Technical Memorandum

Northwest County Recycled Water Strategic Plan

Subject: Task 6.5 – Increasing Flow to RWQCP by Redirecting Existing Permanent Dewatering Systems to Sewers

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Date: December 30, 2020

Reference: 0038-032

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1 Background

The City of Palo Alto (City) and Valley Water have been conceptually evaluating a regional recycled water system to increase potable water supply by either Indirect Potable Reuse (IPR) or Direct Potable Reuse (DPR). To achieve potable reuse, an Advanced Water Purification Facility (AWPF) would receive treated wastewater flows (final effluent) from the Regional Water Quality Control Plant (RWQCP). Flows to the RWQCP have been lower than projected due to water conservation and are not anticipated to fully rebound to pre-drought levels by 2040. As a good steward of water resources, the City is considering creative ways to increase flows to the RWQCP by evaluating all water sources within the region, including local groundwater. The purpose of this technical memorandum (TM) is to analyze the feasibility of redirecting groundwater pumped from permanent dewatering systems at Oregon Expressway and City Hall to increase flows at the RWQCP for a future potable reuse project. To achieve this goal, this study estimates the groundwater volume that can be redirected via existing sewers, identifies permitting considerations pertaining to water quality, and identifies additional study to evaluate sewer system capacity and water quality.

2 RWQCP

Palo Alto owns and operates the RWQCP, a wastewater treatment plant with a dry-weather capacity of 39 million gallons per day (MGD) that currently treats an annual average influent of 20 MGD (2014-2019). The RWQCP discharges treated effluent to an outfall in Lower South San Francisco Bay and to Renzel Marsh, which ultimately drains to the Lower South San Francisco Bay via Matadero Creek. A portion of RWQCP effluent is further treated at tertiary recycled water facilities to produce a non-potable supply of recycled water. The tertiary recycled water facilities have a capacity of 4.5 MGD and currently produce an annual average of 0.6 MGD (2015-2017). The cities of Palo Alto and Mountain View use non-potable recycled water via a purple-pipe distribution system. Recycled water from the RWQCP is also available to Los Altos, Los Altos Hills, Stanford University and East Palo Alto Sanitary District through truck-fill stations. The locations of the RWQCP and the two permanent dewatering sites are presented on Figure 1.

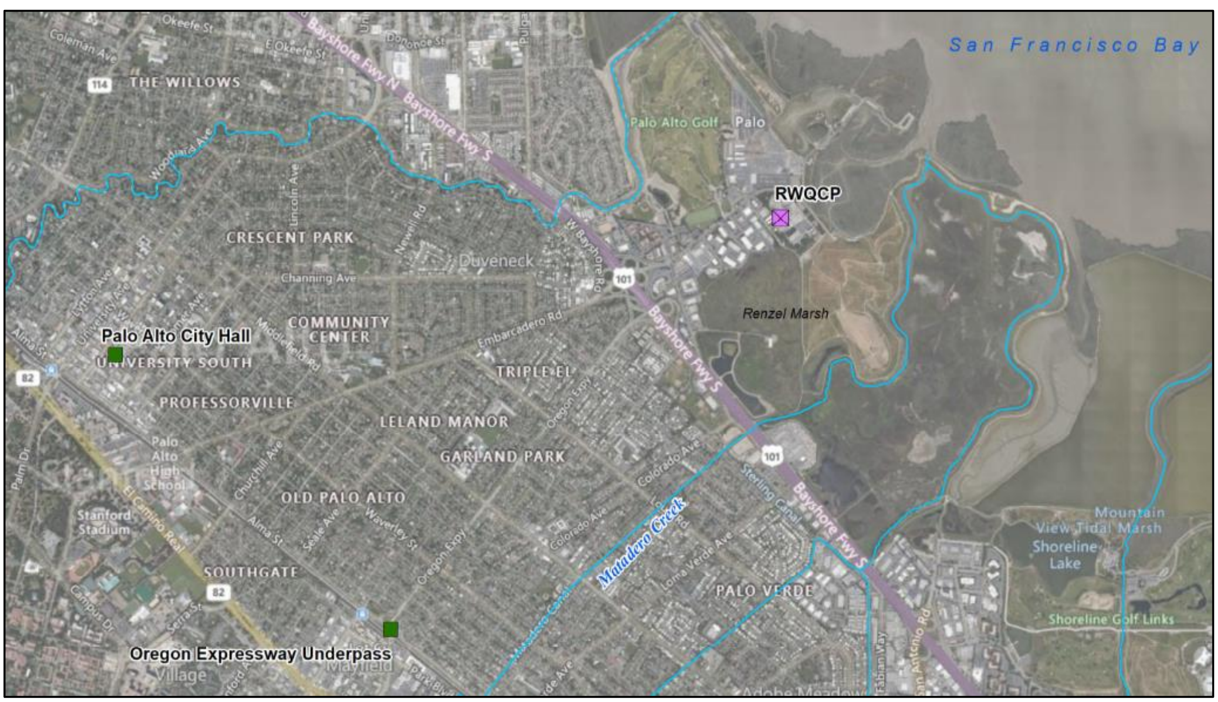


Figure 1: Study Location

3 Groundwater Quality

The City overlies a groundwater aquifer called the Santa Clara Sub-basin (DWR Bulletin 118 Basin 2-009.02), which consists of a shallow "unconfined" aquifer and a deep "confined" aquifer. The shallow and deep aquifers are separated by extensive clay deposits that form a confining layer or "aquitard" which prevents groundwater from moving between the shallow and deep aquifers (Todd Groundwater, 2018).

