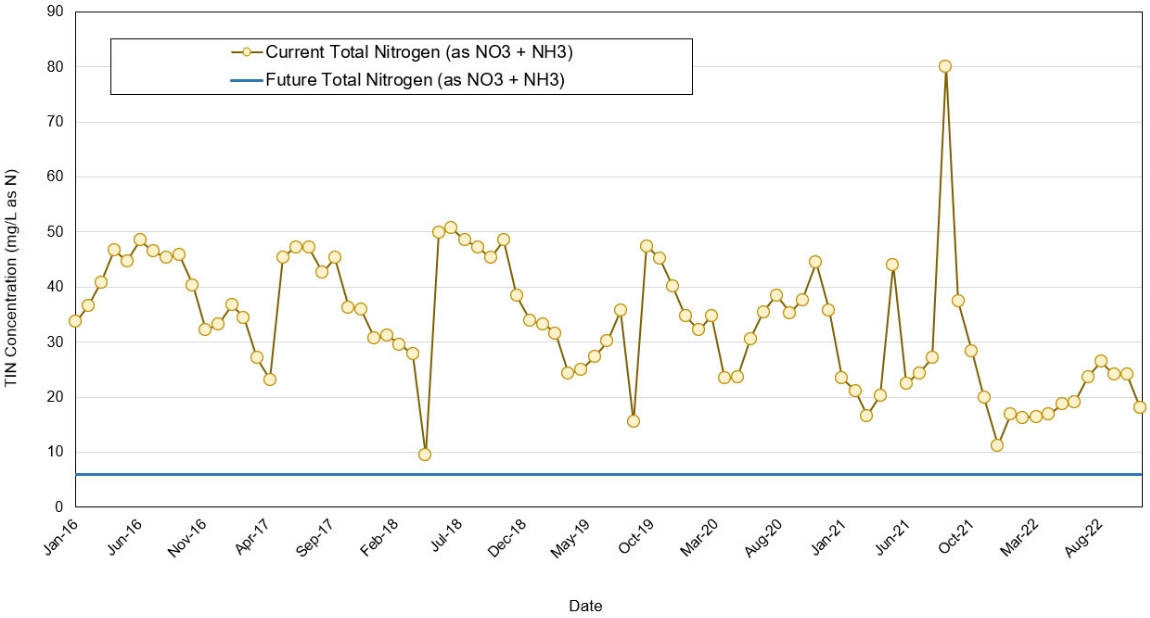
1.1 Project Background

The communities of Gates and Mill City have partnered to develop a modern wastewater treatment system that will treat wastewater to Class A standards and infiltrate it at a series of Rapid Infiltration Basins (RIBs). Currently, wastewater in Gates is infiltrated at individual septic systems, and wastewater in Mill City is infiltrated using an over 30-year-old drainfield located adjacent to the Santiam River. Mill City's drainfield is at the end of its usable life and cannot be expanded under current rules.

The modern wastewater treatment system will significantly improve water quality in the scenic Santiam Canyon because:

- The RIB system will be located further from the Santiam River (i.e., about 2,000 feet along the groundwater flowpath, as compared to Mill City's existing infiltration system that is located adjacent to the river). The increased horizontal separation results in an increased travel time between infiltrated wastewater and the river, which in turn results in increased attenuation of residual pollutants in wastewater. The travel time for groundwater from the RIB system to the river is about 17 months (based on a groundwater seepage velocity of 1,368 feet per year, as discussed in Attachment B and Attachment C), as compared to a travel time on the order of weeks from the existing Mill City system.
- The new RIB system will treat total nitrogen in wastewater to 6 milligrams per liter (mg/L)[1], which is a significant improvement to wastewater quality under current management practices. The individual septic systems and recreational vehicle park waste systems that currently manage wastewater in Gates and Mill City discharge wastewater with a total nitrogen concentration ranging from 30 mg/L to over 500 mg/L[2] (DOH, 2021). Mill City's existing system produces effluent with a total nitrogen concentration that is typically between 20 mg/L and 50 mg/L (see "Current Total Nitrogen (as NO3 + NH3" in Figure 1 below).

Figure 1. Total Nitrogen (as NO_3 + NH_4) Data from Mill City's Existing Wastewater Treatment System.



- In addition to the enhanced removal of total nitrogen, the modern treatment plant will include enhanced treatment from a clarification/separation unit and ultraviolet (UV) disinfection.

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[1] The total nitrogen in treated wastewater consists of 5 mg/L nitrate and 1 mg/L ammonia

[2] According to the Washington State Department of Health, residential strength effluent is characterized by a total nitrogen concentration ranging from 30 mg/L to 100 mg/L. High strength effluent (e.g., RV waste) is characterized by a total nitrogen concentration of more than 500 mg/L.

1.2 Site Selection Activities

A phased approach was used during the spring and summer of 2023 to evaluate infiltration feasibility in the Gates/Mill City area and select a site for the proposed RIBs. The phases included:

- **Phase I.** Excavation of test pits and infiltration testing to characterize shallow soils in four study areas.
- **Phase II.** Construction of a single monitoring well and aquifer testing to characterize deep soils in the three study areas that were considered to be the most favorable for infiltration based on the results of Phase I.
- **Phase III.** Construction of two additional monitoring wells, advancement of two temporary borings within the footprint of the planned infiltration basin area, and aquifer testing in the study area that is most favorable to infiltration based on the results of Phase II.

The four study areas that were considered are shown in Figure 2. Based on infiltration testing at test pits, slug testing at monitoring wells, and analytical modeling using MOUNDSOLV, only study area GM1 was determined to be capable of infiltrating the 2045 wastewater volume from Gates and Mill City. As such, GSI conducted this fate and transport evaluation at Site GM1 to determine the permit type and to evaluate compliance with Oregon's groundwater protection rules.

1.3 Permitting Framework

The pollutant fate and transport evaluation summarized in this TM will inform the permitting of the infiltration system by the Oregon Department of Environmental Quality (DEQ). Specifically, the fate and transport evaluation will inform the permit type (Section 1.3.1) and compliance with Oregon's Groundwater Protection Rules (Section 1.3.2).

1.3.1 Permit Type (NPDES or WPCF)

Oregon law requires that wastewater discharge systems are authorized by a permit from the DEQ. There are two options permitting a wastewater discharge: (1) a National Pollutant Discharge Elimination System (NPDES) permit or (2) a Water Pollution Control Facility (WPCF) permit. For a wastewater discharge system, the type of permit required depends fundamentally on whether or not the wastewater is to be discharged to surface water (directly or indirectly).

- NPDES permits: required for discharge of wastewater *to surface waters*, whether done so directly via an outfall, or *indirectly* via groundwater or within a hyporheic zone. A NPDES permit is a requirement of the Federal Clean Water Act and Oregon law [Oregon Administrative Rules (OAR) 340-045].
- WPCF permits: required for the discharge of wastewater *to the ground*. The primary purpose of a WPCF permit is to ensure that discharge to the ground meets Oregon's Groundwater Protection Rules (OAR 340-040).

There is often uncertainty related to whether an NPDES or WPCF permit is required to operate wastewater discharge systems that infiltrate wastewater. Whether an NPDES permit would be required for discharges of wastes to groundwater with a direct or otherwise significant hydrological connection to surface water (i.e., an *indirect* discharge) is a nuanced question that depends on several site-specific factors. Because new NPDES permits cannot be issued in the Santiam Canyon (because of the Three Basin Rule[3]), the type of permit required for the proposed treated wastewater infiltration system in Mill City is an important consideration. The following sections summarize the criteria used by DEQ to determine whether a NPDES or WPCF permit is

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[3] OAR 340-041-0350

required for a wastewater discharge system that infiltrates wastewater: (1) Oregon regulatory guidance documents, (2) a recent (April 2020) U.S. Supreme Court decision, and (3) site-specific criteria.

Oregon Regulatory Guidance Documents

Some of the uncertainty around permitting of wastewater infiltration systems was reduced in 2007, when DEQ issued an internal management directive (IMD) for disposal of municipal wastewater by indirect discharge to surface water. In the IMD, DEQ defined *indirect discharge systems* as those that "dispose of municipal wastewater plant effluent by indirect discharge to surface water via groundwater or hyporheic water" (DEQ, 2007). As such, indirect discharge systems are intentionally designed such that the wastewater effluent will ultimately discharge to a receiving surface water body. Based on DEQ's indirect discharge IMD, DEQ would require an NPDES permit rather than a WPCF permit for systems that intentionally discharge treated wastewater to surface water, albeit indirectly along a groundwater pathway.

Recent (April 2020 U.S. Supreme Court Decision

A recent U.S. Supreme Court decision is expected to eventually provide DEQ with future guidance and perhaps rule changes for the regulation and permitting of wastewater infiltration systems (*County of Maui, Hawaii v. Hawaii Wildlife Fund, et al.).* The case argued whether the Clean Water Act requires a permit when pollutants that originate from a waste disposal facility (in this case, an underground injection control that was permitted under the Safe Drinking Water Act) can be traced to reach navigable waters of the US through mechanisms such as groundwater transport, regardless of whether discharge to surface water was intended. On April 23, 2020, the Court ruled that such discharges must have an NPDES permit when they are the "functional equivalent of a direct discharge," a new test defined by the ruling. The Court decision will require the U.S. Environmental Protection Agency (EPA) to develop specific rules related to the "functional equivalent" test to be promulgated after public review. These federal rules will eventually be adopted by DEQ for implementation in Oregon. On December 8, 2020, the EPA issued draft guidance to clarify how to apply the Maui case (EPA, 2020). However, the guidance was rescinded on September 16, 2021, and has not been replaced (EPA, 2021). It will likely be years before such a test is developed and implemented into Oregon wastewater permitting regulations.

Site-Specific Criteria

In the memo rescinding the December 8, 2020, guidance, EPA stated that the agency ". . . will continue to apply site-specific, science-based evaluations to determine whether a discharge from a point source through groundwater that reaches jurisdictional surface water is a 'functional equivalent' of a direct discharge." In order to determine if an infiltration system functions equivalently as a direct discharge to surface water, it is necessary to understand the degree to which residual pollutants in wastewater are attenuated as they are transported with groundwater flow. A "site-specific" evaluation would include the hydrogeologic properties that affect pollutant fate and transport, including hydraulic conductivity, horizontal hydraulic gradient, porosity, soil bulk density, and distance between the infiltration point and the compliance point (i.e., which affects attenuation). These data were collected at Site GM1 during the Phase II and Phase III investigations, and are used in this fate and transport evaluation to evaluate the attenuation of residual pollutants and, ultimately, whether a treated wastewater infiltration system at Site GM1 functions equivalently as a direct discharge to the Santiam River.

1.3.2 Oregon's Groundwater Protection Rules

WPCF permits require that discharges to the ground (e.g., infiltration) meet Oregon's groundwater protection rules[4]. These rules require that groundwater is protected to its highest beneficial use, which is usually drinking water[5].

To protect the quality of groundwater used as drinking water, permit-specific **concentration limits** for new facilities[6] are set at background groundwater quality[7] at a downgradient **compliance point** that is chosen by DEQ[8]. The WPCF permit sets **action levels** or **limitations** at the point of discharge[9] at a value that will result in no change in groundwater quality from background at the downgradient, in-groundwater, **compliance point.** The **action levels** or **limitations**, along with proper implementation of conditions set in the permit, protect groundwater used as drinking water and meet background groundwater quality concentrations per the Oregon groundwater protection rules.

On a case-by-case basis, DEQ may also set a **concentration limit variance** in place of a permit-specific **concentration limit**[10] provided that no substantial present or potential hazard to human health or the environment is posed at that level[11]. The factors that the DEQ is to consider for setting a **concentration limit variance** are stipulated in OAR 340-040-0040(4)(c)(A) through (M). Because the Santiam River is subject to Oregon's Three Basin Rule, setting a **concentration limit variance** is subject to the following additional requirements[12]:

- All appropriate groundwater quality protection requirements and compliance monitoring are met, and
- There will be no measurable change in the water quality of the surface water that would be potentially affected by the proposed facility.

In addition, the Environmental Quality Commission (EQC) must find that the proposed facility provides a preferable means of sewage collection, treatment, and disposal as compared to individual on-site sewage disposal systems. "Preferable" is defined as the new system: (1) eliminating a significant number of failing individual on-site sewage systems that cannot be reliably and cost-effectively repaired, (2) treating domestic sewage that would otherwise be treated by individual on-site sewage disposal systems with the cumulative impact to groundwater of the individual on-site sewage disposal systems being greater than the new facility, or (3) the social and economic impacts of the new facility outweigh the possible environmental impacts.

1.4 Conceptual Model for Treated Wastewater Infiltration

A conceptual model for the infiltration of treated wastewater is shown in Figure 3. The treated wastewater will be infiltrated at RIBs, and will be transported downward through unsaturated soils until reaching the groundwater table. After reaching the groundwater table, the water will be transported horizontally by groundwater flow.

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[4] OAR 340-040

[5] OAR 340-040-0020(3)

[6] A "new facility" means a facility authorized to operate under a DEQ-approved permit for the first time after the effective date of OAR 340-040-0030 (i.e., October 27, 1989).

[7] OAR 340-040-0030(3)(b)

[8] OAR 340-040-0030(2)(e)

[9] See Permit No. 101809 for OPRD Silver Falls State Park or Permit No. 103083 for Tri-County Metropolitan Transportation

[10] OAR 340-040-0010(4) and OAR 340-040-0030(4)

[11] OAR 340-040-0030(4)(c)

[12] OAR 340-041-0350(8)(c)(A)

During transport through unsaturated soils and groundwater, the concentrations of residual pollutants in the Class A treated wastewater are attenudated (reduced) by the processes of denitrification, volatilization, dilution, dispersion, sorption, and biodegradation.

- **Denitrification.** Denitrification is a microbial-mediated process in which nitrate and nitrite are reduced to nitrogen gas.
- **Volatilization.** Pollutants volatilize into the gas phase when the pollutant is transferred from the dissolved phase to the vapor phase. Volatilization occurs because soil pores in unsaturated soils are only partially filled with water, and pollutants with a high vapor pressure volatilize into the vapor phase.
- **Dilution.** Residual pollutants in treated wastewater are diluted by precipitation falling over the infiltration basin footprint and groundwater entering the project site from upgradient. Residual pollutants are further diluted downgradient of the RIB by precipitation falling over the property that infiltrates through soil and recharges the groundwater system.
- **Dispersion.** Dispersion is pollutant attenuation caused by spreading of the residual pollutants (i.e., some pollutant travels slower than the average groundwater velocity and other pollutant travels faster than the average groundwater velocity, thereby reducing the concentration of pollutants).
- **Sorption.** During transport, pollutants partition from the aqueous phase onto the solid phase by sorption onto soil (e.g., mineral) surfaces. Physical sorption is caused mainly by van der Waals forces and electrostatic forces between the pollutant molecule and the ions of the soil particle's surface.
- **Biodegradation.** Degradation is pollutant attenuation due to biotic and abiotic processes. Abiotic degradation includes hydrolysis (interaction with water molecules), photolysis (interaction with photons from sunlight), and oxidation-reduction. Biotic degradation involves microorganisms metabolizing pollutants through biochemical reactions. At an infiltration basin, biodegradation is the most significant of these pathways.

The amount of pollutant attenuation caused by these processes can be evaluated with a pollutant fate and transport model. Site-specific properties, shown in Table 1, are input to the model. Collectively, these properties determine the pollutant concentration after transport through porous media and, therefore, whether and infiltration system is functioning equivalently to a direct discharge system; no one single property (e.g., groundwater velocity) should be used to evaluate functional equivalency. Note that the attenuation processes of volatilization and abiotic degradation are not included in Table 1 because they are not being included in the pollutant fate and transport simulations discussed in this TM.

Table 1. Site-Specific Soil and Site Properties that Affect Pollutant Attenuation.

Attenuation Process	Site-Specific Properties Affecting Attenuation
Denitrification	Organic matter, soil water content, soil oxygen supply, soil temperature, soil pH
Dilution	Precipitation, aquifer thickness, infiltration facility footprint, groundwater velocity (a function of sorption, hydraulic conductivity, horizontal hydraulic gradient, and effective porosity), wastewater volume
Dispersion	Distance between the infiltration site and the compliance point, pollutant velocity (a function of sorption, hydraulic conductivity, horizontal hydraulic gradient, and effective porosity)
Sorption	Soil bulk density, fraction organic carbon, total porosity
Biotic Degradation	Pollutant velocity (a function of sorption, hydraulic conductivity, horizontal hydraulic gradient, and effective porosity)

1.5 Purpose and Objectives of the Fate and Transport Evaluation

The purpose of the modeling summarized in this TM is to inform the permitting framework of the proposed treated wastewater infiltration system based on site-specific criteria (specifically, to evaluate whether the new wastewater treatment system at Site GM1 is the functional equivalent of a discharge to the surface water and to evaluate compliance with Oregon's groundwater protection rules). The objectives of the model are:

- Identify pollutants to include in the evaluation based on the concentrations of pollutants likely to be present in treated wastewater, regulatory standards for the pollutants (i.e., EPA Maximum Contaminant Levels or MCLs), and background concentrations of the pollutants.
- Use the Washington State Department of Health's Large Onsite Septic System (LOSS) model to calculate pollutant attenuation by dilution.
- Use the EPA's BIOSCREEN model to calculate pollutant attenuation by dispersion, biodegradation, and sorption.

1.6 TM Organization

The remainder of this TM is organized as follows:

- Section 2.0: Fate and Transport Modeling Methods
- Section 3.0: Fate and Transport Modeling Results
- Section 4.0: Conclusions and Recommendations

The main text of this TM provides an overview of the modeling methods and results. Detailed technical documentation is provided in Attachment A (LOSS model), Attachment B (BIOSCREEN model at the property boundary), and Attachment C (BIOSCREEN model at the Santiam River).

2. Fate and Transport Modeling Methods

The modeling methods were comprised of three steps:

- **Step 1: Select Pollutants for Fate and Transport Modeling.** Wastewater quality and background groundwater quality were characterized based on sampling of untreated wastewater from Mill City's existing wastewater disposal system and sampling of groundwater from monitoring well GM1-MW1 at Site GM1, respectively. Samples were analyzed for pollutants that are regulated under the Safe Drinking Water Act (SDWA). Sampling methods and results are presented in GSI (2023a). Pollutants were selected for fate and transport modeling if: (1) the pollutant was a synthetic organic compound (SOC) or volatile organic compound (VOC) and was detected in untreated wastewater, (2) the pollutant was nitrate (which is a key pollutant for DEQ's regulation of domestic wastewater discharges), or (3) the pollutant was naturally-occurring, exceeded background concentrations in groundwater, and exceeded the MCL[13].
- **Step 2: Calculate Pollutant Attenuation by Dilution Using the LOSS Model.** The LOSS model was developed by the Washington State Department of Health to calculate pollutant attenuation that occurs by dilution when wastewater, precipitation, and groundwater are mixed. While the LOSS

---

[13] Fluoride was detected in a sample of untreated wastewater collected on May 2, 2023 [see GSI (2023)]. Because this high level was an unexpected result, the City re-sampled untreated wastewater for fluoride on October 17, 2023. Fluoride was not detected in the October 17, 2023 sample. Therefore, the May 2 detection of fluoride is considered to be lab error, and the October 17 sample was used for Step 1 (select pollutants for fate and transport modeling).

model was originally developed for calculating dilution of nitrate, it can also be used to calculate dilution of other pollutants by changing values of certain input parameters. Output from the LOSS model is pollutant concentration in groundwater at the downgradient edge of the infiltration basin after dilution. Detailed technical documentation of the LOSS model, model input parameters, and model results is provided in Attachment A.

- **Step 3: Calculate Pollutant Attenuation by Dispersion, Sorption, and Biodegradation using BIOSCREEN.** BIOSCREEN Version 1.4, an analytical pollutant fate and transport model developed by the EPA, was used to calculate pollutant attenuation by dispersion, sorption, and biodegradation based on the Domenico (1987) solution to the three-dimensional Advection Dispersion Equation (ADE) (e.g., Bear, 1972). The output concentration from the LOSS model was used as the initial concentration in BIOSCREEN. Output from BIOSCREEN is pollutant concentration at the property boundary (transport distance of 225 feet from the RIB edge) and in groundwater adjacent to the Santiam River (transport distance of 1,950 feet from the RIB edge) after the effects of dispersion, sorption, and biodegradation. Note that the concentration of nitrate output by BIOSCREEN should be considered an estimate because the ADE assumes that pollutant concentration in the receiving groundwater is zero, but the measured concentration of nitrate in groundwater is 1.1 milligrams per liter (mg/L). Detailed technical documentation of the BIOSCREEN model, model input parameters, and model results is presented in Attachment B (concentration at the property boundary) and Attachment C (concentration in groundwater adjacent to the Santiam River).

This modeling approach is highly conservative for the following reasons, many of which represent simplifying assumptions:

(1) The modeling approach assumes that, except for denitrification, no pollutant attenuation occurs in unsaturated soils (i.e., by dispersion, sorption, degradation, or volatilization).