The aquifer is recharged by rainfall at the "unconfined" or "recharge" areas near the foothills, generally west of State Route 82. The depth of groundwater, indicated by the solid blue lines on Figure 2, decreases toward the northeast, indicating that the overall direction of groundwater flow is toward the Bay. Fall 2016 contour maps are based on water levels measured between October 1 and October 22, 2016 and represent groundwater elevations at the end of the multi-year drought.

Creeks within the City include Adobe, Barron, Matadero and San Francisquito. Depending on the drainage area, dewatering flows that are directed to the storm drain system end up in one of these creeks. Figure 3 shows the drainage areas for the City creeks. All City creeks, other than San Francisquito Creek, have substantial percentages of the channel converted to concrete-lined, engineered channels. The lining greatly restricts flow between these creeks and the groundwater system. In general, flows in Adobe, Barron, and Matadero Creeks will not recharge the groundwater table and will discharge to the Bay.

3.1 Ambient Shallow Groundwater Quality

Redirecting groundwater pumped from permanent dewatering systems at Oregon Expressway and City Hall to increase flows at the RWQCP for a future potable reuse project need to take into account the quality of the groundwater and its potential to negatively impact the AWPF process performance and/or the AWPF residuals/concentrate management handling and disposal.

Discharge of groundwater from the Oregon Expressway pump station is permitted by the National Pollutant Discharge Eliminations System (NPDES) Permit No. C4G912002. Key water quality parameters from the Oregon Expressway groundwater treatment system effluent are summarized in Table 1Table 1. Water quality from the permanent dewatering system at City Hall is not currently monitored but is assumed to be similar to the Oregon Expressway. Water quality at the City Hall dewatering facility should be evaluated to confirm this assumption.

Table 1: Oregon Expressway Groundwater Quality Summary

Sample Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	TDS (mg/L)
6/11/2018	6.86 – 7.95	0.4	1194	-
1/14/2019	8.13	-	-	-
1/17/2019	7.86	2.5	1207	852
1/25/2019	6.77	-	-	-
2/27/2019	7.62	3	1213	863
3/8/2019	7.96	-	-	-
5/9/2019	7.28	-	1241	-
5/29/2019	8.06	-	1228	-
6/10/2019	7.79	-	1217	-
6/21/2019	7.46	-	1215	-
Average	**7.6**	**2**	**1216**	**858**

Source: County of Santa Clara, NPDES Permit No. C4G912002 Self-Monitoring Reports

Given the conductivity/TDS of the Oregon Expressway is similar to the TDS of the RWQCP effluent (858 mg/L average compared to the RWQCP average of 900 mg/L), it is not expected to negatively impact the treatability of the RWQCP effluent at the AWPF; however, the groundwater at the Oregon Expressway is not monitored for other constituents that could have an effect on the selection and performance of the AWPF process train and residuals/concentrate management. Before considering this groundwater supply as a permanent source of water for the RWQCP, the dewatered groundwater should be analyzed and compared to the effluent water quality at the RWQCP to evaluate whether the mass loading of key constituents in the dewatered groundwater would impact the concentration of the RWQCP effluent. This evaluation would include testing for constituents such as silica, iron, nitrate, boron, and others depending on the AWPF treatment process being considered.