(2) Between the downgradient edge of the RIB and the property boundary or river, the modeling approach assumes no pollutant dilution occurs due to mixing with precipitation that infiltrates through subsurface soil and recharges groundwater.

(3) The LOSS model limits the vertical mixing zone in groundwater to 20 feet; in reality, the vertical mixing zone at Site GM1 will be about 30 feet (the thickness of the aquifer from the water table at about 15 feet below ground surface to a gravelly silt layer at 45 feet bgs) (GSI, 2023b).

(4) BIOSCREEN simulations assume that all wastewater is infiltrated at the RIB that is located closest to the downgradient property boundary (225 feet); in reality, infiltration will be cycled between up to four RIBs, most of which are located further from the property boundary (i.e., RIB edges located about 375 feet from the downgradient property boundary).

(5) Conservative values of fate and transport parameters are used. For example:

    a. Dispersion is estimated using the Xu and Eckstein (1995) equation instead of the Gelhar et al. (1991) equation, which results in lower values of dispersivity and, therefore, less pollutant attenuation.

    b. Concentrations of pollutants are based on samples of <u>untreated</u> wastewater. This impacts concentrations of toluene and di(2-ethylhexyl)phthalate, which are expected to be reduced by the proposed wastewater treatment system.

3. Fate and Transport Modeling Results

Model results are provided in Table 2. A detailed discussion of modeling results is provided in Attachment A (LOSS model), Attachment B (BIOSCREEN model between the downgradient edge of the infiltration basin and property boundary), and Attachment C (BIOSCREEN model between the downgradient edge of the infiltration basin and groundwater adjacent to the Santiam River).

Table 2. Results of Pollutant Attenuation Modeling.

Pollutant	Concentration in Wastewater (mg/L)	Concentration at Basin Edge (LOSS Model) (mg/L)	Concentration at Property Boundary (BIOSCREEN) (mg/L)	Concentration in Groundwater Adjacent to Santiam River (BIOSCREEN) (mg/L)	Percent Reduction (mg/L)
Nitrate	6.0	4.3	3.4 to 4.3	1.1 to 4.3	81.7% to 28.3%
DEHP	0.0090	0.0067	< 0.0001	< 0.0001	100%
Toluene	0.0496	0.0371	< 0.0005	< 0.0005	100%

Notes

mg/L = milligrams per liter

DEHP = di(2-ethylhexyl)phthalate

4. Conclusions and Recommendations

The following sections summarize the implications of these concentrations on Oregon's groundwater protection rules (Section 4.1) and permit type (i.e., WPCF or NPDES) (Section 4.2).

4.1 Oregon Groundwater Protection Rules

4.1.1 DEHP and Toluene

Based on model simulations, Toluene and DEHP are predicted to attenuate to below their respective detection limits before reaching the downgradient property boundary. Therefore, Oregon's groundwater protection rules can be met for these pollutants by establishing a permit-specific **concentration limit** equal to background groundwater quality (i.e., non detectable) at a **compliance point** located at the property boundary. Additional modeling would be needed to set the values of the **action levels** or **limitations** in the permit, but based on modeling conducted to date, the values could be at least 0.0496 mg/L for Toluene and 0.00901 mg/L for DEHP.

4.1.2 Nitrate

Concentrations of nitrate are predicted to exceed background concentrations in groundwater at the downgradient property boundary. Therefore, a **concentration limit variance** will need to be established for these pollutants. The **concentration limit variance** may be granted because no substantial present or potential hazard to human health or the environment will be posed once it is confirmed that groundwater downgradient of the facility is not used as a drinking water supply. This may require a door-to-door survey, and decommissioning existing water wells and connecting households to Mill City's municipal groundwater supply system. The **concentration limit variance** is allowed under the Three Basin Rule in OAR 340-041-0350(8)(c)(A) because all appropriate groundwater quality protection requirements and compliance monitoring will be met, and there will be no measureable change in the water quality of the surface water that would potentially be affected by the proposed facility (see discussion in Section 4.2). In addition, the new treatment system meets the Three Basin Rule requirement for a **preferable** means of domestic sewage collection, treatment, and disposal as compared to individual on-site sewage disposal systems, meaning that [see OAR 340-041-0350(8)(c)(B)]:

- The new sewage treatment facility will eliminate a significant number of failing individual on-site sewage disposal systems that cannot be reliably and cost-effectively repaired, or
- The facility will treat domestic sewage that would otherwise be treated by individual on-site sewage disposal systems, from which the cumulative impact to groundwater is projected to be greater than that from the new facility, or
- The social and economic benefits of the discharge outweigh the potential environmental impacts.

4.2 Permitting Framework (NPDES or WPCF)

It is appropriate to permit the RIB facility at Site GM1 with a WPCF permit issued in accordance with OAR 340-045 because:

- There is no waste discharge to surface water (all discharge is to ground),
- All groundwater quality protection requirements of OAR 340-040 can be met, as discussed in Section 4.1, and
- There will be no measurable change in the water quality of the surface water that would potentially be affected by the proposed facility. Specifically, the mean daily discharge in the Santiam River near Mill City ranges from 1,010 cubic feet per second to 6,420 cubic feet per second[14]. Assuming the area of groundwater impacted by residual pollutants is as described in Attachment A and Attachment B[15], the discharge of residual-pollutant-impacted groundwater to the Santiam River is about 0.478 cubic feet per second[16]. Therefore, each cubic foot of groundwater will be diluted by a factor of approximately 2,110 times (corresponding to low-flow conditions with the river flow at 1,010 cubic feet per second) to 13,400 times (corresponding to high-flow conditions with the river flow at 6,420 cubic feet per second). The residual nitrate concentration of 1.1 mg/L to 4.3 mg/L would be diluted to below detectable levels under these conditions.
- Infiltration at the proposed RIBs does not function equivalently to a direct discharge to surface water, given that toluene and DEHP are attenuated by 100% and nitrate (28.3% to 81.7% attenuated are significantly attenuated. The attenuation occurs because the modern infiltration facility is located a significant distance from the Santiam River (about 2,000 feet, as compared to the existing facility located adjacent to the river) which results in a groundwater travel time of approximately 17 months (as compared to a travel time on the order of weeks from the existing facility). The increased travel time of 17 months provides time for pollutant concentrations to decline due to denitrification, dilution, dispersion, sorption, and biodegradation.

Based on these conclusions, we recommend initiating discussions with DEQ to determine: (1) an approach for setting the **action levels** or **limitations** in the WPCF permit for the facility and (2) the process for obtaining a **concentration limit variance** for nitrate.

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[14] USGS 14183000 North Santiam River at Mehama, Oregon (period of record is 10/1/1905 to 9/30/2023). The mean daily discharge of 1,010 is from multiple days in August, and the mean daily discharge of 6,420 cubic feet per second is from November 25.

[15] 20 feet deep and 550 feet wide

[16] Calculated by Darcy's Law. Values used are: seepage velocity of 1,368 feet per year, seepage depth of 20 feet, and seepage width of 550 feet (see Attachment A and Attachment B for details). The resultant flux is 15,048,000 cubic feet per year from the area of groundwater with residual pollutants, which equates to about 0.48 cubic feet per second.

5. References

DOH. 2021. Level 1 Nitrate Balance Instructions for Large On-Site Sewage Systems. DOH 337-069.

Domenico, P. A. 1987. An analytical model for multidimensional transport of a decaying contaminant species. Journal of Hydrology, vol. 91, pp. 49-58.

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EPA. 2021. Rescission of the January 2021 Guidance Document, "Applying the Supreme Court's *County of Maui v. Hawaii Wildlife Fund* Decision in the Clean Water Act Section 402 National Pollutant Discharge Elimination System Permit Program. September 15.

GSI. 2023a. Phase II Subsurface Characterization to Support and Evaluation of Treated Wastewater Infiltration in Gates and Mill City, Marion and Linn Counties, Oregon. September 12.

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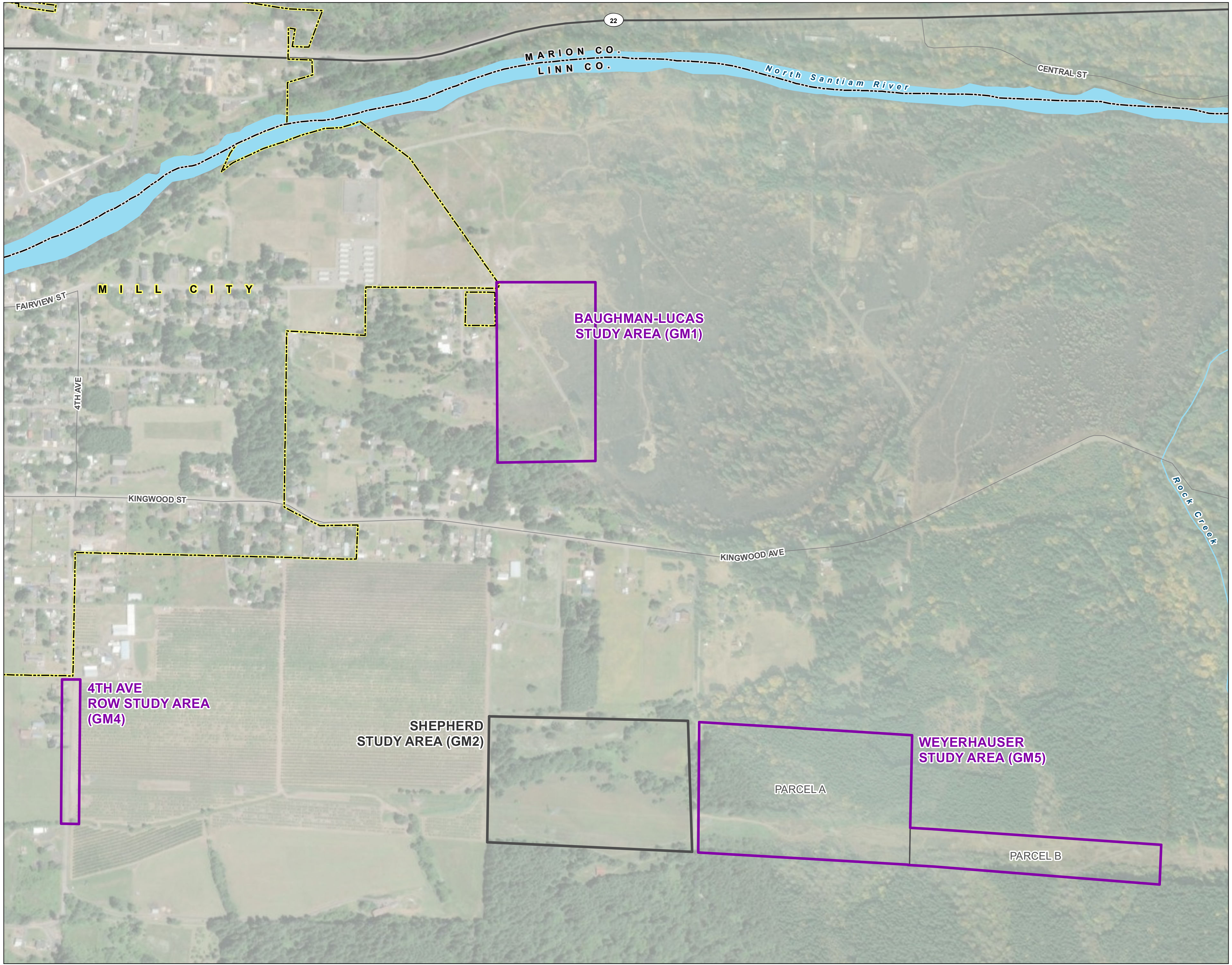
Xu, M. and Y. Eckstein. 1995. Use of Weighted Least-Squares Method in Evaluation of the Relationship Between Dispersivity and Scale. Journal of Groundwater (33), No. 6, pp. 905 – 908.

FIGURES

FIGURE 2

Candidate Sites for Treated Wastewater Infiltration

Site GM1 Pollutant Fate and Transport Evaluation



LEGEND

☐ Site Parcel

Study Areas

☐ Subject of the Phase I Subsurface Characterization

☐ Subject of the Phase I and Phase II Subsurface Characterization

All Other Features

⬚ City Boundary

⬚ County Boundary

╱╲ Major Road

〜 Watercourse

🟦 Waterbody

N

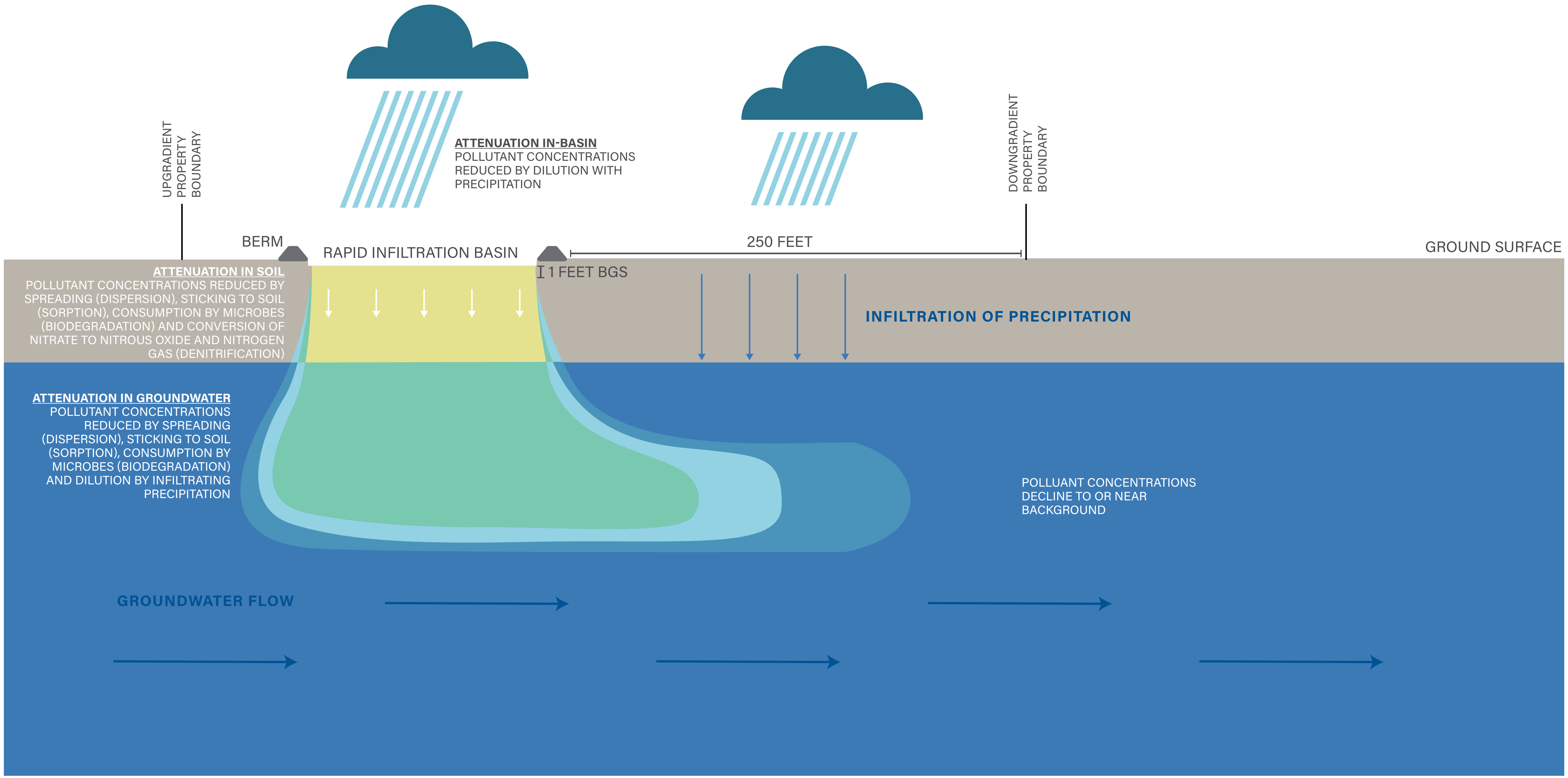
0 300 600 900

Feet

Date: October 23, 2023
Data Sources: BLM, ESRI, ODOT, USGS,
Aerial Photo 2020

GSI
Water Solutions, Inc.

Document Path: Y:\0464_Keller_Assoc\Source_Figures\020_Santiam_Canyon\Phase_II_Subsurface_Characterization\Figure2_Candidate_Sites_Treated.mxd, iramos



LEGEND

Concentrations

🟨 Highest

🟩 Medium

🟦 Low

🟦 At or Near Background

FIGURE 3

Conceptual Model for Pollutant Attenuation During Treated Wastewater Infiltration

Site GM1 Pollutant Fate
and Transport Evaluation

GSI Water Solutions, Inc.

ATTACHMENT A

Technical Documentation for LOSS Model Simulations

ATTACHMENT A

Application of the Large Onsite Septic System (LOSS) Model to Evaluate Pollutant Dilution at Site GM1, Mill City, Oregon

1. Background

This attachment provides technical documentation for application of the Washington State Department of Health's Large Onsite Septic System (LOSS) model to Site GM1 in Mill City, Oregon. The model was used to evaluate dilution of residual wastewater pollutants when they mix with infiltrating precipitation and groundwater at the site.

The LOSS model is an analytical nitrogen mass balance model that calculates the nitrate concentration in groundwater resulting from mixing between nitrogen in wastewater effluent, nitrate in precipitation, and nitrate in background groundwater. The model has been adopted by the Oregon Department of Environmental Quality (DEQ) to evaluate whether wastewater infiltration systems comply with Oregon's Groundwater Protection Rules[1]. With minor modifications to input values, the model can also be used to calculate concentrations of other pollutants in groundwater.

This section provides an overview of the governing equations used by the LOSS model to calculate nitrate concentrations in groundwater (Section 1.1), application of the LOSS model to calculate concentrations of other pollutants in groundwater (Section 1.2), and the purpose of the model simulations (Section 1.3).

1.1 Governing Equation for Nitrate Dilution in Groundwater

The equation used by the LOSS model to calculate the nitrate concentration in groundwater is:

$$N_{GW} = \frac{(Q)(N_B)+(V_W)\big(N_W(1-d)\big)+(V_R)(N_R)}{Q+V_W+V_r} \qquad \text{(A.1)}$$

Where:

N_{GW} is the nitrate concentration in groundwater at the downgradient edge of the wastewater facility (milligrams per liter, or mg/L),

Q is the aquifer flow (gallons per day), calculated as $Q = (K)(i)(b)(W_A)$, where:

K is horizontal hydraulic conductivity (feet per day)

i is horizontal hydraulic gradient (feet per foot)

b is depth of mixing in the aquifer (feet)

---

[1] Oregon Administrative Rules (OAR) 340 - 040

W_A is width of the aquifer (feet)

N_B is the background or upgradient nitrate concentration (mg/L)

V_W is the volume of wastewater (gallons per day)

N_W is the nitrogen concentration in wastewater (mg/L)

d is the nitrate percentage removed by denitrification in soil (dimensionless)

V_R is the volume of precipitation recharge over the facility (gallons per day), calculated as

$V_R - (A_D)(R)(0.0017)$, where:

A_D is the area of the wastewater infiltration facility (square feet)

R is recharge (inches per year)

0.0017 is a units conversion to express V_R in units of gallons per day

N_R is the nitrate concentration in precipitation (mg/L)

In Equation (A.1), the nitrate in background groundwater is represented by the quantity $[(Q)(N_B)]$, the nitrogen in effluent is represented by the quantity $[(V_W)(N_W)(1-d)]$, and the nitrate concentration in precipitation recharge is represented by the quantity $[(V_R)(N_R)]$.

The LOSS model's output (N_{GW}, the concentration of nitrate in the aquifer adjacent and downgradient to the infiltration facility) represents pollutant attenuation only due to dilution (specifically, by mixing between precipitation, treated wastewater, and groundwater entering the site from upgradient). This concentration can be used as input to a pollutant fate and transport model that simulates other pollutant attenuation mechanisms (for example, dispersion, sorption, and biodegradation).

1.2 Application of the LOSS Model to Dilution of Other Pollutants in Groundwater

The LOSS model can be applied to other pollutants if the following input parameter values are set to zero:

- Denitrification (d)
- Nitrate concentration (in this case the concentration of another pollutant) in background groundwater (N_B)[2]
- Nitrate concentration (in this case the concentration of another pollutant) in precipitation (N_R)

And if the nitrate concentration in wastewater (N_W) and nitrate concentration in groundwater (N_{GW}) are changed to the concentration of a pollutant in wastewater (C_W) and the concentration of a pollutant in groundwater (C_{GW}). Making these changes, Equation (A.1) becomes:

$$C_{GW} = \frac{(V_W)(C_W)}{Q+V_W+V_r} \tag{A.2}$$

---

[2] Note that this assumption is supported by groundwater quality sampling data. Specifically, the concentrations of toluene and di(2-ethylhexyl)phthalate (DEHP) in a groundwater sample collected from monitoring well GM1-MW1 on May 28, 2023 (GSI, 2023) were below their detection limits of 0.0005 mg/L, 0.0001 mg/L, and 0.1 mg/L, respectively.

Note that the concentration of the pollutant in groundwater (C_{GW}) represents pollutant attenuation due to dilution (specifically, by mixing between treated wastewater, precipitation, and groundwater entering the site from upgradient).

1.3 Purpose

The purpose of the LOSS modeling is to predict pollutant concentrations in groundwater at the downgradient edge of the proposed wastewater infiltration basin for Site GM1. The pollutant concentrations are to be used as input concentrations for a separate model (i.e., BIOSCREEN) to predict pollutant attenuation by dispersion, sorption, and biodegradation that occurs during transport from the downgradient edge of the infiltration basin to the downgradient property boundary or to groundwater adjacent to the Santiam River.

2. Model Input Parameters

This section provides an overview of the model input parameters used to calculate the nitrate concentration in groundwater, N_{GW} (Section 2.1) and the concentration of other pollutants in groundwater, C_{GW} (Section 2.2).

2.1 Input Parameters for Calculation of Nitrate in Groundwater (N_{GW})

Model input parameters for using Equation (A.1) to calculate the concentration of nitrate in groundwater (N_{GW}) adjacent to the infiltration basin are summarized in Table A.1. The following subsections describe the methods that were used to develop the model input parameters.

Table A.1. LOSS Model Input Parameters for Calculation of N_{GW}.

Model Input Parameter	Symbol	Value	Units	Subsection
Nitrate Concentration in Precipitation	N_R	0.24	mg/L	Subsection 2.1.1
Total Nitrogen Concentration in Wastewater	N_W	6.0	mg/L	Subsection 2.1.2
Soil Denitrification	d	10	percent	Subsection 2.1.3
Aquifer Thickness	b	20	feet	Subsection 2.1.4
Wastewater Infiltration Facility Area	A_D	130,680	ft^2	Subsection 2.1.5
Aquifer Width	W_A	550	feet	Subsection 2.1.6
Horizontal Hydraulic Conductivity	K	88.2	feet/day	Subsection 2.1.7
Hydraulic Gradient	i	0.0102	feet/feet	Subsection 2.1.8
Recharge	R	28	inches/year	Subsection 2.1.9
Nitrate Concentration of Upgradient Groundwater	N_B	1.1	mg/L	Subsection 2.1.10
Wastewater Volume	V_W	237,500	gpd	Subsection 2.1.11

Notes

mg/L = milligrams per liter

gpd = gallons per day

ft^2 = square feet

2.1.1 Nitrate Concentration in Precipitation (N_R)

Precipitation contains a small amount of nitrate from anthropogenic and natural sources. The default value for N_R of 0.24 mg/L from DOH (2021) guidance was used in the LOSS model.

2.1.2 Total Nitrogen Concentration in Wastewater (N_W)

Nitrogen in wastewater is comprised of nitrate, ammonia, and inorganic nitrogen. Because inorganic nitrogen is not expected to convert to nitrate, the LOSS model scenarios are based on the total nitrogen in the forms of nitrate and ammonia (which is expected to nitrify into nitrate in the top layers of the soil). LOSS model simulations are based on a concentration of 5 mg/L nitrate and 1 mg/L ammonia (N_w = 6 mg/L), which is achievable using a sequencing batch reactor (SBR). SBR oxidizes ammonia and denitrifies nitrate.

2.1.3 Soil Denitrification (*d*)

After discharge from the wastewater treatment facility, denitrification in soil reduces the nitrate concentration that reaches groundwater. The default value for *d* of 10 percent from DOH (2021) guidance was used in the LOSS model.

2.1.4 Aquifer Thickness (*b*)

Data from temporary borings and monitoring wells indicate that the aquifer thickness at Site GM1 is about 30 feet. Specifically, the bottom of the aquifer coincided with a gravelly silt at 45 feet below ground surface (bgs) in temporary boring TB-2, and the depth to groundwater was approximately 15 feet bgs in monitoring well GM1-MW1[3]. However, the DOH (2021) guidance requires that the maximum aquifer thickness used for modeling purposes is 20 feet. Therefore, a value for *b* of 20 feet was used in the LOSS model.

2.1.5 Wastewater Infiltration Facility Area (A_D)

As shown in Exhibit A.1, the wastewater infiltration facility will consist of four basins with a total area of 130,680 square feet (ft^2) (i.e., three acres total). It should be noted that the four infiltration basins are planned for 2045 system operation. Day 1 operation is anticipated to require the two eastern-most infiltration basins. Note that the infiltration basin locations shown in Exhibit A.1 have not yet been finalized.

2.1.6 Aquifer Width (W_A)

As shown in Exhibit A.1, groundwater at Site GM1 flows towards the northwest. The aquifer width, which is equivalent to the width of the infiltration facility perpendicular to the groundwater flow direction, is estimated to be 550 feet.

2.1.7 Horizontal Hydraulic Conductivity (*K*)

Hydraulic conductivity is a property of porous materials that describes how easily fluid moves through the pore space, and is correlated with soil type in the aquifer (e.g., clay, silt, sand, or gravel). A hydraulic conductivity of 88.2 feet per day was used in the LOSS model, which is the geometric mean hydraulic conductivity at Site GM-1 based on slug tests at three monitoring wells GM1-MW1 (163.3 feet per day), GM1-MW2 (113.6 feet per day), and GM1-MW3 (37 feet per day). See Attachment B of GSI (in press) for a detailed discussion of slug testing at Site GM1.

2.1.8 Hydraulic Gradient (*i*)

The hydraulic gradient (*i*) is the slope of the water table. Based on groundwater elevation contours developed from water levels measured at monitoring wells GM1-MW1, GM1-MW2, and GM1-MW3 in summer 2023, the horizontal hydraulic gradient at site GM-1 is 0.0102 feet per foot. The groundwater elevation contours are shown in Exhibit A.1.

2.1.9 Recharge (*R*)

Recharge is the amount of precipitation that infiltrates into the aquifer. Conlon et al. (2005) indicate that recharge in the study area is in the range of 26 to 30 inches per year. A value of 28 inches per year (the midrange value) was used in the LOSS model.

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[3] May 29, 2023 measurement

2.1.10 Nitrate Concentration of Upgradient (Background) Ground Water (N_B)

Monitoring Well GM1-MW1 is considered to represent background groundwater quality. A groundwater quality sample collected from monitoring well GM1-MW1 on May 28, 2023, indicates that the background concentration of nitrate in groundwater is 1.1 mg/L (GSI, 2023).

2.1.11 Wastewater Volume (V_w)

The wastewater volume used in the LOSS model is 237,500 gallons per day, which is the projected year 2045 average daily effluent generation rate.

2.2 Input Parameters for Calculation of Toluene and DEHP in Groundwater (C_{GW})

Model input parameters for using Equation A.2 to calculate the concentration of toluene and DEHP in groundwater (C_{GW}) adjacent to the infiltration basin are summarized in Table A.2. With the exception of pollutant concentrations in wastewater (C_W), input parameters are the same as in Table A.1. The concentrations of toluene and DEHP in wastewater were determined based on a sample of untreated wastewater from Mill City's existing wastewater treatment system collected on May 2, 2023. Note that the values of C_W are conservative because they represent concentrations prior to treatment.

Table A.2. LOSS Model Input Parameters for Calculation of C_{GW}.

Model Input Parameter	Symbol	Value	Units	Subsection in the Text
Toluene and DEHP Concentration in Wastewater	C_W	0.0496 (Toluene) 0.00901 (DEHP)	mg/L mg/L	Section 2.2
Aquifer Thickness	b	20	feet	Subsection 2.1.4
Wastewater Infiltration Facility Area	A_D	130,680	ft^2	Subsection 2.1.5
Aquifer Width	W_A	550	feet	Subsection 2.1.6
Horizontal Hydraulic Conductivity	K	88.2	feet/day	Subsection 2.1.7
Hydraulic Gradient	i	0.0102	feet/feet	Subsection 2.1.8
Recharge	R	28	inches/year	Subsection 2.1.9
Wastewater Volume	V_W	237,500	gpd	Subsection 2.1.11

Notes

mg/L = milligrams per liter

gpd = gallons per day

ft^2 = square feet

3. Model Output

This section provides an overview the concentration of nitrate in groundwater after dilution, N_{GW} (Section 3.1), and the concentration of other pollutants in groundwater after dilution, C_{GW} (Section 3.2).

3.1 Nitrate Concentration in Groundwater (N_{GW})

LOSS model calculations for nitrate concentration in groundwater adjacent to the infiltration basin after dilution are provided in Exhibit A.2 and Table A.3 (4.30 mg/L).

Table A.3. LOSS Model Output for Nitrate in Groundwater (N_{GW}).

Scenario	Total Nitrogen Concentration in Treated Wastewater, N_W (mg/L)	Nitrate Concentration in Groundwater, N_{GW} (mg/L)	Exhibit Reference
Nitrate	6.0	4.30	Exhibit A.2

Notes

mg/L = milligrams per liter

3.2 Toluene and DEHP Concentrations in Groundwater (C_{GW})

LOSS model calculations for concentrations of toluene and DEHP in groundwater adjacent to the infiltration basin are provided in Exhibit A.3 (toluene), Exhibit A.4 (DEHP). The output is summarized in Table A.4.

Table A.4. LOSS Model Output for Toluene, DEHP (C_{GW}).

Pollutant	Pollutant Concentration in Treated Wastewater, C_W (mg/L)	Pollutant Concentration in Groundwater, C_{GW} (mg/L)	Exhibit Reference
Toluene	0.0496	0.0371	Exhibit A.3
DEHP	0.0090	0.0067	Exhibit A.4

Notes

mg/L = milligrams per liter

DEHP = di(2-ethylhexyl)phthalate

4. Conclusions

The LOSS model results in Table A.3 and Table A.4 are appropriate to use as initial concentrations in a separate model (i.e., BIOSCREEN) to evaluate the pollutant attenuation that occurs by dispersion, sorption, and biodegradation during transport in groundwater between the edge of the infiltration basin and the downgradient property boundary.

5. References

Conlon, T. D., Wozniak, K. C., Woodcock, D., Herrera, N. B., Fisher, B. J., Morgan, D. S., Lee, K. K., and S. R. Hinkle. 2005. Ground-Water Hydrology of the Willamette Basin, Oregon. U.S. Geological Survey Scientific Investigations Report 2005-5168. 95 pp.

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GSI. In press. Phase III Subsurface Characterization to Support an Evaluation of Treated Wastewater Infiltration in Gates and Mill City, Marion and Linn Counties, Oregon.

LEGEND

- ⊙ Monitoring Well
- ○ Residential Well
- ● Temporary Boring Phase III
- ∼ Groundwater Elevation Contour, feet
- ▭ Site
- ▨ Basin
- ▨ Asphalt Pavement
- ▨ Gravel

All Other Features

- ▭ Tax Lot
- ▭ City Boundary
- ▭ County Boundary
- ∧∨ Major Road

EXHIBIT A.1

Proposed Infiltration Basin Layout

Gates-Mill City Treated
Wastewater Infiltration Evaluation

N

0 60 120 180
Feet

GSI Water Solutions, Inc.

Date: October 9, 2023
Data Sources: BLM, ESRI, ODOT, USGS, Aerial Photo 2020

Document Path: Y:\0464_Keller_Assoc\Source_Figures\020_Santiam_Canyon\Loss_Model\ExhibitA1_Proposed_Infiltration_Basin.mxd, iramos

Exhibit A.2

LOSS Model for Nitrate (Total Nitrogen Concentration = 6.0 mg/L)

Gates-Mill City Treated Wastewater Infiltration Evaluation

Washington State Department of Health

Project name:	**Gates and Mill City Infilitration Basin**
Address, city and county:	**Gates and Mill City, Marion and Linn Counties, OR**
Completed by (name and title):	**M. Kohlbecker (Principal Hydrogeologist)**
Date:	**10/7/2023**

Input Values	Factor	Units	Values	Notes
Nitrate concentration in precipitation	N_R	mg/l as N	0.24	Default
Total nitrogen concentration in wastewater	N_W	mg/l	6.0	Treatment to 6 mg/L total N
Soil denitrification	d	unitless	0.1	Default
Aquifer thickness	b	ft	20	Default or aquifer thickness if known
Drainfield area	A_D	ft^2	130,680	Total basin area
Distance from drainfield to property boundary	D_{pb}	ft	1	Measure in direction of GW flow
Aquifer width	W_A	ft	550	Perpendicular to GW flow
Aquifer hydraulic conductivity	K	ft/day	88.2	Measured from slug testing
Hydraulic gradient	i	ft/ft	0.010	Measured from groundwater elevations
Recharge	R	in/yr	28	Conlon et al. (2005)
Nitrate concentration of upgradient ground water	N_B	mg/l	1.1	GM1-MW1 groundwater sample
Wastewater volume	V_W	gpd	237,500	Design Flows

Output Values				
Groundwater nitrate value	N_{GW}	mg/l as N	4.30	Point of Compliance (POC)
Dilution Factor			1.40	

Exhibit A.3

LOSS Model for Toluene

Gates-Mill City Treated Wastewater Infiltration Evaluation

Washington State Department of Health

Project name: Gates and Mill City Infilitration Basin
Address, city and county: Gates and Mill City, Marion and Linn Counties, OR
Completed by (name and title): M. Kohlbecker (Principal Hydrogeologist)
Date: 10/7/2023

Input Values	Factor	Units	Values	Notes
Pollutant concentration in precipitation	C_R	mg/l	0	Default
Total pollutant concentration in wastewater	C_W	mg/l	0.0496	Treatment to 2 mg/L total N
Soil denitrification	d	unitless	0	Default
Aquifer thickness	b	ft	20	Default or aquifer thickness if known
Drainfield area	A_D	ft^2	130,680	Total basin area
Distance from drainfield to property boundary	D_{pb}	ft	1	Measure in direction of GW flow
Aquifer width	W_A	ft	550	Perpendicular to GW flow
Aquifer hydraulic conductivity	K	ft/day	88.2	Measured from slug testing
Hydraulic gradient	i	ft/ft	0.010	Measured from groundwater elevations
Recharge	R	in/yr	28	Conlon et al. (2005)
Pollutant concentration of upgradient ground water	C_B	mg/l	0	GM1-MW1 groundwater sample
Wastewater volume	V_W	gpd	237,500	Design Flows

Output Values				
Groundwater Concentration	C_{GW}	mg/l	0.0371	Point of Compliance (POC)
Dilution Factor			1.34	

DOH 337-070

Exhibit A.4

LOSS Model for DEHP

Gates-Mill City Treated Wastewater Infiltration Evaluation

Washington State Department of Health

Project name:	**Gates and Mill City Infilitration Basin**
Address, city and county:	**Gates and Mill City, Marion and Linn Counties, OR**
Completed by (name and title):	**M. Kohlbecker (Principal Hydrogeologist)**
Date:	**10/7/2023**

Input Values	Factor	Units	Values	Notes
Pollutant concentration in precipitation	C_R	mg/l	0	Default
Total pollutant concentration in wastewater	C_W	mg/l	0.0090	Treatment to 2 mg/L total N
Soil denitrification	d	unitless	0	Default
Aquifer thickness	b	ft	20	Default or aquifer thickness if known
Drainfield area	A_D	ft^2	130,680	Total basin area
Distance from drainfield to property boundary	D_{pb}	ft	1	Measure in direction of GW flow
Aquifer width	W_A	ft	550	Perpendicular to GW flow
Aquifer hydraulic conductivity	K	ft/day	88.2	Measured from slug testing
Hydraulic gradient	i	ft/ft	0.010	Measured from groundwater elevations
Recharge	R	in/yr	28	Conlon et al. (2005)
Pollutant concentration of upgradient ground water	C_B	mg/l	0	GM1-MW1 groundwater sample
Wastewater volume	V_W	gpd	237,500	Design Flows

Output Values				
Groundwater Concentration	C_{GW}	mg/l	0.0067	Point of Compliance (POC)
Dilution Factor			1.34	

DOH 337-070

ATTACHMENT B

Technical Documentation for BIOSCREEN Model Simulations Between the Rapid Infiltration Basin and the Downgradient Property Boundary

ATTACHMENT B

Application of BIOSCREEN to Evaluate Dispersion, Sorption, and Biodegradation of Pollutants in Groundwater Between an Infiltration Basin and the Downgradient Property Boundary, Mill City, Oregon

1. Background

BIOSCREEN is an analytical model developed by the U.S. Environmental Protection Agency (EPA) to simulate pollutant fate and transport in saturated porous media (EPA, 1996). The model simulates pollutant attenuation by dispersion, biodegradation, and sorption. This section provides an overview of the governing equations used by BIOSCREEN to simulate pollutant fate and transport (Section 1.1) and the purpose of the model simulations (Section 1.2).

1.1 Governing Equation Used by BIOSCREEN

Pollutant attenuation by dispersion, degradation, and sorption can be modeled with the advection dispersion equation (e.g., Bear, 1972). BIOSCREEN uses the Domenico (1987) solution to the three-dimensional advection dispersion equation with first-order decay of the source concentration into the solution. The Domenico (1987) solution for transport in three dimensions with first-order source decay is (EPA, pg. 9, 1996):

$$C\left(x, y, z, t\right) = \frac{C_0}{8} e^{-k_s t} f_x f_y f_t \tag{B.1}$$

Where:

$$f_x = \exp\left[\frac{x\left(1-\sqrt{1+\frac{4\lambda\alpha_x}{v}}\right)}{2\alpha_x}\right] erfc\left[\frac{x - vt\sqrt{\frac{1+4\lambda\alpha_x}{v}}}{2\sqrt{\alpha_x vt}}\right] \tag{B.2}$$

$$f_y = erf\left[\frac{\left(y+\frac{Y}{2}\right)}{2\sqrt{\alpha_y x}}\right] - erf\left[\frac{y-\left(\frac{Y}{2}\right)}{2\sqrt{\alpha_y x}}\right] \tag{B.3}$$

$$f_z = erf\left[\frac{(Z)}{2\sqrt{\alpha_z x}}\right] - erf\left[\frac{-Z}{2\sqrt{\alpha_z x}}\right] \tag{B.4}$$

In Equation (B.1) through Equation (B.4), *erf* is the error function, and *erfc* is the complimentary error function. These functions model pollutant transport according to a standard normal (Gaussian) probability density function. The variables in Equation (B.1) through Equation (B.4) are[1]:

> $C(x,y,z,t)$ is the dissolved concentration (M/L^3) at the spatial coordinates x, y, and z and time t (note that x is in the direction of groundwater flow, y is the cross-gradient direction, and z is the vertical direction),
>
> C_0 is the dissolved concentration in the source zone at time = 0 (M/L^3),
>
> α_L is dispersivity in the x-direction (longitudinal dispersivity) (L),
>
> α_T is dispersivity in the y-direction (transverse dispersivity) (L),
>
> α_V is dispersivity in the z-direction (vertical dispersivity) (L),
>
> λ is the first-order decay constant for dissolved pollutants (T^{-1}),
>
> v is groundwater velocity (L/T),
>
> Y is the source width (L),
>
> Z is the source thickness (L), and
>
> t is time (T).

Equation (B.1) assumes that the initial pollutant concentration in the source is $C = C_0$, and the initial pollutant concentration in groundwater is $C = 0$. Note that this condition is not met for nitrate, which is present in the aquifer at a concentration of 1.1 milligrams per liter (mg/L). Therefore, for nitrate, the estimates of pollutant concentration should be considered an approximation.

1.2 Purpose

The purpose of the BIOSCREEN modeling summarized in this attachment is to predict pollutant concentrations in groundwater at the downgradient property boundary of Site GM1 (see Exhibit B.1). The simulations are based on the pollutant attenuation by dispersion, sorption, and biodegradation that is expected to occur during transport from the downgradient edge of the infiltration basin to the downgradient property boundary.

2. Model Input Parameters

Model input parameters are summarized in Table B.1. The following subsections describe the methods that were used to develop the model input parameters. Model input parameters were developed based on

---

[1] For units, “M” indicates mass, “L” indicates length, and “T” indicates time.

scientific literature and site-specific data collected during the Phase II and Phase III Subsurface Characterizations at Site GM1 (GSI, 2023; GSI, in press).

Table B.1. BIOSCREEN Model Input Parameters.

Model Input Parameter	Symbol	Value	Units	Subsection in the Text
Seepage Velocity	v_s	1,368	feet/year	Subsection 2.1
Dispersivity	α_L α_T α_V	11.8 (Longitudinal) 3.9 (Transverse) 0.59 (Vertical)	feet feet feet	Subsection 2.2
Retardation Factor	R	1.0 (Nitrate) 635 (DEHP) 1.70 (Toluene)	dimensionless dimensionless dimensionless	Subsection 2.3
Half Life	h	∞ (Nitrate) 3.5 (DEHP) 4.67 (Toluene)	days days days	Subsection 2.4
Initial Concentration	C_0	4.30 (Nitrate) 0.0371 (Toluene) 0.0067 (DEHP)	mg/L mg/L mg/L	Subsection 2.5
Source Width and Thickness	W_s T_s	550 20	feet feet	Subsection 2.6
Model Width and Length	W_m L_m	250 1,000	feet feet	Subsection 2.7
Simulation Time	t	10,000	years	Subsection 2.8
Source Type	--	Constant Concentration	--	Subsection 2.9

Notes

mg/L = milligrams per liter

2.1 Seepage Velocity (v_s)

Seepage velocity is calculated by the following equation:

$$v_s = \frac{K}{n_e} \nabla h \tag{B.5}$$

Where:

v_s is the seepage velocity (feet per day)

K is the horizontal hydraulic conductivity (feet per day)

η_e is effective porosity (dimensionless)

∇h is the horizontal hydraulic gradient (feet per foot)

Table B.2 summarizes the values used to calculate seepage velocity for input to the BIOSCREEN model. Because BIOSCREEN requires that seepage velocity be input in units of feet per year, the 3.75 feet per day in Table B.2 was converted to 1,368 feet per year when it was input into the model.