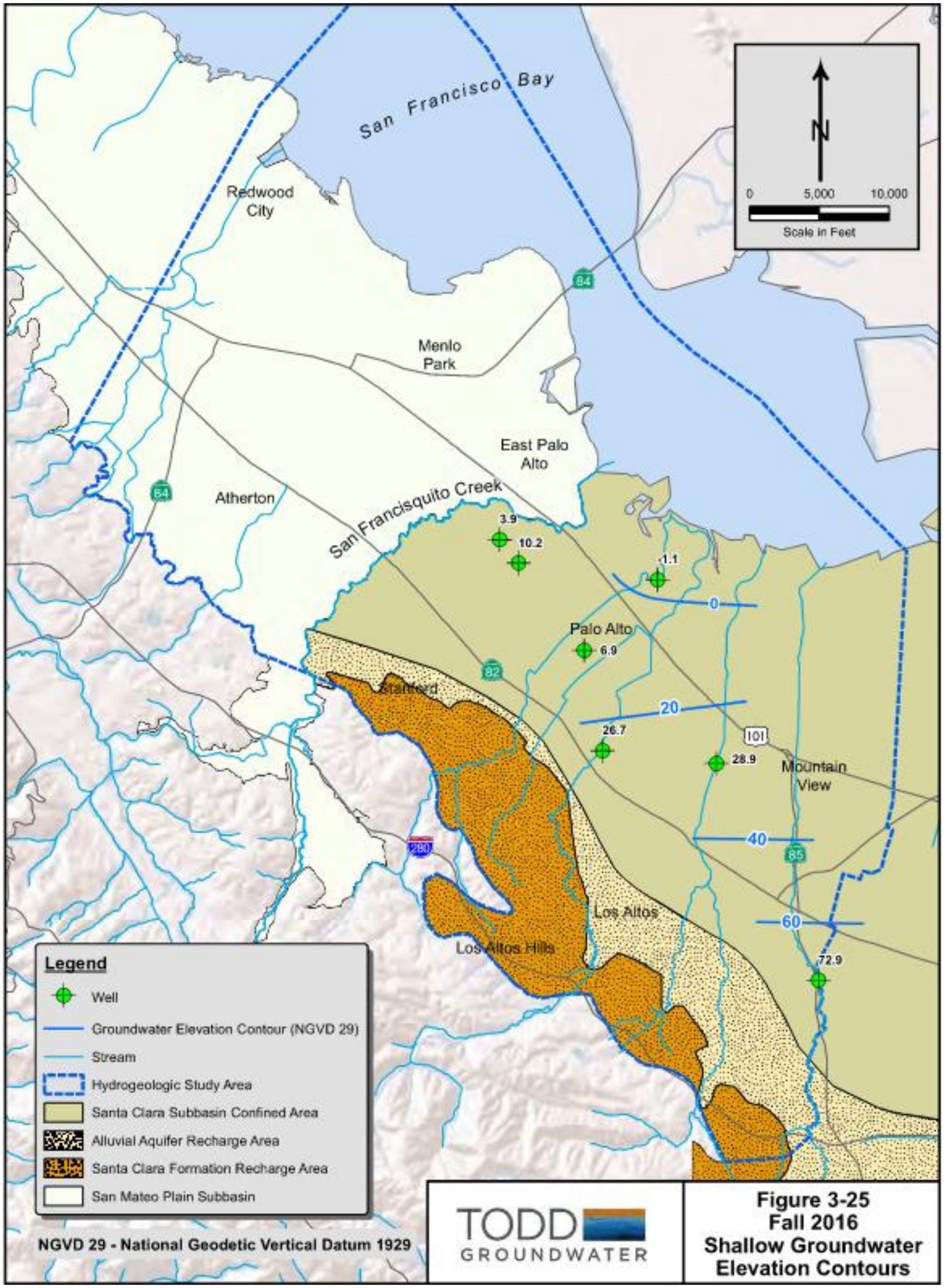
3.2 Groundwater Contamination

Groundwater contamination has been identified based on reports of releases and site investigations required by State and Federal environmental policies and regulations, or during due diligence investigations for real estate property transactions. Many of these sites have been investigated through installation and sampling of monitoring wells, and some sites have been partially or completely remediated, while others remain contaminated. Investigation and remediation are typically conducted by the responsible party or property owner under the supervision of the regulating agency or agencies.

At sites with groundwater contamination, downward gravity-driven migration through the vadose (unsaturated) zone causes contaminants to enter the saturated groundwater zone, where they flow via advection in groundwater, spread laterally and vertically due to dispersion and molecular diffusion, and depending on chemical type, can adsorb onto the solid aquifer matrix and/or degrade into other compounds. The extents of chemical plumes in groundwater are controlled by chemical properties and site-specific hydrogeologic conditions (e.g., groundwater flow rates and directions, both laterally and vertically, and the presence of fine- and coarse-grained layers that could impede or allow migration), as well as the size, duration, and timing of the release.