Table B.2. Seepage Velocity Calculation.

Model Input Parameter	Symbol	Value	Units	Notes
Horizontal Hydraulic Conductivity	K	88.2	feet/day	Geometric mean from slug tests at GM1-MW1, GM1-MW2 and GM1-MW3
Effective Porosity	η_e	0.24	--	Specific yield for a "Gravel, medium" from Heath (1983)
Horizontal Hydraulic Gradient	∇h	0.0102 [1]	feet/foot	Groundwater elevation measurements at GM1-MW1, GM1-MW2 and GM1-MW3 in summer 2023
Seepage Velocity	v_s	3.75	feet/day	Equation (B.5)

Notes

(1) This horizontal hydraulic gradient was measured in summer of 2023 and, therefore, represents ambient aquifer conditions (i.e., no mounding due to infiltration). According to groundwater mounding modeling with MOUNDSOLV, the horizontal hydraulic gradient will not significantly change during infiltration at the scale of the GM-1 site (although groundwater levels will increase).

2.2 Dispersivity (α_L, α_T, α_V)

Dispersivity is a three-dimensional, scale-dependent variable that describes the amount of pollutant spreading (i.e., dispersion) that occurs during pollutant transport. Dispersivity in the direction of flow is called longitudinal dispersivity. Longitudinal Dispersivity was calculated using the Xu and Eckstein (1995) equation:

$$\alpha_L = 0.83\left[log\left(L_p\right)\right]^{2.414} \tag{B.6}$$

Where:

α_L is longitudinal dispersivity (meters)

L_p is the length of the pollutant plume (meters)

As shown in Exhibit B.1, the shortest distance between an infiltration basin and the downgradient property boundary along the groundwater flow path is about 225 feet. Using the shortest distance is conservative because it will result in the smallest value for dispersivity and, therefore, least amount of dispersion. Based on a pollutant plume length of 68.6 meters (225 feet), the longitudinal dispersivity is 3.6 meters (11.8 feet) according to Equation (B.6).

According to ASTM (1995), transverse dispersivity can be assumed to be 33% of longitudinal dispersivity (i.e., 1.2 meters or 3.9 feet), and vertical dispersivity can be assumed to be 5% of longitudinal dispersivity (i.e., 0.18 meters or 0.59 feet)

2.3 Retardation

Pollutants in porous media partition between the liquid, solid, and gas phases. This modeling evaluation conservatively assumes that pollutants only partition between the liquid phase (i.e., aqueous or dissolved phase) and solid phase (i.e., adhere to soil particles). Partitioning between the liquid and solid phases is called sorption, which is caused primarily by van der Waals forces and electrostatic forces between the contaminant molecule and the ions of the soil particle surface. Some pollutants partition preferentially into the aqueous phase, while other pollutants preferentially partition onto the soil particles.

Due to sorption, a pollutant velocity may be slower than groundwater velocity. A pollutant's velocity relative to groundwater is quantified by the retardation factor (e.g., Freeze and Cherry, 1979):

$$R = 1 + \frac{(\rho_b)(K_{oc})(f_{oc})}{\eta} \qquad \text{(B.7)}$$

Where:

R is the retardation factor (dimensionless)

ρ_b is soil bulk density (kilograms per liter)

K_{oc} is the organic carbon-water partitioning coefficient (liters per kilogram)

f_{oc} is the fraction organic carbon in soil (dimensionless)

η is total porosity (dimensionless)

Note that a retardation factor of 2 indicates that a pollutant travels half the speed of groundwater. Table B.3 summarizes the values that were used to calculate retardation factor for the pollutants modeled with BIOSCREEN.

Table B.3. Retardation Factor Calculation.

Model Input Parameter	Units	Nitrate	DEHP	Toluene
Soil Bulk Density (ρ_b) [1]	kg/L	1.66	1.66	1.66
Organic Carbon-Water Partitioning Coefficient (K_{oc}) [2]	L/kg	0.0	149,000	165
Fraction Organic Carbon (f_{oc}) [3]	--	0.001	0.001	0.001
Total Porosity (η) [4]	--	0.39	0.39	0.39
Retardation Factor	--	1.0	635	1.70

Notes

(1) Average dry bulk density based on soil samples collected from the monitoring well GM1-MW1 boring. See Attachment B of the Phase II Subsurface Characterization (GSI, 2023).

(2) The K_{oc} for nitrate was set to 0.0 L/kg to simulate transport in the aqueous phase only (i.e., not sorption to soil). Koc for DEHP and toluene is based on a literature review (see Appendix A).

(3) Recommended default value from ASTM (1995). Soil analysis pending.

(4) Average total porosity based on soil samples collected from the monitoring well GM1-MW1 boring. See Attachment B of the Phase II Subsurface Characterization (GSI, 2023).

kg/L = kilograms per liter

L/kg = liters per kilogram

DEHP = di(2-ethylhexyl)phthalate

Note that the retardation factors for nitrate is 1.0, indicating that these pollutants do not sorb to soil and travel at the same velocity as groundwater. The retardation factor for toluene indicates that it travels at about half the velocity as groundwater, and the retardation factor for di(2-ethylhexyl)phthalate (DEHP) indicates that it travels at 1/635th the velocity of groundwater.

2.4 Half Life (h) and First Order Decay Constant (λ)

Pollutants degrade by photolysis (exposure to sunlight), hydrolysis (interaction with water), and biodegradation (degradation by microbes). We conservatively only include the degradation pathway of biodegradation in the BIOSCREEN modeling analysis. GSI conducted an extensive literature review of biodegradation rates for DEHP and toluene. Nitrate does not degrade under aerobic conditions and, therefore, biodegradation was not simulated in the BIOSCREEN model for these pollutants.

Biodegradation is described by a half life, which is the time required for a pollutant concentration to decline by 50%, and first order decay constant, which is calculated as the natural log of 2 divided by the half life. Because half life and decay constant depend on oxygen levels (i.e., whether the subsurface is aerobic or anaerobic), only aerobic-based half lives and decay constants were used. The half lives and decay constants used in the fate and transport evaluation are summarized in Table B.4. Because BIOSCREEN requires that half life and decay constant be input in units of years, the values in Table B.4 were converted to from days to years for input into the model.

Table B.4. Biodegradation Rates.

Scenario	Half Life	First Order Decay Constant [1]	Notes
Nitrate	Infinite	NA	No degradation
DEHP	3.5 days	0.198 days $^{-1}$	See Appendix A for tabulation of half lives
Toluene	4.67 days	0.149 days $^{-1}$	See Appendix A for tabulation of half lives

Notes

(1) Calculated by the following equation: $\lambda = \ln(2)/h$

DEHP = di(2-ethylhexyl)phthalate

2.5 Initial Pollutant Concentration (C_0)

The initial nitrate concentration in BIOSCREEN was calculated by the Large Onsite Septic System (LOSS) model (see Attachment A for a detailed discussion) based on the scenario that was run as summarized in Table B.5.

Table B.5. Initial Pollutant Concentrations.

Scenario	Treatment	Total Nitrogen in Wastewater	Nitrate in Groundwater
Nitrate	Sequencing Batch Reactor (SBR)	6 mg/L	4.30 mg/L

Notes

mg/L = milligrams per liter

Initial concentrations in BIOSCREEN for toluene (0.0371 mg/L), and DEHP (0.0067 mg/L were also calculated using the LOSS model (see Attachment A for a detailed discussion).

2.6 Source Width (W_s) and Thickness (T_s)

The width of the source, W_s, is the infiltration basin width perpendicular to the direction of groundwater flow. As shown in Exhibit B.1, groundwater flows towards the northwest, and the width of the infiltration basins perpendicular to the groundwater flow direction is about 550 feet. Source thickness in the saturated zone was selected to be 20 feet to align the BIOSCREEN model with the LOSS model. Specifically, the LOSS model guidance (DOH, 2021) assumes that infiltrating wastewater will mix with the upper 20 feet of the saturated zone at a maximum.

2.7 Model Width (W_m) and Model Length (L_m)

The width of the area being modeled (W_m) should be larger than the pollutant plume, and was selected to be 1,000 feet in the BIOSCREEN model. The length of the area being modeled (L_m) is equivalent to the length over which concentrations are to be calculated, and was selected to be 250 feet in the BIOSCREEN model.

This model length value output pollutant concentrations at 225 feet from the source (i.e., the shortest distance between the downgradient edge of an infiltration basin and the downgradient property boundary).

2.8 Simulation Time (*t*)

Simulation time (*t*) is the time period over which transport occurs. A simulation time of 10,000 years was used for the BIOSCREEN simulations. It was determined empirically that the pollutants plumes reach a steady state condition by this time.

2.9 Source Type

Pollutant fate and transport simulations can be conducted using several different source types. For example, a source can be simulated as continuous with constant concentration, continuous with a concentration that decays over time, a pulse of known concentration, etc. The infiltration of treated wastewater was conservatively simulated as a continuous source with constant concentration in the BIOSCREEN model by entering a “Source Half Life” of “Infinite” in the model. It should be noted that this is a conservative assumption because infiltration basins will not be operated continuously (specifically, every twelve days, a basin will infiltrate treated wastewater for two days).

3. Model Output

This section summarizes output from the BIOSCREEN model (i.e., pollutant concentration at the downgradient property boundary assuming a separation of 225 feet between the property boundary and closest infiltration basin) for nitrate (Section 3.1) and for toluene and DEHP (Section 3.2).

3.1 Nitrate

Nitrate concentration at the downgradient property boundary is summarized in Table B.6. The BIOSCREEN input and output are provided in Exhibit B.2.

Table B.6. Nitrate Concentration at the Downgradient Property Boundary.

Pollutant	Total Nitrogen Concentration in Treated Wastewater, N_W	Nitrate Concentration in Groundwater at the Basin Edge (from the LOSS Model), N_{GW}	Nitrate Concentration at the Downgradient Property Boundary (from BIOSCREEN)
Nitrate	6.0 mg/L	4.30 mg/L	3.36 mg/L to 4.30 mg/L

Notes

mg/L = milligrams per liter

As discussed in the introduction section, the nitrate concentrations output from the BIOSCREEN model should be considered an approximation because the equation on which BIOSCREEN is based assume, in this case, mixing between a nitrate source concentration of 4.30 mg/L and a groundwater nitrate concentration of 0.0 mg/L. In reality, the groundwater nitrate concentration is 1.1 mg/L. As a result, the nitrate concentration at the downgradient property boundary is listed in Table B.6 as falling somewhere between the concentration predicted by the LOSS model (4.30 mg/L) and the concentration predicted by BIOSCREEN based on mixing with zero-nitrate groundwater (3.36 mg/L). Numerical modeling could be used to determine where in the range of 3.36 mg/L to 4.30 mg/L the nitrate concentration would fall.

3.2 Toluene and DEHP

Predicted concentrations of toluene and DEHP at the downgradient property boundary of Site GM1 are summarized in Table B.7. The BIOSCREEN input and output are provided in Exhibit B.3 (toluene), and Exhibit B.4 (DEHP). Values reported as “< X” in Table B.7 indicate that the predicted concentration is less than the detection limit for the pollutant, with the value of “X” indicating the detection limit. Detection limits were selected based on laboratory detection limits for groundwater samples collected during the Phase II Subsurface Characterization (GSI, 2023).

Table B.7. Toluene and DEHP Concentrations at the Downgradient Property Boundary.

Scenario	Concentration in Treated Wastewater, C_W	Concentration in Groundwater at the Basin Edge (from the LOSS Model), C_{GW}	Concentration at the Downgradient Property Boundary (from BIOSCREEN)
Toluene	0.0496 mg/L	0.0371 mg/L	< 0.0005 mg/L
DEHP	0.0090 mg/L	0.0067 mg/L	< 0.0001 mg/L

Notes

mg/L = milligrams per liter

DEHP = di(2-ethylhexyl)phthalate

4. Conclusions

Based on modeling of dilution, dispersion, biodegradation, and sorption described in Attachment A (LOSS model) and Attachment B (BIOSCREEN model), we make the following preliminary conclusions assuming basin configurations shown in Exhibit B.1:

- Toluene (see Exhibit B.3 plot) and DEHP (see Exhibit B.4 plot) attenuate to below their respective detection limit within 100 feet and 25 feet of the infiltration basin, respectively. We recommend a 50 percent factor of safety for the modeling simulations, and siting infiltration basins no closer than 150 feet from the downgradient property boundary.
- The estimated nitrate concentration at the downgradient property boundary is between 3.36 mg/L and 4.30 mg/L.

5. References

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LEGEND

- ⊙ Monitoring Well
- ○ Residential Well
- ● Temporary Boring Phase III
- ~ Groundwater Elevation Contour, feet
- ▭ Site
- ▨ Basin
- ▨ Asphalt Pavement
- ▨ Gravel

All Other Features

- ▭ Tax Lot
- ▭ City Boundary
- ▭ County Boundary
- ∧ Major Road

EXHIBIT B.1

Proposed Infiltration Basin Layout

Gates-Mill City Treated
Wastewater Infiltration Evaluation

N

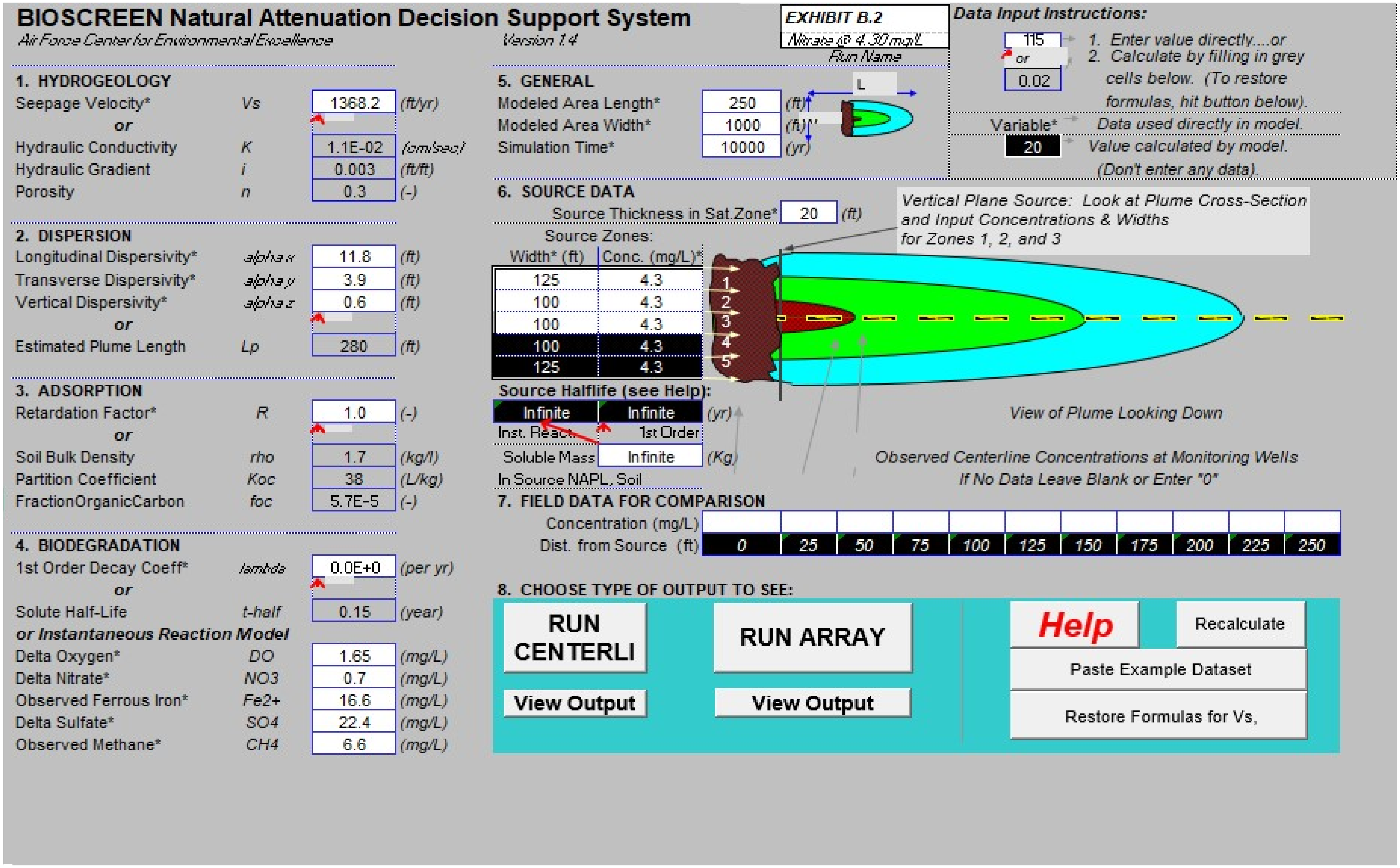
0 60 120 180
Feet

Date: October 9, 2023
Data Sources: BLM, ESRI, ODOT, USGS, Aerial Photo 2020

Document Path: Y:\0464_Keller_Assoc\Source_Figures\020_Santiam_Canyon\Bioscreen\ExhibitB1_Proposed_Infiltration_Basin.mxd, iramos

EXHIBIT B.2

BIOSCREEN Input for Nitrate (6.0 mg/L Total Nitrogen in Wastewater)



BIOSCREEN Natural Attenuation Decision Support System
Air Force Center for Environmental Excellence
Version 1.4

EXHIBIT B.2
Nitrate @ 4.30 mg/L
Run Name

Data Input Instructions:

115 or 0.02	1. Enter value directly....or 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
Variable*	Data used directly in model.
20	Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	1368.2	(ft/yr)
or			
Hydraulic Conductivity	K	1.1E-02	(cm/sec)
Hydraulic Gradient	i	0.003	(ft/ft)
Porosity	n	0.3	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	11.8	(ft)
Transverse Dispersivity*	alpha y	3.9	(ft)
Vertical Dispersivity*	alpha z	0.6	(ft)
or			
Estimated Plume Length	Lp	280	(ft)

3. ADSORPTION

Retardation Factor*	R	1.0	(-)
or			
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	38	(L/kg)
FractionOrganicCarbon	foc	5.7E-5	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	0.0E+0	(per yr)
or			
Solute Half-Life	t-half	0.15	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	1.65	(mg/L)
Delta Nitrate*	NO3	0.7	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	22.4	(mg/L)
Observed Methane*	CH4	6.6	(mg/L)

5. GENERAL

Modeled Area Length*	250	(ft)
Modeled Area Width*	1000	(ft)
Simulation Time*	10000	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 20 (ft)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones:

Width* (ft)	Conc. (mg/L)*
125	4.3
100	4.3
100	4.3
100	4.3
125	4.3

Source Halflife (see Help):

Infinite	Infinite	(yr)
Inst. React.	1st Order	
Soluble Mass	Infinite	(Kg)
In Source NAPL, Soil		

View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

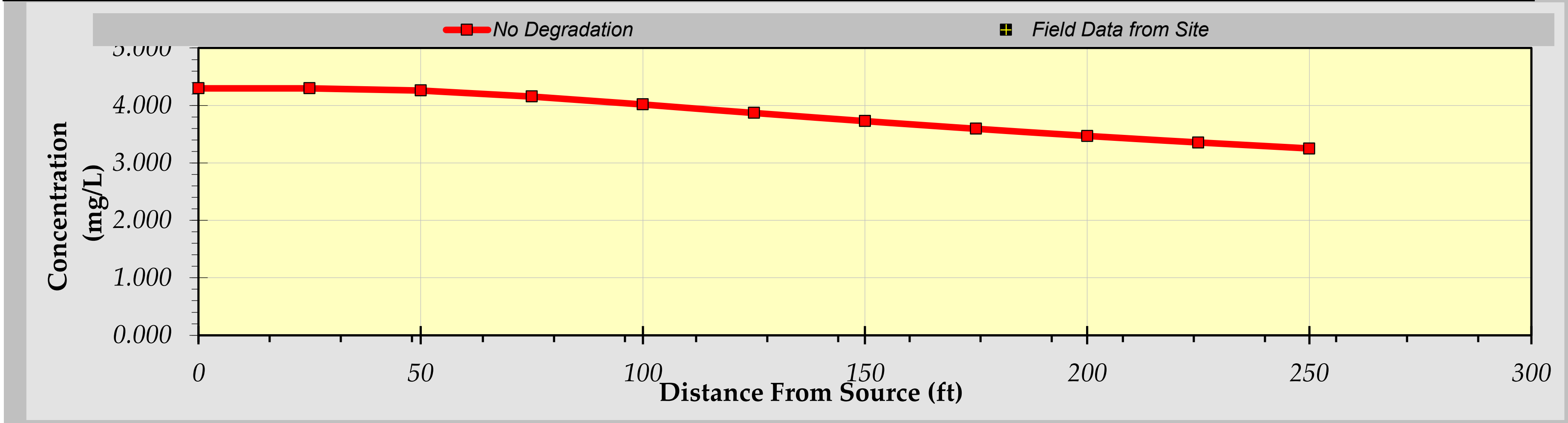
Concentration (mg/L)											
Dist. from Source (ft)	0	25	50	75	100	125	150	175	200	225	250

8. CHOOSE TYPE OF OUTPUT TO SEE:

EXHIBIT B.2

BIOSCREEN Results for Nitrate 6.0 mg/L Total Nitrogen in Wastewater)

	Distance from Source (ft)										
TYPE OF MODEL	0	25	50	75	100	125	150	175	200	225	250
No Degradation	4.300	4.299	4.260	4.156	4.018	3.872	3.729	3.595	3.470	3.355	3.250
Field Data from Site											



Calculate Animation

Time:

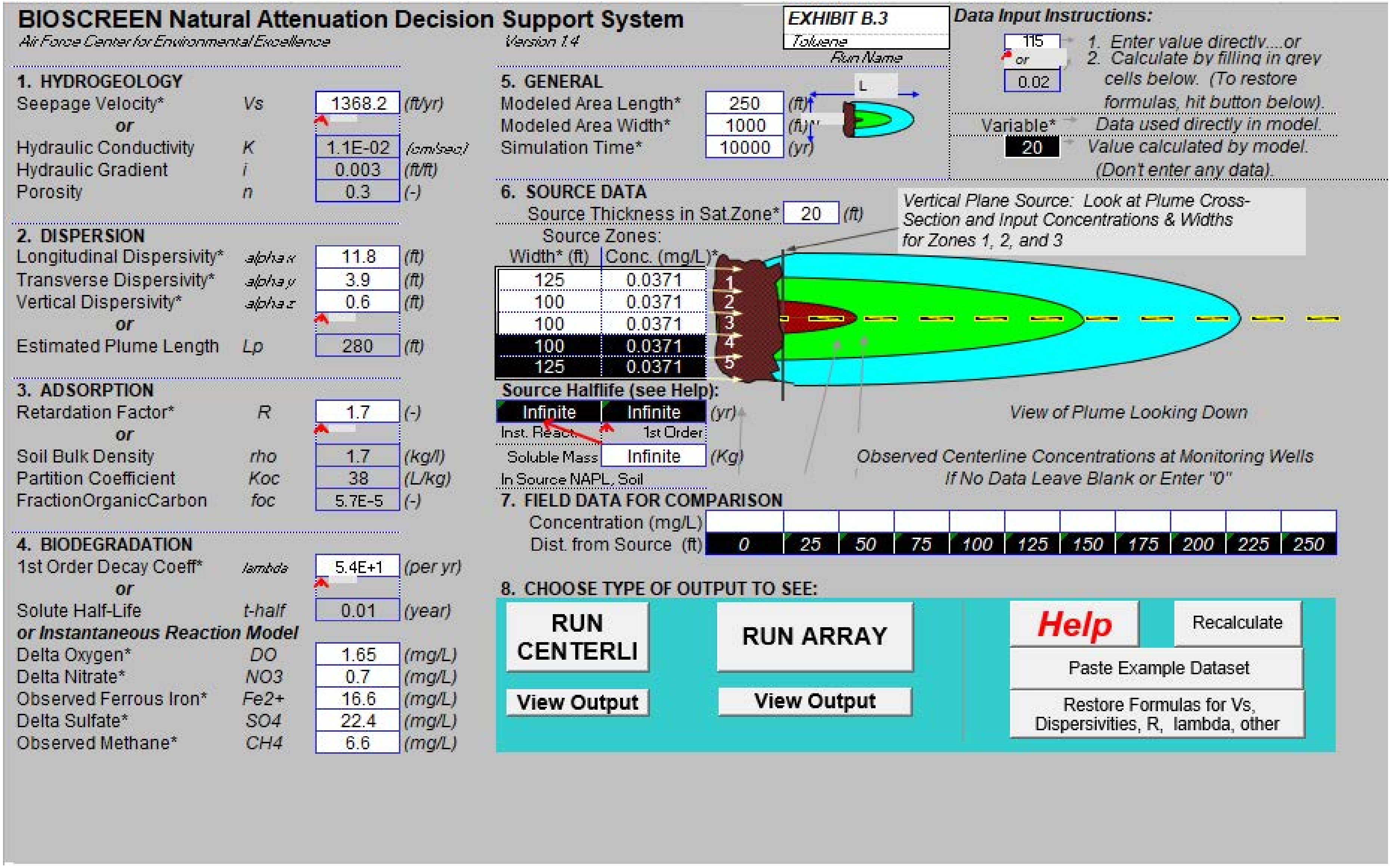
10,000 Years

Return to

Recalculate This

EXHIBIT B.3

BIOSCREEN Input for Toluene



BIOSCREEN Natural Attenuation Decision Support System

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Version 1.4

EXHIBIT B.3
Toluene
Run Name

Data Input Instructions:

1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* Data used directly in model.

20 Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	1368.2	(ft/yr)
or			
Hydraulic Conductivity	K	1.1E-02	(cm/sec)
Hydraulic Gradient	i	0.003	(ft/ft)
Porosity	n	0.3	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	11.8	(ft)
Transverse Dispersivity*	alpha y	3.9	(ft)
Vertical Dispersivity*	alpha z	0.6	(ft)
or			
Estimated Plume Length	Lp	280	(ft)

3. ADSORPTION

Retardation Factor*	R	1.7	(-)
or			
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	38	(L/kg)
FractionOrganicCarbon	foc	5.7E-5	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	5.4E+1	(per yr)
or			
Solute Half-Life	t-half	0.01	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	1.65	(mg/L)
Delta Nitrate*	NO3	0.7	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	22.4	(mg/L)
Observed Methane*	CH4	6.6	(mg/L)

5. GENERAL

Modeled Area Length*	250	(ft)
Modeled Area Width*	1000	(ft)
Simulation Time*	10000	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 20 (ft)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones:

Width* (ft)	Conc. (mg/L)*
125	0.0371
100	0.0371
100	0.0371
100	0.0371
125	0.0371

Source Halflife (see Help):

Inst. React.	1st Order	
Infinite	Infinite	(yr)

Soluble Mass In Source NAPL, Soil: Infinite (Kg)

View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

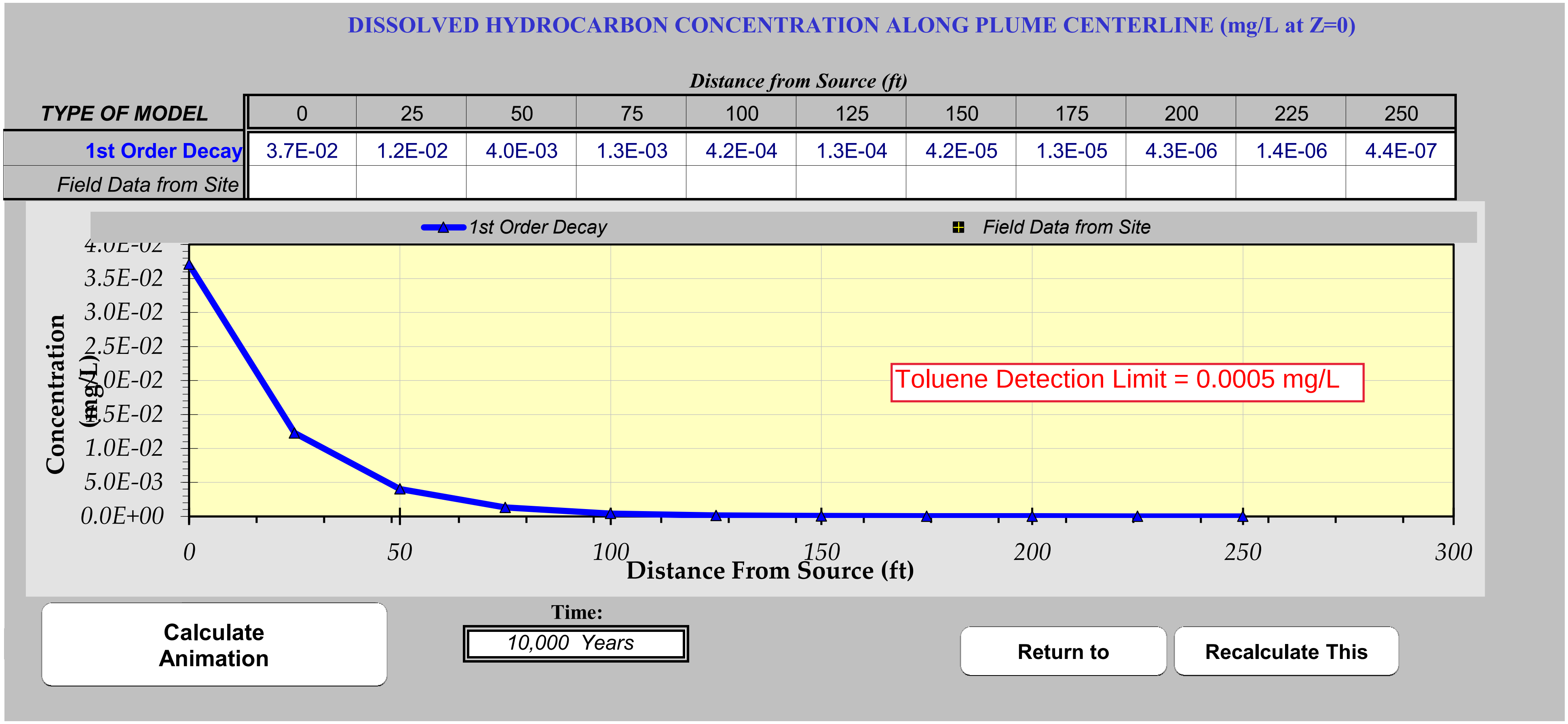
7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)	0	25	50	75	100	125	150	175	200	225	250

8. CHOOSE TYPE OF OUTPUT TO SEE:

EXHIBIT B.3

BIOSCREEN Results for Toluene



DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

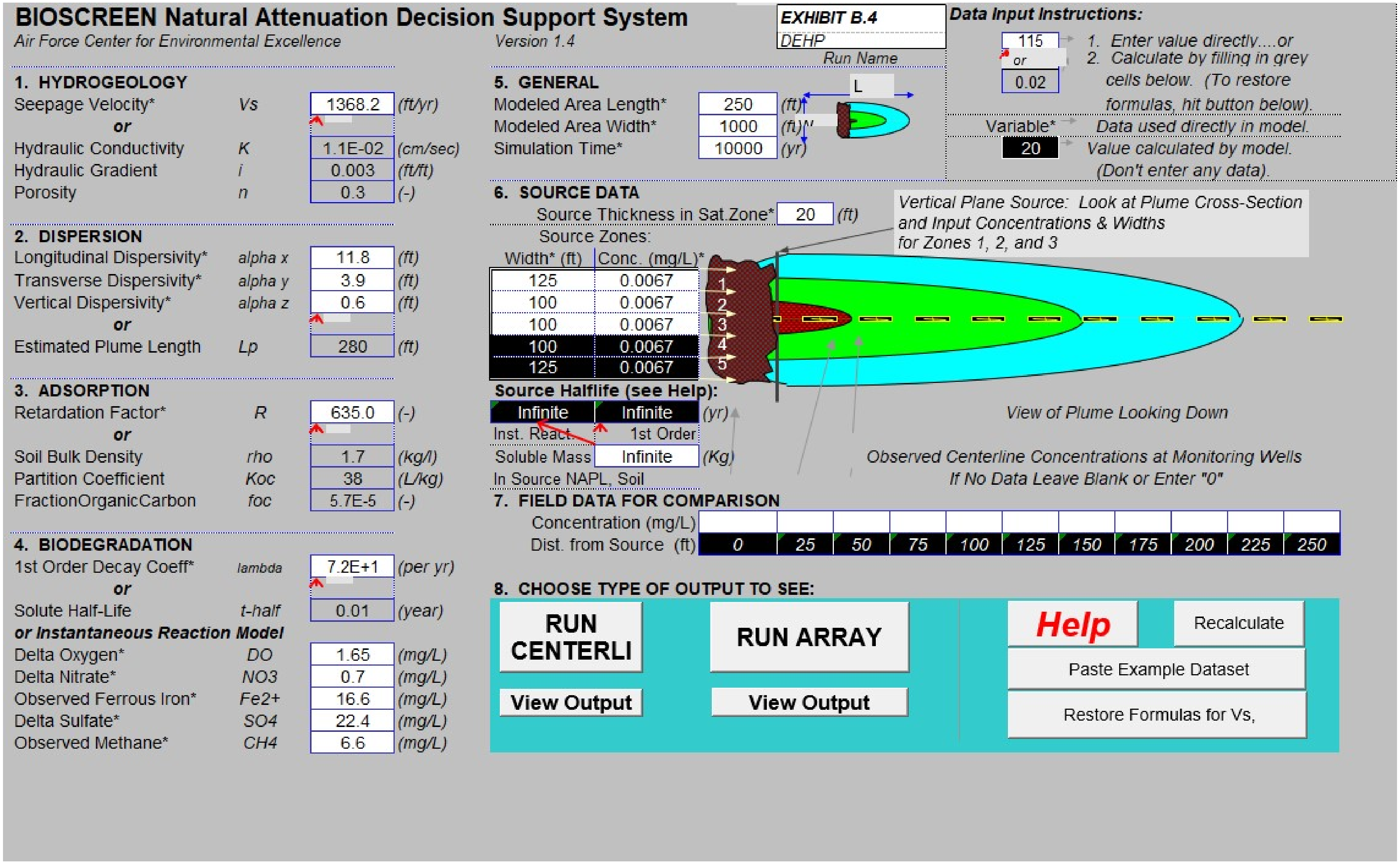
	Distance from Source (ft)										
TYPE OF MODEL	0	25	50	75	100	125	150	175	200	225	250
1st Order Decay	3.7E-02	1.2E-02	4.0E-03	1.3E-03	4.2E-04	1.3E-04	4.2E-05	1.3E-05	4.3E-06	1.4E-06	4.4E-07
Field Data from Site											

Toluene Detection Limit = 0.0005 mg/L

Time: 10,000 Years

EXHIBIT B.4

BIOSCREEN Input for DEHP



BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence

Version 1.4

EXHIBIT B.4
DEHP
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or → 2. Calculate by filling in grey cells below. (To restore
0.02 formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model.
(Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	1368.2	(ft/yr)
or			
Hydraulic Conductivity	K	1.1E-02	(cm/sec)
Hydraulic Gradient	i	0.003	(ft/ft)
Porosity	n	0.3	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	11.8	(ft)
Transverse Dispersivity*	alpha y	3.9	(ft)
Vertical Dispersivity*	alpha z	0.6	(ft)
or			
Estimated Plume Length	Lp	280	(ft)

3. ADSORPTION

Retardation Factor*	R	635.0	(-)
or			
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	38	(L/kg)
FractionOrganicCarbon	foc	5.7E-5	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	7.2E+1	(per yr)
or			
Solute Half-Life	t-half	0.01	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	1.65	(mg/L)
Delta Nitrate*	NO3	0.7	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	22.4	(mg/L)
Observed Methane*	CH4	6.6	(mg/L)

5. GENERAL

Modeled Area Length*	250	(ft)
Modeled Area Width*	1000	(ft)
Simulation Time*	10000	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 20 (ft)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones:

Width* (ft)	Conc. (mg/L)*	
125	0.0067	1
100	0.0067	2
100	0.0067	3
100	0.0067	4
125	0.0067	5

Source Halflife (see Help):

Infinite	Infinite	(yr)
Inst. React.	1st Order	
Soluble Mass	Infinite	(Kg)
In Source NAPL, Soil		

View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

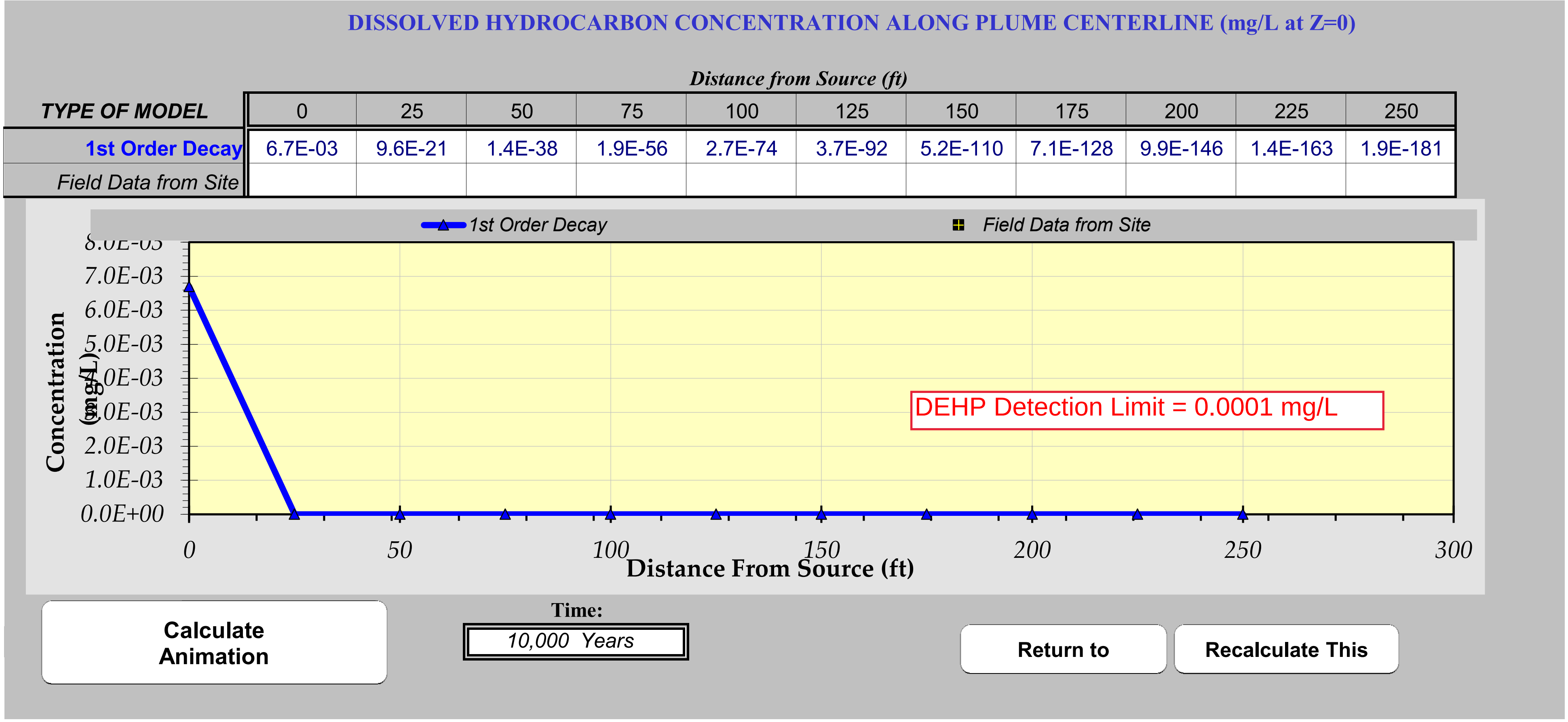
7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)	0	25	50	75	100	125	150	175	200	225	250

8. CHOOSE TYPE OF OUTPUT TO SEE:

EXHIBIT B.4

BIOSCREEN Results for DEHP



DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	25	50	75	100	125	150	175	200	225	250
1st Order Decay	6.7E-03	9.6E-21	1.4E-38	1.9E-56	2.7E-74	3.7E-92	5.2E-110	7.1E-128	9.9E-146	1.4E-163	1.9E-181
Field Data from Site											

DEHP Detection Limit = 0.0001 mg/L

Time: *10,000 Years*

Appendix A.1

Half Life and K_{oc} Values for DEHP

Site GM1 BIOSCREEN Pollutant Fate and Transport Evaluation

Geomean	3.50	
Media	Half Life (days)	Full Citation
N/A	10	Howard, P. H. (Ed.). (1991). *Handbook of environmental degradation rates* . CRC Press.
soil	0.83	Zhao, H. M., Du, H., Lin, J., Chen, X. B., Li, Y. W., Li, H., ... & Wong, M. H. (2016). Complete degradation of the endocrine disruptor di-(2-ethylhexyl) phthalate by a novel Agromyces sp. MT-O strain and its application to bioremediation of contaminated soil. Science of the total Environment, 562, 170-178.
soil	2.92	Zhao, H. M., Du, H., Lin, J., Chen, X. B., Li, Y. W., Li, H., ... & Wong, M. H. (2016). Complete degradation of the endocrine disruptor di-(2-ethylhexyl) phthalate by a novel Agromyces sp. MT-O strain and its application to bioremediation of contaminated soil. Science of the total Environment, 562, 170-178.
surface water	50	Versar, Inc. (2010). Review of Exposure Data and Assessments for Select Dialkyl Ortho-phthalates. Prepared for the US Consumer Product Safety Commission. Feb 24
soil	300	Versar, Inc. (2010). Review of Exposure Data and Assessments for Select Dialkyl Ortho-phthalates. Prepared for the US Consumer Product Safety Commission. Feb 24
soils/sludge (aerobic)	0.42	World Health Organization. (1996). Guidelines for drinking-water quality, 2nd ed. Vol. 2. Health criteria and other supporting information. Geneva.
soils/sludge (aerobic)	1.46	World Health Organization. (1996). Guidelines for drinking-water quality, 2nd ed. Vol. 2. Health criteria and other supporting information. Geneva.
soil	0.54	Wang, P., Gao, J., Zhao, Y., Zhang, M., & Zhou, S. (2021). Biodegradability of di-(2-ethylhexyl) phthalate by a newly isolated bacterium Achromobacter sp. RX. Science of The Total Environment, 755(Part 1), 142476. https://doi.org/10.1016/j.scitotenv.2020.142476
soil	0.67	Wang, P., Gao, J., Zhao, Y., Zhang, M., & Zhou, S. (2021). Biodegradability of di-(2-ethylhexyl) phthalate by a newly isolated bacterium Achromobacter sp. RX. Science of The Total Environment, 755(Part 1), 142476. https://doi.org/10.1016/j.scitotenv.2020.142476

Geomean	5.13	1.49E+05	
Media	logKoc	Koc (L/kg)	Full Citation
groundwater	4.1	1.22E+04	GSI. (2020). Groundwater Protectiveness Demonstration for Underground Injection Control Devices, City of Scappoose, Oregon. Prepared by GSI Water Solutions, Inc. (GSI), for City of Scappoose.
groundwater	5.2	1.58E+05	European Chemicals Agency. (2014, December 11). Bis(2-ethylhexyl) phthalate (DEHP): Report.
soil	4	1.00E+04	United States Environmental Protection Agency. (1995). National Primary Drinking Water Regulations Phthalate, di(2-ethylhexyl) (Report No. EPA 811-F-95-003 y-T).
soil	5	1.00E+05	United States Environmental Protection Agency. (1995). National Primary Drinking Water Regulations Phthalate, di(2-ethylhexyl) (Report No. EPA 811-F-95-003 y-T).
soil	5.17	1.48E+05	Krop, H. B., et al. (2001). *Rev Environ Contam Toxicol, 169* , 1-122.
soil	6.23	1.70E+06	Krop, H. B., et al. (2001). *Rev Environ Contam Toxicol, 169* , 1-122.
soil	5.72	5.25E+05	Thomsen, M., et al. (1999). *Chemosphere, 38* , 2613-24.
soil	4.94	8.71E+04	Schuurmann, G., et al. (2006). *Environ Sci Technol, 40* , 7005-11.
soil	5.68	4.79E+05	Lu, C. (2009). *Bull Environ Contam Toxicol, 83* , 168-73.
soil	5.72	5.25E+05	Lu, C. (2009). *Bull Environ Contam Toxicol, 83* , 168-73.