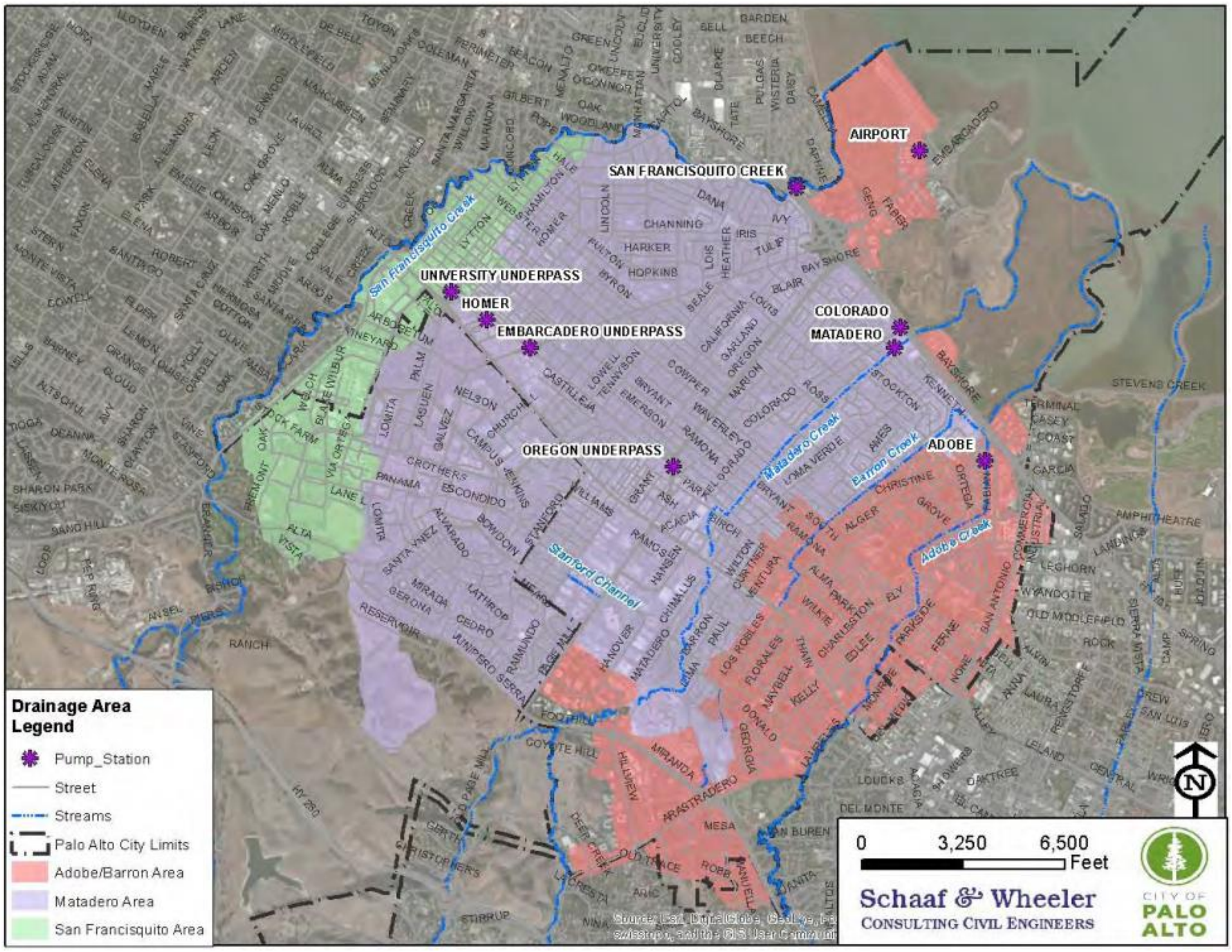
Figure 4 maps locations of known contaminant sites within the City, including leaking underground storage tank (LUST) locations. This map is provided to clarify the presence of volatile organic compounds (VOCs) in the groundwater pumped from the Oregon Expressway underpass dewatering site, which is located near the California Olive Emerson (COE) Study Area. Groundwater in much of the COE Study Area was contaminated with VOCs from former industrial sites, including tetrachloroethylene (PCE) and trichloroethylene (TCE) and their degradation products.

Since the construction of the Oregon Expressway in the 1960s, the underpass has been kept passable by actively pumping groundwater from a gallery of subdrains. The presence of VOCs requires the groundwater to be treated prior to discharge to the storm drain system. In 1987, a groundwater pump and treat system was permitted to allow the discharge of treated groundwater to Matadero Creek (RWQCB, 1987). Details of the Oregon Expressway Underpass treatment system are provided in Section 4.1.