Appendix A.2

Half Life and K_{oc} Values for Toluene

Site GM1 BIOSCREEN Pollutant Fate and Transport Evaluation

Geomean	4.67		Geomean	2.21	165	
Site Name	Half Life (days)	Full Citation	Media	logKoc	Koc (L/kg)	Full Citation
Canada Forces Base, Borden, ON	22	Barker J.F., G.C. Patrick, and D. Major. 1987. Natural attenuation of aromatic hydrocarbons in a shallow sand aquifer. Ground Water Monit. Rev. 7: 64-72.	Groundwater	2.78	603	Poulson, S. R., Drever, J. I., Colberg, P. J. S. (1997). Estimation of Koc values for deuterated benzene, toluene, and ethylbenzene, and application to ground water contamination studies. Chemosphere, 35(10), 2215-2224. https://doi.org/10.1016/S0045-6535(97)00300-7.
Canada Forces Base, Borden, ON	19	Barker J.F., G.C. Patrick, and D. Major. 1987. Natural attenuation of aromatic hydrocarbons in a shallow sand aquifer. Ground Water Monit. Rev. 7: 64-72.	Soil	2.17	148	Mallon, B. J. (1989). Transport and environmental chemistry of selected C sub 1 and C sub 2 chlorinated compounds and petroleum hydrocarbons in soils and ground water (No. UCRL-53952). Lawrence Livermore National Lab.(LLNL), Livermore, CA (United States).
Canada Forces Base, Borden, ON	15	American Petroleum Institute, 1994. Transport and fate of dissolved methanol, methyl-tertiary-butyl-ether, and monoaromatic hydrocarbons in a shallow sand aquifer. American Petroleum Institute. Health Environ. Sci. Dept. API Publ. No. 4601. April.	soil	2.25042	178	Wilson, J.T., Enfield, C.G., Dunlap, W.J., Cosby, R.L., Foster, D.A. and Baskin, L.B. (1981), Transport and Fate of Selected Organic Pollutants in a Sandy Soil. Journal of Environmental Quality, 10: 501-506. https://doi.org/10.2134/jeq1981.00472425001000040016x
Canada Forces Base, Borden, ON	13	Allen-King R.M., J.F. Barker, R.W. Gillham, and B.K. Jensen. 1994. Substrate- and nutrient-limited toluene biotransformation in sandy soil. Environ. Toxicol. Chem. 13: 693-705.	N/a	2.39	245	Baker, J. R., Mihelcic, J. R., Luehrs, D. C., & Hickey, J. P. (1997). Evaluation of Estimation Methods for Organic Carbon Normalized Sorption Coefficients. *Water Environment Research* , *69* (2), 136–145. http://www.jstor.org/stable/25044855
Canada Forces Base, Borden, ON	8.7	Allen-King R.M., J.F. Barker, R.W. Gillham, and B.K. Jensen. 1994. Substrate- and nutrient-limited toluene biotransformation in sandy soil. Environ. Toxicol. Chem. 13: 693-705.	soil	2.146128	140	Environmental Protection Agency (1996). Soil Screening Guidance Technical Background Document (Publication No. Publication 9355.4-17A).
Canada Forces Base, Borden, ON	7.9	American Petroleum Institute, 1994. Transport and fate of dissolved methanol, methyl-tertiary-butyl-ether, and monoaromatic hydrocarbons in a shallow sand aquifer. American Petroleum Institute. Health Environ. Sci. Dept. API Publ. No. 4601. April.	soil	2.4517864	283	Jin, Y., & O'Connor, G. A. (1990). *Behavior of Toluene Added to Sludge-Amended Soils* (Vol. 19, No. 3, pp. 573-579). American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America.
Canada Forces Base, Borden, ON	5.6	Allen-King R.M., J.F. Barker, R.W. Gillham, and B.K. Jensen. 1994. Substrate- and nutrient-limited toluene biotransformation in sandy soil. Environ. Toxicol. Chem. 13: 693-705.	soil	1.97	93	Seip, H.M., J. Alstad, G.E. Carlberg, K. Martinsen, and R. Skanne. 1986. Measurement of mobility of organic compounds in soils. Sci. Total Environ. 50:87-101.
Canada Forces Base, Borden, ON	4.6	Allen-King R.M., J.F. Barker, R.W. Gillham, and B.K. Jensen. 1994. Substrate- and nutrient-limited toluene biotransformation in sandy soil. Environ. Toxicol. Chem. 13: 693-705.	esturary soil	2	100	Vowles, P.D., and R.F.C. Mantoura. 1987. Sediment-water partition coefficients and HPLC retention factors of aromatic hydrocarbons. Chemosphere. 16(1):109-116.
Canada Forces Base, Borden, ON	4.4	Barker J.F., G.C. Patrick, and D. Major. 1987. Natural attenuation of aromatic hydrocarbons in a shallow sand aquifer. Ground Water Monit. Rev. 7: 64-72.	lab	2.06	115	Abdul, A.S., T.L. Gibson, and D.N. Rai. 1987. Statistical correlations for predicting the partition coefficient for nonpolar organic contaminants between aquifer organic carbon and water. Hazardous Waste & Hazardous Materials 4(3):211-222.
Canada Forces Base, Borden, ON	4.4	Allen-King R.M., J.F. Barker, R.W. Gillham, and B.K. Jensen. 1994. Substrate- and nutrient-limited toluene biotransformation in sandy soil. Environ. Toxicol. Chem. 13: 693-705.	zein	2.09	123	Garbarini, D.R., and L.W. Lion. 1986. Influence of the nature of soil organics on the sorption of toluene and trichloroethylene. Environ. Sci. Technol. 20(12):1263-1269.
Canada Forces Base, Borden, ON	4.3	Allen-King R.M., J.F. Barker, R.W. Gillham, and B.K. Jensen. 1994. Substrate- and nutrient-limited toluene biotransformation in sandy soil. Environ. Toxicol. Chem. 13: 693-705.	lab	2.1	126	Szabo, G., S.L. Prosser, and R.A. Bulman. 1990. Determination of the adsorption coefficient (Koc) of some aromatics for soil by RP-HPLC on two immobilized humic acid phases. Chemosphere. 21(6):777-788.
Canada Forces Base, Borden, ON	1.8	Allen-King R.M., J.F. Barker, R.W. Gillham, and B.K. Jensen. 1994. Substrate- and nutrient-limited toluene biotransformation in sandy soil. Environ. Toxicol. Chem. 13: 693-705.	soil	2.13	135	Seip, H.M., J. Alstad, G.E. Carlberg, K. Martinsen, and R. Skanne. 1986. Measurement of mobility of organic compounds in soils. Sci. Total Environ. 50:87-101.
Canada Forces Base, Borden, ON	0.81	Allen-King R.M., J.F. Barker, R.W. Gillham, and B.K. Jensen. 1994. Substrate- and nutrient-limited toluene biotransformation in sandy soil. Environ. Toxicol. Chem. 13: 693-705.	sand	2.18	151	Wilson, J.T., C.G. Enfield, W.J. Dunlap, R.L. Cosby, D.A. Foster, and L.B. Baskin. 1981. Transport and fate of selected organic pollutants in a sandy soil. J. Environ. Qual. 10(4):501-506.
Vejen City, Jutland, Denmark	5.5	Albrechtsen H-J., P.M. Smith, P. Nielsen, and T.H. Christensen. 1996. Significance of biomass support particles in laboratory studies on microbial degradation of organic chemicals in aquifers. Wat. Res. 30: 2977-2984.	soil	2.18	151	Garbarini, D.R., and L.W. Lion. 1986. Influence of the nature of soil organics on the sorption of toluene and trichloroethylene. Environ. Sci. Technol. 20(12):1263-1269.
Vejen City, Jutland, Denmark	0.35	Albrechtsen H-J., P.M. Smith, P. Nielsen, and T.H. Christensen. 1996. Significance of biomass support particles in laboratory studies on microbial degradation of organic chemicals in aquifers. Wat. Res. 30: 2977-2984.	lignin	2.18	151	Garbarini, D.R., and L.W. Lion. 1986. Influence of the nature of soil organics on the sorption of toluene and trichloroethylene. Environ. Sci. Technol. 20(12):1263-1269.

Grindsted, Denmark	2.73	Albrechtsen H-J., P.M. Smith, P. Nielsen, and T.H. Christensen. 1996. Significance of biomass support particles in laboratory studies on microbial degradation of organic chemicals in aquifers. Wat. Res. 30: 2977-2984.
Livermore, California	27	Fuller M.E., D.Y. Mu, and K.M. Scow. 1995. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in vadose sediments. Microb. Ecol. 29: 311-325. 1995.
Livermore, California	22	Fuller M.E., D.Y. Mu, and K.M. Scow. 1995. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in vadose sediments. Microb. Ecol. 29: 311-325. 1995.
Livermore, California	12	Fuller M.E., D.Y. Mu, and K.M. Scow. 1995. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in vadose sediments. Microb. Ecol. 29: 311-325. 1995.
Livermore, California	2.1	Fuller M.E., D.Y. Mu, and K.M. Scow. 1995. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in vadose sediments. Microb. Ecol. 29: 311-325. 1995.
Livermore, California	7.9	Fuller M.E., D.Y. Mu, and K.M. Scow. 1995. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in vadose sediments. Microb. Ecol. 29: 311-325. 1995.
Livermore, California	0.42	Fuller M.E., D.Y. Mu, and K.M. Scow. 1995. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in vadose sediments. Microb. Ecol. 29: 311-325. 1995.
Livermore, California	0.15	Fuller M.E., D.Y. Mu, and K.M. Scow. 1995. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in vadose sediments. Microb. Ecol. 29: 311-325. 1995.
Traverse City, Michigan	693	Aelion C.M., D.C. Dobbins, and F.K. Pfaender. 1989. Adaptation of aquifer microbial communities to the biodegradation of xenobiotic compounds: influence of substrate concentration and preexposure. Environ. Toxicol. Chem. 8: 75-86.
Pickett, Oklahoma	495	Wilson J.T., R.L. Cosby, and G.B. Smith. 1984. Potential for biodegradation of organo-chlorine compounds in ground water. Pre-publication. Ada, OK: RS Kerr Environmental Res. Lab.
Fort Polk, Louisiana	365	Wilson J.T., R.L. Cosby, and G.B. Smith. 1984. Potential for biodegradation of organo-chlorine compounds in ground water. Pre-publication. Ada, OK: RS Kerr Environmental Res. Lab.
Fort Polk, Louisiana	231	Wilson J.T., R.L. Cosby, and G.B. Smith. 1984. Potential for biodegradation of organo-chlorine compounds in ground water. Pre-publication. Ada, OK: RS Kerr Environmental Res. Lab.
Yolo County, California	72	Fan S. and K.M. Scow. 1993. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in soil. Appl. Environ. Microbiol. 59: 1911-1918.
Yolo County, California	60	Mu D.Y. and K.M. Scow. 1994. Effect of trichloroethylene (TCE) and toluene concentrations on TCE and toluene biodegradation and the population density of TCE and toluene degraders in soil. Appl. Environ. Microbiol. 60: 2661-2665.
Yolo County, California	5.1	Mu D.Y. and K.M. Scow. 1994. Effect of trichloroethylene (TCE) and toluene concentrations on TCE and toluene biodegradation and the population density of TCE and toluene degraders in soil. Appl. Environ. Microbiol. 60: 2661-2665.
Yolo County, California	5.1	Fan S. and K.M. Scow. 1993. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in soil. Appl. Environ. Microbiol. 59: 1911-1918.
Yolo County, California	4.7	Fan S. and K.M. Scow. 1993. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in soil. Appl. Environ. Microbiol. 59: 1911-1918.
Yolo County, California	4.1	Mu D.Y. and K.M. Scow. 1994. Effect of trichloroethylene (TCE) and toluene concentrations on TCE and toluene biodegradation and the population density of TCE and toluene degraders in soil. Appl. Environ. Microbiol. 60: 2661-2665.

soil	2.21	162	Garbarini, D.R., and L.W. Lion. 1986. Influence of the nature of soil organics on the sorption of toluene and trichloroethylene. Environ. Sci. Technol. 20(12):1263-1269.
lab	2.26	182	Szabo, G., S.L. Prosser, and R.A. Bulman. 1990. Determination of the adsorption coefficient (Koc) of some aromatics for soil by RP-HPLC on two immobilized humic acid phases. Chemosphere. 21(6):777-788.
lab	2.39	245	Schwarzenbach, R.P., and J. Westall. 1981. Transport of nonpolar organic compounds from surface water to groundwater. Laboratory sorption studies. Environ. Sci. Technol. 15(11):1360-1367.

Yolo County, California	3.1	Fan S. and K.M. Scow. 1993. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in soil. Appl. Environ. Microbiol. 59: 1911-1918.
Yolo County, California	2	Mu D.Y. and K.M. Scow. 1994. Effect of trichloroethylene (TCE) and toluene concentrations on TCE and toluene biodegradation and the population density of TCE and toluene degraders in soil. Appl. Environ. Microbiol. 60: 2661-2665.
Yolo County, California	1.8	Fan S. and K.M. Scow. 1993. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in soil. Appl. Environ. Microbiol. 59: 1911-1918.
Yolo County, California	1.8	Fan S. and K.M. Scow. 1993. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in soil. Appl. Environ. Microbiol. 59: 1911-1918.
Yolo County, California	1.8	Fan S. and K.M. Scow. 1993. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in soil. Appl. Environ. Microbiol. 59: 1911-1918.
Yolo County, California	1.2	Fan S. and K.M. Scow. 1993. Biodegradation of trichloroethylene and toluene by indigenous microbial populations in soil. Appl. Environ. Microbiol. 59: 1911-1918.
Yolo County, California	0.94	Mu D.Y. and K.M. Scow. 1994. Effect of trichloroethylene (TCE) and toluene concentrations on TCE and toluene biodegradation and the population density of TCE and toluene degraders in soil. Appl. Environ. Microbiol. 60: 2661-2665.
Yolo County, California	0.93	Mu D.Y. and K.M. Scow. 1994. Effect of trichloroethylene (TCE) and toluene concentrations on TCE and toluene biodegradation and the population density of TCE and toluene degraders in soil. Appl. Environ. Microbiol. 60: 2661-2665.
Yolo County, California	0.34	Mu D.Y. and K.M. Scow. 1994. Effect of trichloroethylene (TCE) and toluene concentrations on TCE and toluene biodegradation and the population density of TCE and toluene degraders in soil. Appl. Environ. Microbiol. 60: 2661-2665.
No Name	53	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	41	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	32	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	28	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	26	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	26	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	7.1	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	1.5	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	1.4	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	1.3	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.

No Name	1.3	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	1.2	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	0.96	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	0.67	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	0.46	Davis J.W. and S. Madsen. Factors affecting the biodegradation of toluene in soil. Chemosphere. 33: 107-130. 1996.
No Name	2.1	McNabb J.F., B.H. Smith, and J. T. Wilson. 1981. Biodegradation of toluene and chlorobenzene in soil and groundwater. 81st Annual Meeting of the Amer. Society for Microbiology. Dallas, TX. March 1-6. 213 pp.
Jurere Beach, Brazil	0.37	Corseuil H.X., R.C.F. dos Santos, and M.D.M. Marins. 1997. Gasoline spills in Brazil: effect of ethanol on groundwater contamination. Presented at: IAWQ Inter. Conf. Waste Control Environ. Manag. Large Metro. Areas. Sao Paolo, Brazil. May.
Hanahan, South Carolina	32	Bradley P.M. and F.H. Chapelle. 1995. Rapid toluene mineralization by aquifer microorganisms at Adak, Alaska: Implications for intrinsic bioremediation in cold environments. Environ. Sci. Technol. 29: 2778-2781.
Lua, Oklahoma	41	Swindoll C.M., C.M. Aelion, and F.K. Pfaender. 1988. Influence of inorganic and organic nutrients on aerobic biodegradation and on the adaptation response of subsurface microbial communities. Appl. Environ. Microbiol. 54: 212-217.
Lula, Texas	17	Wilson J.T., G.D. Miller, W.C. Ghiorse, and F.R. Leach, 1986. Relationship between the ATP content of subsurface material and the rate of biodegradation of alkylbenzenes and chlorobenzene. J. Contam. Hydrol. 1: 163-170.
Lula, Texas	2	Wilson J.T., G.D. Miller, W.C. Ghiorse, and F.R. Leach, 1986. Relationship between the ATP content of subsurface material and the rate of biodegradation of alkylbenzenes and chlorobenzene. J. Contam. Hydrol. 1: 163-170.
Lula, Texas	1.9	Wilson J.T., G.D. Miller, W.C. Ghiorse, and F.R. Leach, 1986. Relationship between the ATP content of subsurface material and the rate of biodegradation of alkylbenzenes and chlorobenzene. J. Contam. Hydrol. 1: 163-170.
Naval Air Station Adak, AK	2.9	Bradley P.M. and F.H. Chapelle. 1995. Rapid toluene mineralization by aquifer microorganisms at Adak, Alaska: Implications for intrinsic bioremediation in cold environments. Environ. Sci. Technol. 29: 2778-2781.
Santa Catarina Island, Brazil	2.2	Hunt C.S. and P.J.J. Alvarez. 1997. Effect of ethanol on aerobic BTX degradation. In: In Situ and On-Site Bioremediation. Volume I. 4th International In situ and On-Site Bioremediation Symposium. Biorem. 4: 49-54.
Riverside, California	0.02	Jin Y., T. Streck, and W.A. Jury. 1994. Transport and biodegradation of toluene in unsaturated soil. J. Contam. Hydrol. 17: 111-127.

Riverside, California	0.02	Jin Y., T. Streck, and W.A. Jury. 1994. Transport and biodegradation of toluene in unsaturated soil. J. Contam. Hydrol. 17: 111-127.
N/A	13	Howard, P. H. (Ed.). (1991). *Handbook of environmental degradation rates* . CRC Press.