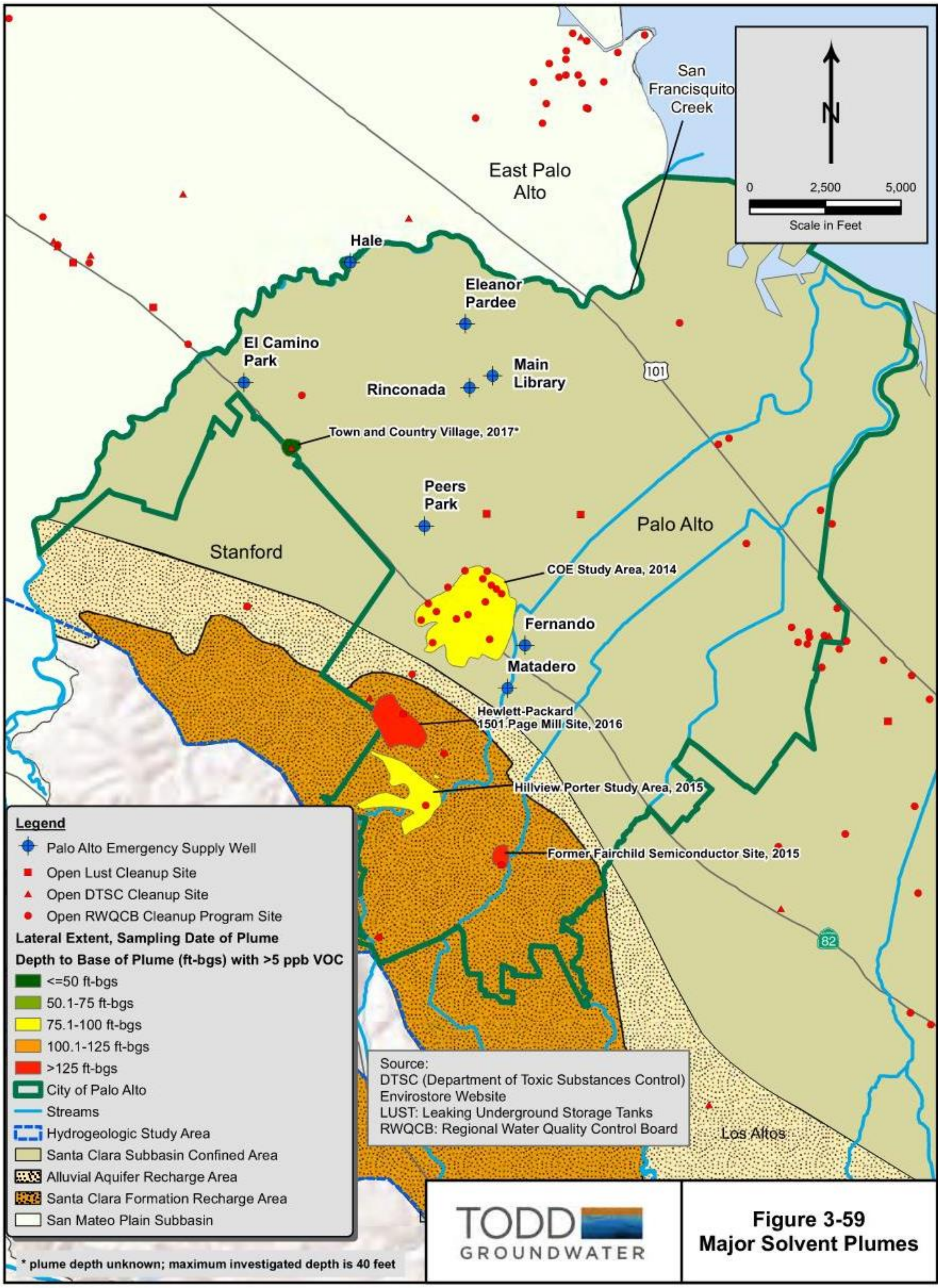
Source: Todd Groundwater, 2018

Figure 2: Shallow Groundwater Elevation Contours – Fall 2016



Source: Schaaf & Wheeler, 2015

Figure 3: Creek Drainage Areas



Source: Todd Groundwater, 2018

Figure 4: Groundwater Contaminant Plume Locations

4 Permanent Dewatering Sites

The City owns and maintains several pump stations that serve various purposes. When it rains, stormwater runoff is conveyed through the storm drain network for discharge to creeks or the Bay. Stormwater pump stations are necessary in some places to convey the stormwater through the network.

In other locations, dewatering pump stations remove groundwater to prevent it from seeping into underground facilities such as basements. Pump stations are also needed in underpasses to keep the roadways dry and allow vehicles to safely pass. Since groundwater is always present, pump stations that pump groundwater from roadway underpasses operate year-round to keep the roadways safe for travel.

One of the existing permanent dewatering sites evaluated in this study is the Oregon Expressway underpass pump station owned and operated by the County of Santa Clara. Another permanent dewatering facility operated by the City at the Palo Alto City Hall could also potentially also be used to augment flows. These are both discussed in the following sections.

4.1 Oregon Expressway Underpass

The Oregon Expressway underpass pump station is owned and operated by Santa Clara County and is located between Alma Street and the train tracks as indicated on Figure 5. The dewatering system conveys groundwater and surface stormwater runoff to the stormwater system using a pump station. Without this dewatering system, groundwater and stormwater would inundate the underpass roadway. The pump station also acts to contain the migration of contaminants in the shallow groundwater (RWQCB, 1987).

Source: Schaaf & Wheeler, 2015

Figure 5: Oregon Expressway Underpass Pump Station

Groundwater is collected by a gallery of underground collection drains that flow to a jockey pump at the pump station. Groundwater is pumped to an air stripper to remove VOCs. Stormwater is not treated. The capacity of the low flow jockey pump for groundwater is estimated at 350 gallons per minute (gpm), or 0.5 MGD. The larger stormwater pumps are two 15-horsepower float-controlled pumps which are estimated to have a maximum capacity of 1,200 gpm (1.7 MGD) each (RWQCB, 1987). The pump station discharges to a 6-foot square concrete box culvert which discharges into Matadero Creek At the discharge location, Matadero Creek is a concrete lined channel that flows northeasterly and ultimately discharges into the Bay.

Discharge of extracted and treated groundwater resulting from the cleanup of VOCs was originally permitted in 1987 under NPDES CA0029246, Order No. 87-129 by the San Francisco Bay Regional Water Quality Control Board (RWQCB). The discharge is now permitted under the General Permit Order No. R2-2018-0050, NPDES Permit No. CAG912002, which requires continuous flow monitoring and routine sampling.