ATTACHMENT C

Technical Documentation for BIOSCREEN Model Simulations Between the Rapid Infiltration Basin and Groundwater Adjacent to the Santiam River

ATTACHMENT C

Application of BIOSCREEN to Evaluate Dispersion, Sorption, and Biodegradation of Pollutants in Groundwater Between an Infiltration Basin and Groundwater Adjacent to the Santiam River, Mill City, Oregon

1. Background

BIOSCREEN is an analytical model developed by the U.S. Environmental Protection Agency (EPA) to simulate pollutant fate and transport in saturated porous media (EPA, 1996), as discussed in Attachment B. Nitrate was modeled with BIOSCREEN at Site GM1 because it potentially migrates offsite at concentrations above background (see Attachment B). The purpose of the BIOSCREEN modeling is to predict pollutant concentrations in groundwater adjacent to the Santiam River due to wastewater infiltration at Site GM1 (see Exhibit C.1) The simulations are based on the pollutant attenuation by dispersion, sorption, and biodegradation that is expected to occur during transport from the downgradient edge of the infiltration basin to the groundwater adjacent to the Santiam River.

2. Model Input Parameters

Model input parameters are summarized in Table C.1. The following subsections describe the methods that were used to develop the model input parameters. Model input parameters were developed based on scientific literature and site-specific data collected during the Phase II and Phase III Subsurface Characterizations at GM1 (GSI, 2023; GSI, in press).

Table C.1. BIOSCREEN Model Input Parameters.

Model Input Parameter	Symbol	Value	Units	Subsection in the Text
Seepage Velocity	v_s	1,368	feet/year	Subsection 2.1
Dispersivity	α_L	32.0 (Longitudinal)	feet	Subsection 2.2
	α_T	10.6 (Transverse)	feet	
	α_V	1.6 (Vertical)	feet	
Retardation Factor	R	1.0 (Nitrate)	dimensionless	Subsection 2.3
Half Life	h	∞ (Nitrate)	days	Subsection 2.4
Initial Concentration	C_0	4.30 (Nitrate)	mg/L	Subsection 2.5
Source Width and Thickness	W_s	550	feet	Subsection 2.6
	T_s	20	feet	
Model Width and Length	W_m	1,000	feet	Subsection 2.7
	L_m	1,950	feet	
Simulation Time	t	10,000	years	Subsection 2.8
Source Type	--	Constant Concentration	--	Subsection 2.9

Notes

mg/L = milligrams per liter

2.1 Seepage Velocity (v_s)

Table C.2 summarizes the values used to calculate seepage velocity for input to the BIOSCREEN model using the equations and site-specific data in Attachment B (subsection 2.1).

Table C.2. Seepage Velocity Calculation.

Model Input Parameter	Symbol	Value	Units	Notes
Horizontal Hydraulic Conductivity	K	88.2	feet/day	Geometric mean from slug tests at GM1-MW1, GM1-MW2 and GM1-MW3
Effective Porosity	η_e	0.24	--	Specific yield for a "Gravel, medium" from Heath (1983)
Horizontal Hydraulic Gradient	∇h	0.0102 [1]	feet/foot	Groundwater elevation measurements at GM1-MW1, GM1-MW2 and GM1-MW3 in summer 2023
Seepage Velocity	v_s	3.75	feet/day	Attachment B (subsection 2.1)

Notes

(1) This horizontal hydraulic gradient was measured in summer of 2023 and, therefore, represents ambient aquifer conditions (i.e., no mounding due to infiltration). According to groundwater mounding modeling with MOUNDSOLV, the horizontal hydraulic gradient will not significantly change during infiltration at the scale of the GM-1 site (although groundwater levels will increase).

2.2 Dispersivity (α_L, α_T, α_V)

Dispersity was calculated using the equations and conditions discussed in Attachment B (subsection 2.2). As shown in Exhibit C.1, the shortest distance between an infiltration basin and groundwater adjacent to the Santiam River along the groundwater flow path is about 1,950 feet. Based on a pollutant plume length of 594.3 meters (1,950 feet), the longitudinal dispersivity is 9.8 meters (32.0 feet) according to Equation (B.6). According to ASTM (1995), transverse dispersivity can be assumed to be 33% of longitudinal dispersivity (i.e., 3.2 meters or 10.6 feet), and vertical dispersivity can be assumed to be 5% of longitudinal dispersivity (i.e., 0.49 meters or 1.6 feet).

2.3 Retardation

Retardation of nitrate was calculated using the same methods referenced in Attachment B (see subsection 2.3). Table C.3 summarizes the values that were used to calculate retardation factor for nitrate.

Table C.3. Retardation Factor Calculation.

Model Input Parameter	Units	Nitrate
Soil Bulk Density (ρ_b) [1]	kg/L	1.66
Organic Carbon-Water Partitioning Coefficient (K_{oc}) [2]	L/kg	0.0
Fraction Organic Carbon (f_{oc}) [3]	--	0.001
Total Porosity (η) [4]	--	0.39
Retardation Factor	--	1.0

Notes

(1) Average dry bulk density based on soil samples collected from the monitoring well GM1-MW1 boring. See Attachment B of the Phase II Subsurface Characterization (GSI, 2023).

(2) The K_{oc} for nitrate was set to 0.0 L/kg to simulate transport in the aqueous phase only (i.e., not sorption to soil).

(3) Recommended default value from ASTM (1995). Soil analysis pending.

(4) Average total porosity based on soil samples collected from the monitoring well GM1-MW1 boring. See Attachment B of the Phase II Subsurface Characterization (GSI, 2023).

kg/L = kilograms per liter

L/kg = liters per kilogram

Note that the retardation factors for nitrate are 1.0, indicating that these pollutants do not sorb to soil and travel at the same velocity as groundwater.

2.4 Half Life (h) and First Order Decay Constant (λ)

Nitrate do not degrade under aerobic conditions. Therefore, the first order decay coefficient was entered into BIOSCREEN for nitrate as zero.

Table C.4. Biodegradation Rates.

Scenario	Half Life	First Order Decay Constant [1]	Notes
Nitrate	Infinite	0.0	No degradation

Notes

(1) Calculated by the following equation: $\lambda = \ln(2)/h$

2.5 Initial Pollutant Concentration (C_0)

The initial nitrate concentrations in BIOSCREEN were calculated by the Large Onsite Septic System (LOSS) model (see Attachment A for a detailed discussion) based on the scenario run as summarized in Table C.5.

Table C.5. Initial Pollutant Concentrations.

Scenario	Treatment	Concentration in Wastewater	Concentration in Groundwater
Nitrate	SBR	6 mg/L	4.30 mg/L

Notes

mg/L = milligrams per liter

SBR = sequencing batch reactor

2.6 Source Width (W_s) and Thickness (T_s)

The width of the source, W_s, is the infiltration basin width perpendicular to the direction of groundwater flow. As shown in Exhibit C.1, groundwater flows towards the northwest, and the width of the infiltration basins perpendicular to the groundwater flow direction is about 550 feet. Source thickness in the saturated zone was selected to be 20 feet to align the BIOSCREEN model with the LOSS model. Specifically, the LOSS model guidance (DOH, 2021) assumes that infiltrating wastewater will mix with the upper 20 feet of the saturated zone at a maximum.

2.7 Model Width (W_m) and Model Length (L_m)

The width of the area being modeled (W_m) should be larger than the pollutant plume and was selected to be 1,000 feet in the BIOSCREEN model. The length of the area being modeled (L_m) is equivalent to the length over which concentrations are to be calculated and was selected to be 1,950 feet in the BIOSCREEN model (i.e., the shortest distance between the downgradient edge of an infiltration basin and groundwater adjacent to the Santiam River).

2.8 Simulation Time (t)

Simulation time (t) is the time period over which transport occurs. A simulation time of 10,000 years was used for the BIOSCREEN simulations. It was determined empirically that the pollutants plumes reach a steady state condition by this time.

2.9 Source Type

Pollutant fate and transport simulations can be conducted using several different source types. For example, a source can be simulated as continuous with constant concentration, continuous with a concentration that decays over time, a pulse of known concentration, etc. The infiltration of treated wastewater was conservatively simulated as a continuous source with constant concentration in the BIOSCREEN model by entering a “Source Half Life” of “Infinite” in the model. It should be noted that this is a conservative assumption because infiltration basins will not be operated continuously (specifically, every twelve days, a basin will infiltrate treated wastewater for two days).

3. Model Output

This section summarizes output from the BIOSCREEN model (i.e., pollutant concentration in groundwater adjacent to the Santiam River assuming a separation of 1,950 feet between the and closest infiltration basin and groundwater adjacent to the Santiam River) for nitrate (Section 3.1).

3.1 Nitrate

Nitrate concentrations in groundwater adjacent to the Santiam River are summarized in Table C.6. The BIOSCREEN input and output are provided in Exhibit C.2 and Exhibit C.3, respectively.

Table C.6. Nitrate Concentration in Groundwater Adjacent to the Santiam River.

Scenario	Total Nitrogen Concentration in Treated Wastewater, N_W	Nitrate Concentration in Groundwater at the Basin Edge (from the LOSS Model), N_{GW}	Nitrate Concentration in Groundwater Adjacent to River (from BIOSCREEN)
Nitrate	6.0 mg/L	4.30 mg/L	1.1 mg/L to 4.30 mg/L[1]

Notes

mg/L = milligrams per liter

(1) The BIOSCREEN model calculates a concentration of 0.739 mg/L for the low-end concentration (see Exhibit C.3 at 1,950 feet). However, concentration could not fall below the background of 1.1 mg/L, so the lower end of the range is set to be 1.1 mg/L.

As discussed in the introduction section, the nitrate concentrations output from the BIOSCREEN model should be considered approximations because the equation on which BIOSCREEN is based assume, in this case, mixing between a nitrate source concentration of 4.30 mg/L and a groundwater nitrate concentration of 0.0 mg/L. In reality, the groundwater nitrate concentration is 1.1 mg/L. As a result, the nitrate concentrations in groundwater adjacent to the Santiam River are listed in Table C.6 as falling somewhere between the concentration predicted by the LOSS model (4.30 mg/L) and the concentration in background groundwater (1.1 mg/L). The concentration predicted by BIOSCREEN (0.739 mg/L) is not listed in Table C.6 because the nitrate concentration cannot be attenuated to below background by dispersion alone.

4. Conclusions

Based on modeling of dilution, dispersion, biodegradation, and sorption described in Attachment A (LOSS model) and Attachment C (BIOSCREEN model), we conclude that the nitrate concentration in groundwater adjacent to the Santiam River is between 1.1 mg/L and 4.30 mg/L. assuming basin configurations shown in Exhibit C.1.

5. References

ASTM. 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. ASTM E-1739-95. Philadelphia, PA.

DOH. 2021. Level 1 Nitrate Balance Instructions for Large One-Site Sewage Systems. DOH 337-069. May.

EPA. 1996. BIOSCREEN Natural Attenuation Decision Support System User's Manual Version 1.3. Office of Research and Development. EPA/600/R-96/087. August.

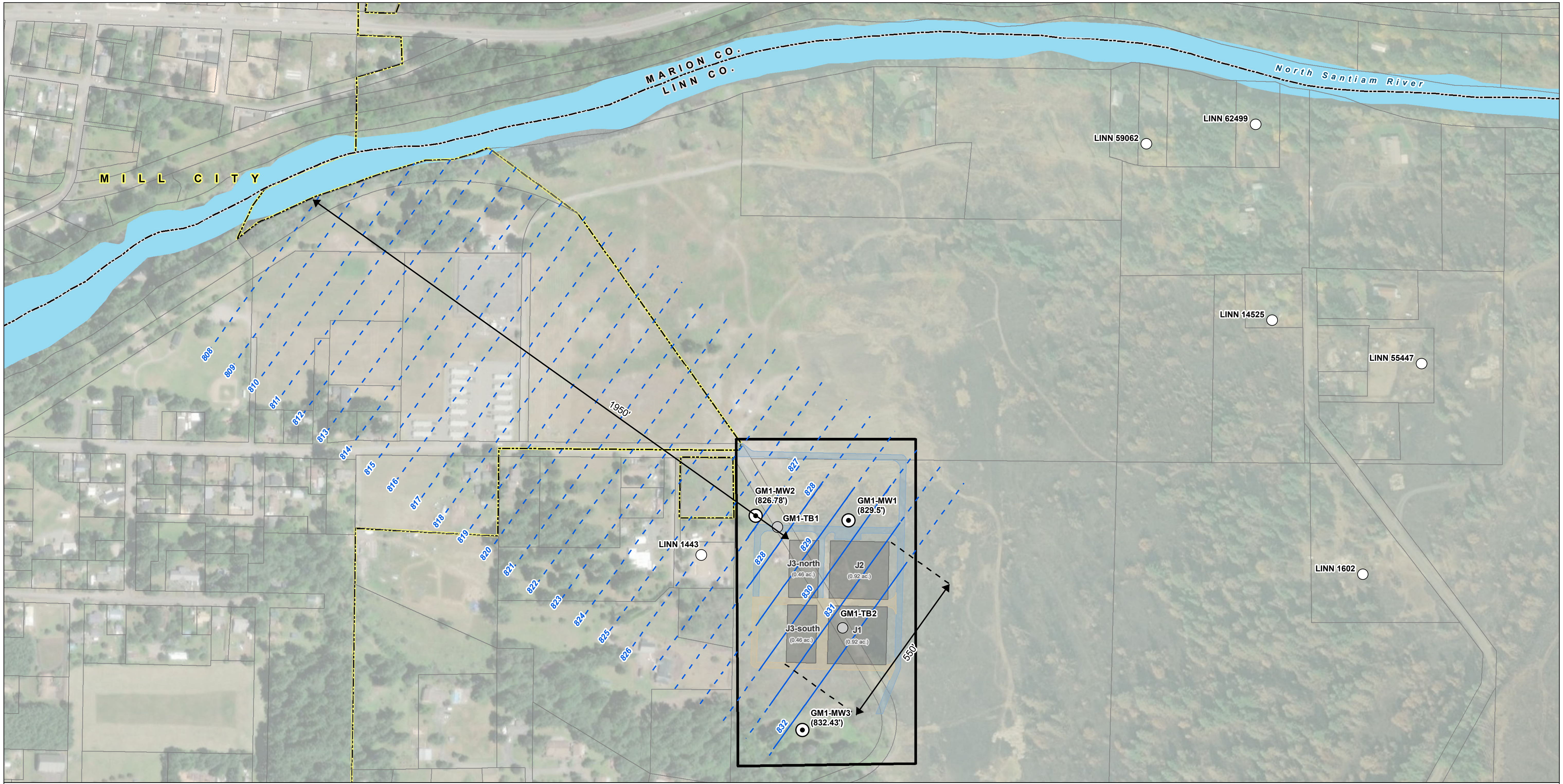
Freeze, R. A. and J. A. Cherry. 1979. Groundwater. 604 pp.

GSI. 2023. Phase II Subsurface Characterization to Support and Evaluation of Treated Wastewater Infiltration in Gates and Mill City, Marion and Linn Counties, Oregon. September 12.

GSI. In press. Phase III Subsurface Characterization to Support an Evaluation of Treated Wastewater Infiltration in Gates and Mill City, Marion and Linn Counties, Oregon.

Heath, R. C. 1983. Basic ground-water hydrology. U.S. Geological Survey Water-Supply Paper 2220, 86 p.

Xu, M. and Y. Eckstein. 1995. Use of Weighted Least-Squares Method in Evaluation of the Relationship Between Dispersivity and Scale. Journal of Groundwater (33), No. 6, pp. 905 – 908.



LEGEND

- ◉ Monitoring Well
- ○ Residential Well
- ● Temporary Boring Phase III
- ～ Groundwater Elevation Contour, feet

- ☐ Site
- ▨ Basin
- ▨ Gravel
- ▨ Asphalt Pavement

All Other Features

- ☐ Tax Lot
- ☐ City Boundary
- ☐ County Boundary
- ╱╲ Major Road

EXHIBIT C.1

Proposed Infiltration Basin Layout

Gates-Mill City Treated
Wastewater Infiltration Evaluation

N

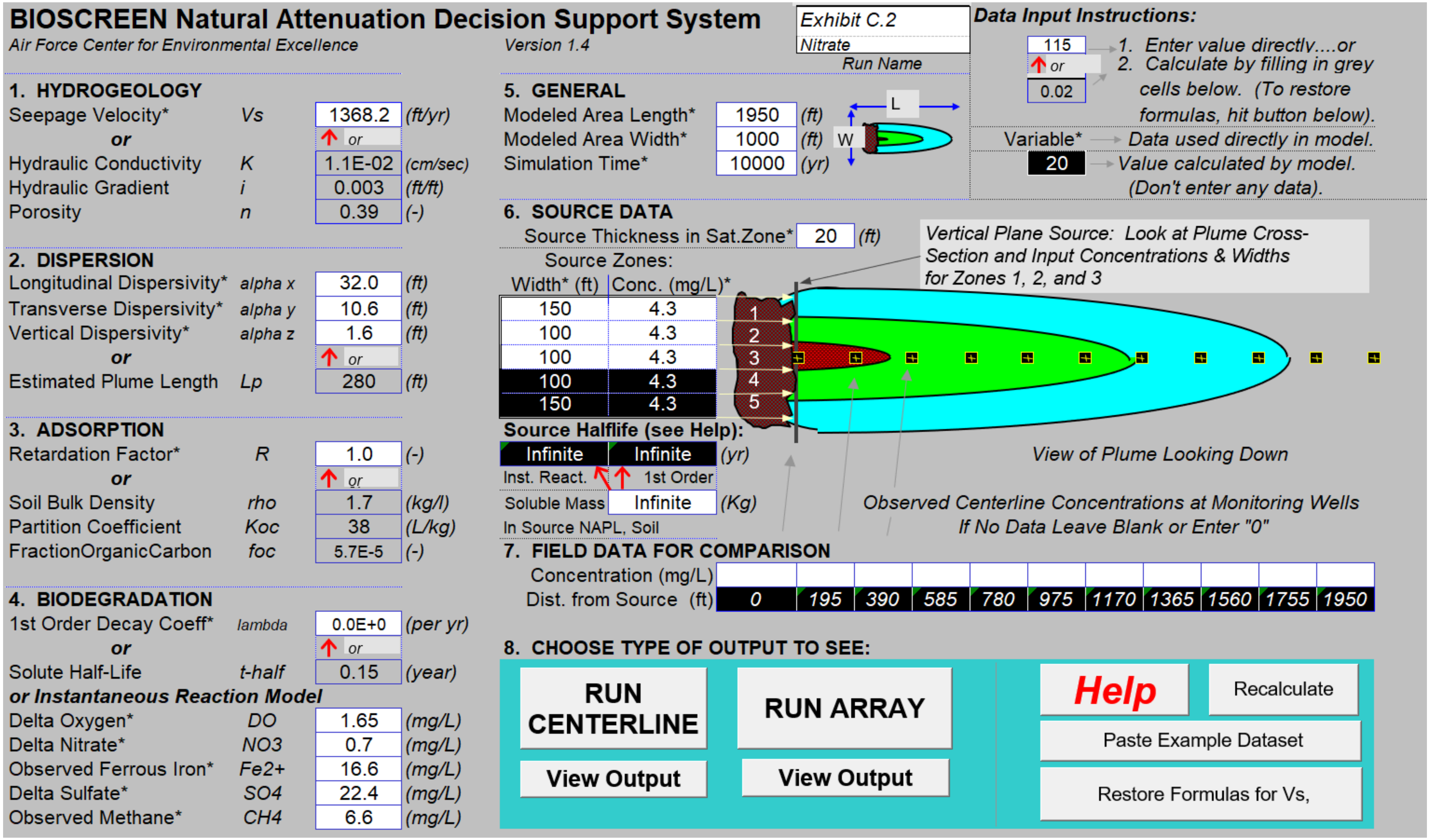
0 160 320 480
Feet

GSI
Water Solutions, Inc.