In addition to the permit to discharge to the storm drain, the Oregon Expressway underpass pump station is permitted to discharge groundwater into the City's sanitary sewer system by the City of Palo Alto Public Works Groundwater Discharge Permit 201207, effective March 15, 2020 to March 14, 2021. The intent of this permit is to allow minimal intermittent discharge to the sanitary sewer when the air stripper system is not operational due to a maintenance or technical issue or when routine planned preventative maintenance is required. Discharge to the sanitary sewer is not allowed if the treatment system is operating and fails to meet the NPDES requirements. The permit states that the flow to the sewer is to be halted completely during storm events where rainfall exceeds 1 inch in 24 hours. The permitted discharge location and maximum allowable discharge rates are listed in Table 2.

Table 2: Permitted Sewer Discharge Location and Maximum Flows

Discharge Location	Maximum Instantaneous Flow Rate (gpm)	Maximum Daily Flow (gpd)
City Manhole #43-6-04	450	648,000

Flow totalizer data were provided for the period of January 2016 through June 2020. An analysis shows that the highest discharge to the sewer reached about 70% of the maximum permitted flow in April 2019 when the sewer discharge was approximately 450,000 gpd. Annual discharge amounts to the storm drain, sewer, and total are summarized in Table 3. Total discharge ranged from a minimum of 103 million gallons per year in 2016 to a maximum of 179 million gallons per year in 2017. Data for the year 2020 is not complete as of this writing.

Table 3: Oregon Expressway Underpass Pump Station Annual Discharge

Period	Annual Discharge to Storm Drain (Gallons)	Annual Discharge to Sewer (Gallons)	Total Annual Discharge (Gallons)
2016	100,943,724	2,404,278	103,348,002
2017	164,951,586	13,632,992	178,584,578
2018	124,805,248	3,191,790	127,997,038
2019	103,271,145	28,258,694	131,529,839
Jan - June 2020	62,994,391	2,129,128	65,123,519

Average daily discharge from January 2016 to June 2020 is illustrated on Figure 6. The average daily flow varied from a low of 286,000 gallons per day (GPD) (0.3 MGD) in 2016 to a high of 482,000 gpd (0.5 MGD) in 2017. Flows during the last three years from 2016 to 2019 were more consistent at approximately 354,000 gpd (0.4 MGD). The annual discharge to the sewer has ranged from a minimum of 2% of the total discharge in 2016 to a maximum of 20% in 2019, as indicated by the blue line on the graph.

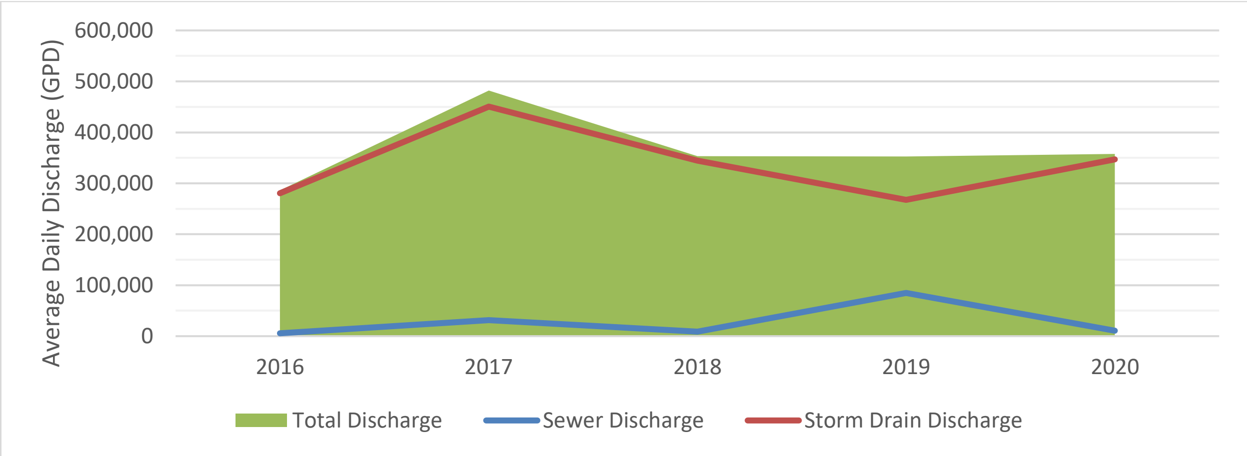


Figure 6: Oregon Expressway Underpass Pump Station Average Daily Discharge

The seasonality of the discharge is depicted in Figure 7, which illustrates that total discharge is generally highest from February through July and then declines to a low in December and January. Seasonal high flows in July are approximately 430,000 gpd.

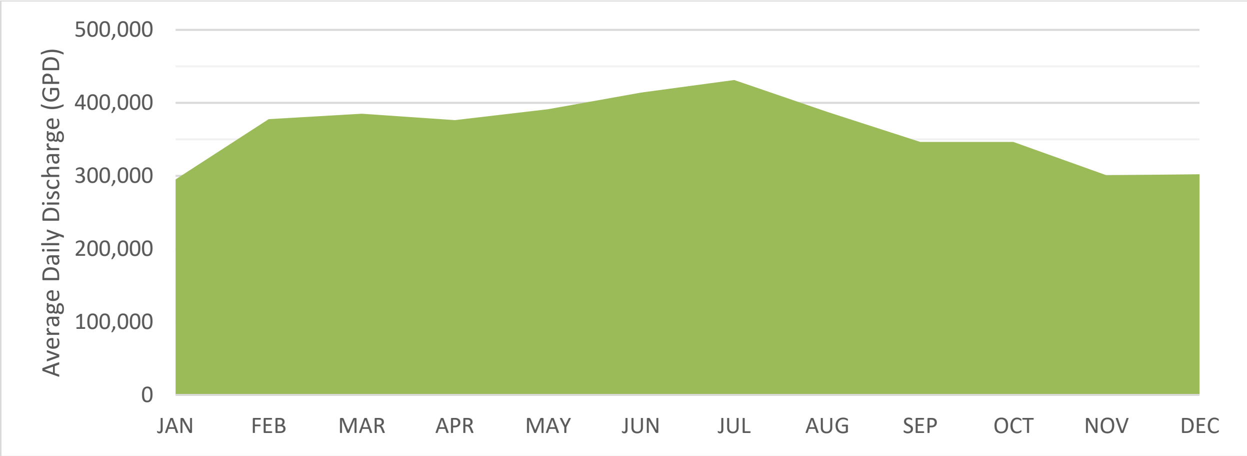


Figure 7: Seasonal Discharge 2016-2019

4.2 City Hall

Another permanent dewatering facility that could be potentially used to augment flows to the RWQCP is operated by the City and located at the City Hall. This site is not within a known groundwater contaminant plume and does not have a treatment system. Since it is not regulated, discharge monitoring is not required, and the City does not maintain flow records. Without flow records, it is assumed that the volume of water dewatered from the City Hall facility would be approximately the same as the Oregon Expressway underpass. Flow monitoring should be conducted at the City Hall dewatering facility to confirm this assumption.

5 Sewer Collection System

Information regarding the sewer collection system capacity was not available for review for City Hall or Oregon Expressway. Sewer capacity is estimated at Oregon Expressway based on totalizer flow data from the Oregon Expressway underpass pump station.

Per the permit described in Section 4.1, the maximum allowable instantaneous discharge from the Oregon Expressway underpass pump station to the sewer is 450 gpm with a maximum allowable daily flow of 648,000 gpd. The capacity of the groundwater pump limits the flow to the sewer to 350 gpm. Flow data show that discharges to the sewer have not reached or exceeded the maximum allowable limits. Per flow totalizer data, a maximum discharge to the sewer of 450,000 gpd (0.5 MGD) occurred in April 2019, which is about 70 percent of the maximum allowable daily flow permitted for intermittent discharge to the sewer collection system downstream of the Oregon Expressway.

Flow totalizer data from the Oregon Expressway pump station indicate that the sewer collection system has accommodated intermittent flows up to 0.5 MGD. To evaluate the flows that the sewer collection system could accept from the dewatering systems on a permanent basis, sewer modeling should be performed downstream of both the Oregon Expressway and City Hall sites.

6 Enhanced Source Control for Potable Reuse

The addition of permanent dewatering system water, or any new source of flow into the wastewater system, needs to consider the eventual treatability at the RWQCP. Source control in wastewater treatment is a critical element of environmental and public health protection. For conventional wastewater treatment, source control is achieved through pretreatment programs, which are components of the NPDES program. The objectives of approved pretreatment programs include:

- Prevention of interference, defined as a discharge that 1) inhibits or disrupts the treatment plant, its processes or operations, or its sludge processes, uses or disposal, and 2) is therefore a cause of a violation of any requirement in the treatment plant's NPDES permit;
- Prevention of pass through, defined as a discharge that enters waters of the US in quantities or concentrations that result in a violation of the NPDES permit; and
- Improvement of opportunities to recycle municipal and industrial wastewaters and sludges.

If a potable reuse project is implemented, regulations for enhanced source control would be more detailed and complex than those currently required for the RWQCP pretreatment program under the NPDES program. Pretreatment programs for potable reuse are primarily differentiated by the focus on providing a barrier for the protection of the recycled water with respect to both quality and reliability (i.e., human health), rather than focusing on the quality of wastewater discharged (i.e., environmental health).

Separate from assessing impacts of the ambient groundwater quality on treatability at the AWPF, regulatory requirements for enhanced source control programs reduce discharge of toxic chemicals into the municipal wastewater collections system that is a water source for a potable reuse program. Enhanced source control programs for potable reuse would, at a minimum, include:

- An assessment of the fate of State Board-specified and Regional Board-specified chemicals and contaminants through the wastewater and recycled municipal wastewater treatment systems
- Chemical and contaminant source investigations and monitoring that focuses on State Board-specified and Regional Board-specified chemicals and contaminants
- An outreach program to industrial, commercial, and residential communities for the purpose of managing and minimizing the discharge of chemicals and contaminants at the source, and

- A current inventory of chemicals and contaminants, including new chemicals and contaminants resulting from new sources or changes to existing sources, that may be discharged into the wastewater collection system.