Document Path: Y:\0464_Keller_Assoc\Source_Figures\020_Santiam_Canyon\Bioscreen\ExhibitC1_Proposed_Infiltration_Basin.mxd, iramos

EXHIBIT C.2

BIOSCREEN Input for Nitrate



BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence

Version 1.4

Exhibit C.2
Nitrate
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ or → 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
0.02

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	1368.2	(ft/yr)
or		↑ or	
Hydraulic Conductivity	K	1.1E-02	(cm/sec)
Hydraulic Gradient	i	0.003	(ft/ft)
Porosity	n	0.39	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	32.0	(ft)
Transverse Dispersivity*	alpha y	10.6	(ft)
Vertical Dispersivity*	alpha z	1.6	(ft)
or		↑ or	
Estimated Plume Length	Lp	280	(ft)

3. ADSORPTION

Retardation Factor*	R	1.0	(-)
or		↑ or	
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	38	(L/kg)
FractionOrganicCarbon	foc	5.7E-5	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	0.0E+0	(per yr)
or		↑ or	
Solute Half-Life	t-half	0.15	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	1.65	(mg/L)
Delta Nitrate*	NO3	0.7	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	22.4	(mg/L)
Observed Methane*	CH4	6.6	(mg/L)

5. GENERAL

Modeled Area Length*	1950	(ft)
Modeled Area Width*	1000	(ft)
Simulation Time*	10000	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 20 (ft)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones:

Width* (ft)	Conc. (mg/L)*
150	4.3
100	4.3
100	4.3
100	4.3
150	4.3

Source Halflife (see Help):

Infinite	Infinite	(yr)
Inst. React. ↑	↑ 1st Order	
Soluble Mass	Infinite	(Kg)
In Source NAPL, Soil		

View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

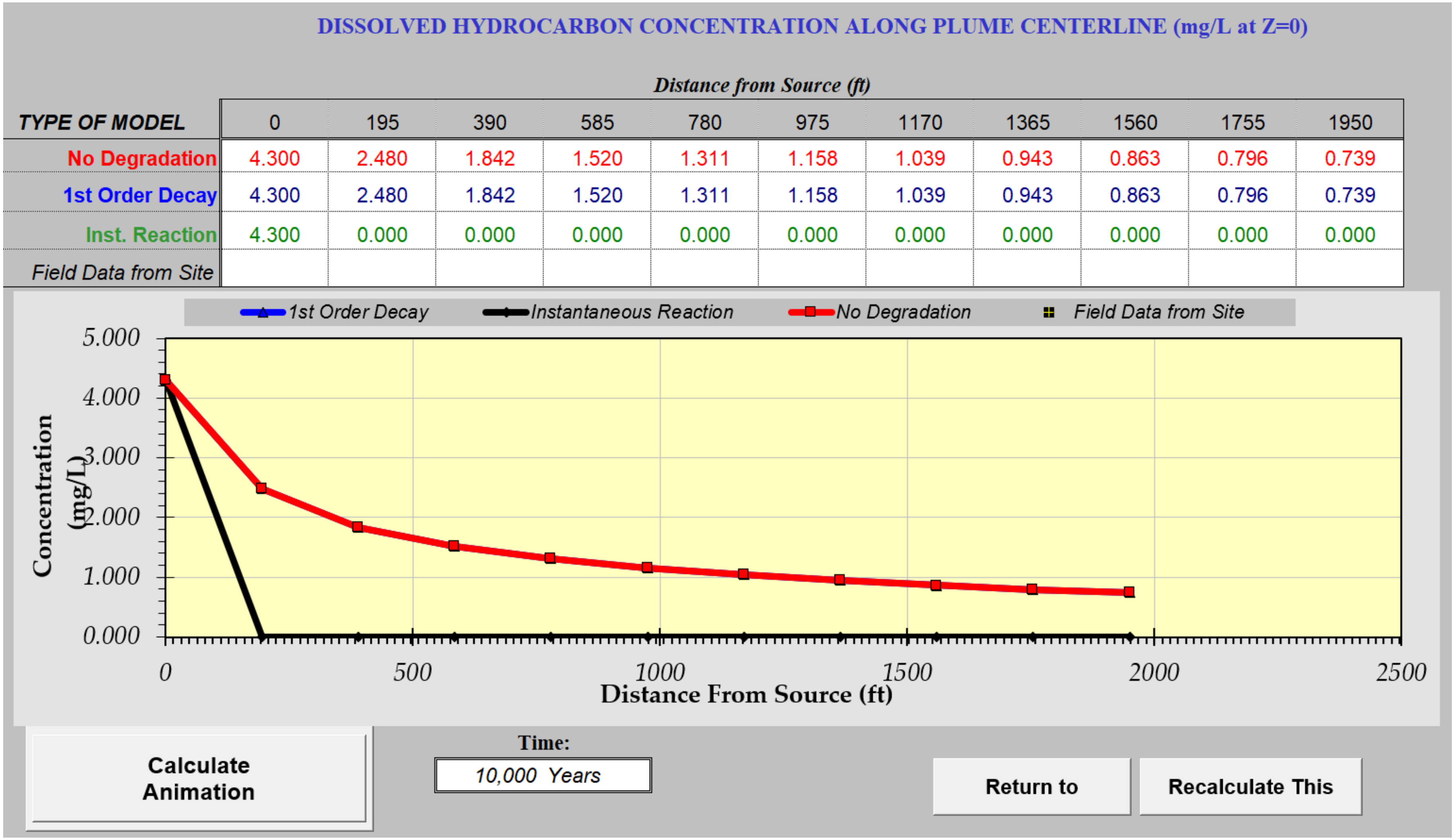
7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)	0	195	390	585	780	975	1170	1365	1560	1755	1950

8. CHOOSE TYPE OF OUTPUT TO SEE:

EXHIBIT C.3

BIOSCREEN Centerline Output for Nitrate



DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	195	390	585	780	975	1170	1365	1560	1755	1950
No Degradation	4.300	2.480	1.842	1.520	1.311	1.158	1.039	0.943	0.863	0.796	0.739
1st Order Decay	4.300	2.480	1.842	1.520	1.311	1.158	1.039	0.943	0.863	0.796	0.739
Inst. Reaction	4.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											

Time: *10,000 Years*

APPENDIX J

Agency Permitting and Approvals

Anticipated Agency Permits and Approvals -

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
Federal						
Lead Federal Agency (to be determined [TBD] based on funding)	Federal decision	National Environmental Policy Act (NEPA)	While ARPA funding does not trigger NEPA, additional federal funding could trigger NEPA. Additional trigger for NEPA would be the need for a U.S. Army Corps of Engineers [USACE] Individual Permit [IP] NEPA. If the projects are able to get a Nationwide Permit [NWP] NEPA would not be needed. See descriptions of these permits below.)	The type of NEPA documentation depends on the level of complexity of the project. Categorical Exclusion (CE): Limited to a specific category of actions that federal agencies have determined do not have significant effects. Public involvement not needed. Complete basic documentation. Environmental Assessment (EA): Significant impacts not expected, low level of complexity or controversy. Public involvement and public review required. Baseline studies may be needed. Only one action alternative required. Environmental Impact Statement (EIS): Significant impacts expected, high level of complexity or controversy. Public involvement and public review required. Baseline studies may be needed. Typically includes input from cooperating agencies and considers more than one action alternative.	Duration: CE: <6 months EA: 6–12 months EIS: 2 years Timing: Other consultations (e.g., ESA, National Historic Preservation Act [NHPA] Section 106) must be complete prior to permit issuance.	All

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
USACE	IP or NWP 58 (if permanent impacts can be reduced to less than 0.5 acre) IP/NWP submitted concurrently with Oregon Department of State Lands (DSL) Removal-Fill Permit in a Joint Permit Application (JPA)	Clean Water Act (CWA), Section 404	Discharge of fill material or removal of substrate or sediment in Waters of the U.S. (WOTUS). May be avoided by avoiding work below ordinary high water and disturbance of wetlands.	Conduct a survey of WOTUS (i.e., wetland delineation) for the project. Complete a pre-application meeting with USACE. Prepare a cover letter, USACE application (Engineer Form 4345 for an IP or Form 6082 for NWP), and supplemental information. Submit a conceptual compensatory mitigation plan as part of the IP application. Before issuance of an IP, USACE must identify a Least Environmentally Damaging Practicable Alternative (LEDPA). As part of the JPA (for an IP or NWP), submit an alternatives analysis consistent with CWA Section 404(b)(1) Guidelines and NEPA requirements. A Public Notice is required (for both IPs and NWPs) and public comments are addressed within 30 days of the comment period close. For both an IP and a NWP, the USACE must complete consultations under ESA Section 7 with the U.S. Fish and Wildlife Services (USFWS) and/or National Oceanic and Atmospheric Administration's National Marine Fisheries (NOAA Fisheries) as well as with the Oregon State Historic Preservation Office (SHPO) under NHPA Section 106.	Duration: IP: up to 22 months once USACE has determined the application package complete for a project that may be controversial, may not be considered the LEDPA, may result in the take of ESA species, may impact cultural resources, or requires a CWA Section 401 Water Quality Certification (WQC). NWP 58: up to 12 months. Duration of permitting is largely influenced by the timing and duration of external consultations (e.g., ESA, NHPA Section 106) required for permit issuance. Timing: Project design components described in Section 5 of this plan must be drafted to complete either an IP or NWP. Other consultations (e.g., ESA, NHPA Section 106) must be complete prior to permit issuance.	All

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
NOAA Fisheries	ESA Section 7 consultation and concurrence	ESA Section 7	Actions that may affect federally listed species or their critical habitat; in this case, Upper Willamette River Chinook salmon and Upper Willamette River steelhead. May be avoided by avoiding in-water work and disturbance of riparian area. Consultation triggered by any federal nexus (e.g., federal funding, or federal permit).	Formal Consultation (for likely to adversely affect [LAA] determinations): Prepare biological assessment (BA) that analyzes the project's potential impacts on listed species (higher level of effort). If NOAA Fisheries concurs, they issue a biological opinion. Informal Consultation (for not LAA determinations): Prepare a biological evaluation (BE; lower level of effort). If NOAA Fisheries concurs, they issue a Letter of Concurrence.	<u>Duration:</u> <u>Formal Consultation</u>: 135 days once NOAA Fisheries determines the application package (BA) complete. <u>Informal Consultation</u>: 60 days once NOAA Fisheries determines the application package (BE) complete. <u>Timing</u>: If NEPA is required, consultation begins once the preferred alternative has been identified. Consultation is completed only on the preferred alternative.	Dogwood LS, Gates Regional LS, and Riverview LS and 2-Gates System Layout Gates-Mill City FM
NOAA Fisheries	Essential Fish Habitat (EFH) consultation and recommendations	Magnuson-Stevens Fishery Conservation and Management Act	Actions that may affect federally designated EFH; in this case, Pacific salmon EFH. May be avoided by avoiding in-water work and disturbance of riparian areas.	Prepare an EFH assessment. Can be included as part of the BA for ESA consultation.	<u>Duration</u>: 30 to 60 days for NOAA Fisheries to provide EFH conservation recommendations once they determine the application package (EFH assessment) complete. <u>Timing</u>: Same as ESA Section 7	Dogwood LS, Gates Regional LS, and Riverview LS and 2-Gates System Layout Gates-Mill City FM

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
USFWS	ESA Section 7 consultation and concurrence	ESA Section 7	Actions that may affect federally listed species or their critical habitat; in this case, one bird, two insects, and three flowering plants. May be avoided by avoiding habitat for these species, such as old growth forests, upland prairie, dry prairie, oak savanna, or wet prairie habitats. Consultation triggered by any federal nexus (e.g., federal funding, or federal permit).	Formal Consultation (for LAA determinations): Prepare a BA that analyzes the project's potential impacts on listed species (higher level of effort). If USFWS concurs, they issue a biological opinion. Informal Consultation (for not LAA determinations): Prepare a BE (lower level of effort). If USFWS concurs, they issue a Letter of Concurrence.	Duration: Formal Consultation: 135 days once NOAA Fisheries determines the application package (BA) complete. Informal Consultation: 60 days once NOAA Fisheries determines the application package (BE) complete. Timing: Same as ESA Section 7 for NOAA Fisheries.	All
Lead Federal Agency (TBD – If NEPA is not required, USACE would be lead federal agency)	NHPA Section 106 Consultation	NHPA Section 106	Consultation triggered by any federal nexus (e.g., federal funding, or federal permit). Lead agency determines if the undertaking has potential to affect historic properties.	Support lead federal agency to initiate government-to-government consultation with interested Tribal entities, SHPO, and other interested parties as applicable. Conduct cultural resources background research (e.g., records search, Tribal coordination, etc.) and conduct a cultural resources field survey. Draft cultural resources inventory report. If the lead federal agency determines the undertaking may cause adverse effects to historic properties, mitigation (e.g., memorandum of agreement [MOA], historic properties treatment plan [HPTP], etc.) would be required.	Duration and Timing: Government-to-government consultation would be ongoing through the duration of the permitting process. Up to 60 days to receive fieldwork authorizations. Up to 6 months to complete the cultural resources technical report review process. At least 1 year to complete the mitigation process (e.g., lead agency completes an MOA and HPTP, and adverse effects are resolved), if applicable.	All, depending on if there is a federal nexus due to funding or permit needs

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
State and Local						
Oregon Department of Fish and Wildlife (ODFW)	Scientific Taking Permit	Oregon Administrative Rule (OAR) 635-007-0900	Required to handle fish in Waters of the State if fish removal/salvage is needed for construction. May be avoided by avoiding in-water work.	Prepare summary of study plan and methods. Complete application form. Requires annual and final reporting of all fish handled, their location, and final disposition.	Duration: 60 days from submittal of application.	Gates-Mill City FM
ODFW	Fish Passage Plan Approval or Waiver	Oregon Revised Statute (ORS) 509.580 to 509.910 OAR 635-412	Installation, replacement, or abandonment of artificial obstructions in native fish streams. May be avoided by avoiding waterbody crossings.	Submit application to ODFW with fish passage designs plans showing how all fish passage criteria are met. An operations and maintenance plan and monitoring and reporting plan may be required. ODFW will evaluate and provide comments for the applicant to resolve. Public comment period is required for exemptions or waivers.	Duration: Typically 6 months to 1 year for larger projects. (No required time frame for passage plan approval.)	Gates-Mill City FM
DSL	Removal-Fill Permit Submitted concurrently with USACE IP/NWP application in a JPA	ORS 196.795 to 196.910 OAR 141-85	Removal of material from, or placement of fill in, Waters of the State (50 cubic yards or greater). Cannot be avoided. Although removal and/or fill of less than 50 cubic yards in a wetland or waterway does not require a permit, any amount of removal/fill in state-designated Essential Salmonid Habitat (such as the Santiam River) requires a permit.	See details for USACE IP or NWP. Conduct a wetland delineation and submit report to DSL for concurrence. Submit removal-fill application to DSL. DSL will review application for completeness, request additional information as needed, hold a public comment period, and issue a decision.	Duration: Approximately 120 days from submittal of complete application.	All

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
Oregon Department of Agriculture (ODA)	Listed Plant Permit or Consultation	ORS 564 OAR 603-73	Any land action on Oregon non-federal public lands which results, or might result, in the taking of a threatened or endangered plant species. May be avoided by avoiding habitat for threatened or endangered plant species, such as upland prairie, ecotones between grassland and forest, or open prairie remnants along the margins of streams, sloughs, ditches, roadsides, fence rows, and drainage swales and in fallow fields.	Prior to consultation, complete site-specific surveys for listed plant species and submit a survey report to ODA. ODA will review report and provide comments within 90 days, including a determination on whether formal consultation or a permit is required. If consultation is required, an evaluation of potential impacts on listed plant species would be required. If a permit is required, submit application form and supporting documentation to ODA. ODA will review application and request additional information as needed.	Duration: Written notification of denial or a copy of the permit will be sent to the applicant within 120 days of receipt of the complete application.	All
Oregon Water Resources Department (OWRD)	Water Use Permit	ORS 537.141 and 537.143 OAR 690-310 and 690-340	Constructing a water system and use of water.	Submit application to OWRB that includes legal property descriptions, maps, written authorizations from landowners, and land use consistency information. OWRB will review application for completeness, request additional information as needed, and review the proposed use for compliance with their criteria.	Duration: Approximately 1 year from submittal of a complete application.	All

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
DEQ	CWA Section 401 WQC	CWA, 33 United States Code (U.S.C.) 1341 OAR 340-48	Discharge of fill material into or removal of substrate or sediment in WOTUS and Waters of the State that also require a federal removal-fill permit from USACE. May be avoided by avoiding in-water work and disturbance of wetlands.	A pre-application consultation is recommended for large, complex projects prior to application submittal. Submit WQC application and stormwater management plan to DEQ concurrent with federal CWA Section 404 permit application submittal to USACE. USACE's public comment period for the CWA Section 404 permit will also apply to the associated CWA Section 401 WQC request. DEQ will review the application and provide comments to be resolved by the applicant.	Duration: Approximately 1 year from complete application submittal. However, the timeline can increase depending on the time it takes applicant to resolve DEQ's comments.	All
DEQ	National Pollutant Discharge Elimination System (NPDES) 1200-C Construction Stormwater permit	ORS 468B.050 OAR 340-45	Construction projects involving more than 1 acre of ground disturbance and the potential for discharge into surface waters. May be avoided if construction disturbance is less than 1 acre of ground-disturbance.	Submit completed application form, land use affidavit, and erosion and sediment control plan (ESCP) to DEQ. DEQ will review application for completeness, request additional information as needed, hold public review period, perform technical review of ESCP, and notify applicant of any technical deficiencies that need to be resolved prior to permit issuance.	Duration: Approximately 3 to 6 months from application submittal. However, timeline can increase depending on the time it takes applicant to resolve any technical deficiencies raised by DEQ.	All

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
DEQ	Water Pollution Control Facilities (WPCF) Individual Permit Category 3 permit for projects with few effects or less controversy. Category 4 permit for projects with potential for significant effects or controversy.	ORS 468B.055 OAR 340-45 and 340-71	Required to construct and operate a disposal system with no discharge to navigable waters.	Submit completed application form, land use compatibility statement, and biosolids management plan to DEQ. DEQ reviews application and requests additional information as needed. Category 3: DEQ holds public review period and public hearing (if requested). Category 4: DEQ holds information gathering community meeting and requests draft edits if necessary. Both categories: Environmental Quality Commission board provides comments to address prior to permit issuance.	Duration: Category 3: Approximately 3 to 6 months from application submittal. Category 4: Approximately 4 to 7 months from application submittal. Timeline can increase depending on the duration required to resolve information requests and comments by DEQ.	All
DEQ	Air Contaminant Discharge Permit	ORS 468A.040 to 468A.060 OAR 340-216	Any operation, permanent or temporary, including construction, that can be considered an air contaminant source by the State of Oregon.	Submit application form, fees, and land use compatibility statement to DEQ. DEQ will review application for completeness, request additional information as needed, and provide comments for applicant to address prior to permit issuance.	Duration: Typically 6 months to 1 year for larger projects. No required time frame for permit approval.	All
SHPO	Archaeological Excavation Permit	ORS 97.745, 358.920, and 390.235 OAR 736-51	Required to excavate or alter an archaeological site on public lands, make an exploratory excavation on public lands to determine the presence of an archaeological site, or remove from public lands any material of an archaeological, historical, prehistorical, or anthropological nature.	Submit permit application and supporting documents to SHPO. Separate permits are needed for each property owner, city, or county where archaeological investigations are proposed. SHPO will review application for completeness, request additional information as needed, and once deemed complete, send the application out for review by the Legislative Commission on Indian Services, appropriate Tribes, landowners, local planning department, and the University of Oregon Museum of Natural and Cultural History.	Duration: Approximately 30 days after application is deemed complete by SHPO. Permit issuance may be delayed if the permit reviewers have objections that need to be resolved.	All

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Oregon Department of Transportation (ODOT)	Utility Facility Permit	ORS 374 OAR 734-055-0080	Any utility installations within the right-of-way of a state highway in Oregon. May be avoided if the project avoids ODOT right-of-way.	Submit application form and supporting materials to ODOT. Performance bond may be required.	Duration: Approximately 3 to 6 months after a complete application is submitted.	Gates System Layout Gates-Mill City FM
ODOT	Oversize Load Movement Permit/Load Registration	OAR 734-82	Transport of vehicles or loads having weight or dimension greater than that allowed by statute. May be avoided if construction vehicles do not have loads or a dimension greater than that allowed by statue.	Submit application form and supporting materials to ODOT.	Duration: Applications are worked in the order they are received, typically within 1 to 2 months.	All
ODOT	Permit to Construct a State Highway Approach; Permit to Operate, Maintain, and Use a State Highway Approach	ORS 374 OAR 734-51	Use of any access from Oregon state highways during construction or operation.	Following a pre-application meeting with ODOT, submit application form and supporting materials. ODOT will review application for completeness, request additional information as needed, and reviews application against design standards.	Duration: Approximately 120 days from the time application is deemed complete by ODOT. Additional time may be needed to resolve comments from ODOT on the proposed design.	Gates System Layout Gates-Mill City FM
Local Jurisdictions (Marion County)	Local Land Use/Zoning Change Permits	Applicable county codes	Construction of new utility facilities within local land use jurisdictions.	Submit application for zoning change. Once land use decision is issued, submit approval request for utility facilities. Public hearings required.	Duration: Approximately 12 months	All
Local Jurisdictions (Linn County)	Rural Resource Zoning District Conditional Use Permit	Applicable county codes Title 9 Community Development Chapter 933	Construction of a utility facility necessary for public service.	Submit permit application, which includes a narrative addressing the applicable decision criteria, site maps, and detailed information regarding the project. Public hearings required.	Duration: Approximately 4 months from the time application is deemed complete by the county.	WPCFRIB Gates System Layout

Agency	Permit or Approval	Regulation	Permit Trigger	Application Process	Timing Considerations	Applicable to Project?
Local Jurisdictions (Linn and Marion Counties)	Grading and Building Permits	Applicable county codes	Construction of new structures.	Following land use permit approvals, submit application and site plans to local jurisdictions' building departments.	Duration: Typically 3 to 6 months from application submittal.	All
Local Jurisdictions (Gates and Mill City)	Right-of-way	Applicable city codes	Construction of new pipelines and facilties.			All

Source: DSL (2023), Linn County (2023), Marion County (2023), NOAA Fisheries (2023), ODFW (2023a, b), Oregon Secretary of State (2022a–d), USACE (2021), USFWS (2023a, b).

KELLER
ASSOCIATES