Non-treatment barriers, such as enhanced source control, are an important part of ensuring the public safety of potable reuse but significant work is needed to develop enhanced source control criteria. (SWRCB, 2018).

7 Private Dewatering Systems

Of the groundwater containment treatment sites shown in Figure 4, some are in the form of long-term private "pump and treat" dewatering systems that discharge treated water into the storm drain system (approximately 40 currently active sites). From the 2018 average annual water balance, it is estimated that 900 to 2,500 acre-feet [252 to 700 MG] was extracted from the groundwater basin for remediation (Todd Groundwater, 2018, Table 3-5).

There are currently about 40 active private pump and treat sites in the City. While it may be physically possible to redirect these discharges to the sewer collection system, infrastructure and sewer capacity would have to be evaluated for each of the sites. Considerations would also have to be taken with respect to enhanced source control for potable reuse as discussed previously. Evaluation of the large number of pump and treat sites may be time consuming and costly.

Private dewatering pump and treat sites have additional institutional challenges to consider. Private sites would require negotiation of agreements (including transfer of liability) with private companies responsible for the sites as well as approvals from the agencies with regulatory oversight of the sites (USEPA, RWQCB, California Department of Toxic Substances Control, Santa Clara County Environmental Health Services (Todd Groundwater, 2018)).

Detailed information on the containment cleanup sites can be found in *the Groundwater Assessment and Indirect Potable Reuse Feasibility Evaluation and Implementation Strategy Northwest County Recycled Water Strategic Plan* (Todd Groundwater, 2018).

8 Findings and Recommended Next Steps

This evaluation shows that dewatering from the Oregon Expressway Underpass pump station could supply an average of 350,000 gpd and up to 450,000 gpd (0.5 MGD) of additional water to the RWQCP using existing pumps and sewer infrastructure. This would add approximately 2% to the total average RWQCP flow of 20 MGD. The additional flow to the RWQCP could potentially be increased to 1 MGD if the City Hall dewatering facility has similar groundwater flows and available sewer capacity. To confirm available flows, flow monitoring is recommended at the City Hall site. Sewer modeling should be performed downstream of both the Oregon Expressway and City Hall sites to assess the flows that the sewer collection system could accept from the dewatering systems and to support a permit for sewer discharge on a permanent basis.

Dewatering data from Oregon Expressway show that flows are typically higher in the spring and early summer than in the winter. Since potable water demands are typically higher during the warmer seasons, the dewatering supply would be available when it is needed most to meet customer demands, which is an added benefit for a potable reuse project.

Given the available groundwater quality information and the relatively small volume of flow expected in comparison to the total RWQCP flows, both sites would likely be an acceptable additional supply for a potable reuse project. Before considering these groundwater supplies as a permanent source of water for the RWQCP, the groundwater at both sites should be analyzed and compared to the effluent water quality at the RWQCP to evaluate whether the mass loading of key constituents in the dewatered groundwater would impact downstream purification treatment processes and/or impact residuals/concentrate handling from the AWPF. This water quality evaluation would include testing for constituents such as silica, iron, nitrate, boron, and others depending on the AWPF treatment process being considered.

Enhanced source control requirements for potable reuse are currently unknown but are anticipated to be more stringent than that required for current NPDES pretreatment programs. Groundwater contamination levels at Oregon Expressway would have to be compared to enhanced source control requirements when they are available to see if the supply would be compliant as source water for a potable reuse project.

Both sites would require permits from Public Works to discharge to the sewer on a permanent basis. The Oregon Expressway site presents additional institutional and permitting challenges since it is owned by the County of Santa Clara and operates under a NPDES permit. The recommended next steps for both sites are summarized in Table 4.

Table 4: Recommended Next Steps

Recommended Next Step	City Hall	Oregon Expressway
Flow Monitoring	X	
Sewer Modeling	X	X
Water Quality Evaluation	X	X
Enhanced Source Control Compliance		X
Institutional Coordination: Public Works	X	X
Institutional Coordination: Santa Clara County, Regional Board		X

9 References

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San Francisco Bay Regional Water Quality Control Board (RWQCB). 1987. Waste Discharge Requirements for Santa Clara County Transportation Agency Oregon Expressway Underpass Dewatering System; Order No. 87-129; NPDES Permit No. CA0029146.

San Francisco Bay Regional Water Quality Control Board (RWQCB). 2018. General Waste Discharge Requirements for Discharge or Reclamation of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Volatile Organic Compounds (VOCs), Fuel Leaks, Fuel Additives, and Other Related Wastes (VOC and Fuel General Permit); Order No. R2-2018-0050; NPDES Permit No. CAG912002.

Schaaf & Wheeler. 2015. Storm Drain Master Plan Update. June.

Todd Groundwater, Woodard & Curran. 2018. Groundwater Assessment and Indirect Potable Reuse Feasibility Evaluation and Implementation Strategy Northwest County Recycled Water Strategic Plan. November.

Appendix A – Schematic (Confidential)