

Technical Memorandum: Water Reuse Basis of Design

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1.0 INTRODUCTION

This technical memorandum is intended to outline the design criteria for the proposed district wastewater collection, treatment, and reuse system for Google's Downtown West Mixed-Use Project in San Jose, California. Relevant decisions that affect the direction of the Project have also been identified as they are key in ensuring a successful progression of the wastewater treatment plant design. Sherwood requests that Google provide feedback on the scenarios outlined below, so that Sherwood can prepare a summarized Basis of Design memo for presentation to the City of San José in January 2020. Google is requested to make decisions on the following aspects of the Project:

1. Overflow connection to the City's sanitary sewer - see [Section 5.4](#)
2. Odor and noise mitigation - see [Section 5.2.1](#)
3. Additional recycled water demand options to be studied - see [Section 3.0](#)

1.1 Project Background

The Downtown West Mixed-Use Project (Project) is an 11.6 million gross square feet (gsf) mixed-use development within the Diridon Station Area. The Project proposes district utility systems to satisfy its resource demands, including treating wastewater for non-potable water supply. The water reuse facility would likely be installed with the other mechanical equipment that will be co-located within the central utility plant(s).

1.1.1 Design Objectives and Considerations

Google intends to build a district water reuse system to mitigate the environmental impact of the Project and contribute to positive environmental change. Decentralized water reuse systems have been found to use less energy for pumping than conventional centralized treatment plants, when built at an optimal scale and in the right location (Kavvada, 2016). An analysis for the Project site found that a district water reuse system could be associated with fewer greenhouse gas emissions than the City's collection, treatment, and distribution system when considering the energy sources for each system. Further, developing a district water reuse system would align with Google's goal of being a leader in urban water systems and highlight the potential for innovation in response to a changing climate, increasing urbanization, and aging infrastructure.

Google's district water reuse system would include a sanitary sewer collection network, water reuse facility (WRF), and non-potable recycled water distribution system. The water reuse system would serve non-potable uses, such as toilet flushing, irrigation, and mechanical cooling.

The Project's proposed WRF could be owned and operated by (1) Google; (2) a third-party contracted by Google; (3) a multi-stakeholder entity comprised of local stakeholders (e.g., joint venture); (4) and/or the City of San José via a public-private partnership (P3). To date, the Project team has characterized the proposed collection, treatment, and distribution systems as Google-owned private systems. Under this pathway, Google or its contractor would be responsible for the ownership and operation and maintenance of the water reuse system.

The two main sanitary sewer trunk lines flowing through the Project site, the Lincoln Line (under Park Avenue) and the Sunol Line (under West Julian Street), are flowing roughly one-half and two-thirds full during dry weather flow conditions, respectively (Diridon Station Area Plan [DSAP] Existing Conditions Report, 2017). As outlined below, these sewer trunk lines flow under the Guadalupe and Los Gatos creeks via sewer siphons. The Existing Conditions Report notes that the City of San José "typically does not allow increases of flow rates through their existing siphons." Thus, the Project design includes a private sanitary sewer collection system and district wastewater reuse system to minimize new sanitary flows being discharged to the existing sanitary sewer system. This solution has the potential to obviate the need to upsize the City's system and reduce flows being sent to the San José-Santa Clara Regional Wastewater Facility (SJ-SC RWF). Flow modeling efforts are underway with the City to evaluate the capacity of the existing sanitary sewer system and are further detailed and discussed below.

Municipal recycled water is not currently available within the Project area. The closest municipal recycled water main is located in Autumn Parkway and ends on the north side of the Union Pacific Railroad tracks, beyond the Project boundary. No improvements to the pipeline were formally included in the City's DSAP, although an alignment for this pipeline was shown ([Figure 5.5.1, Diridon Station Area Infrastructure Analysis, 2017](#)). It should also be noted that HMM's "Infrastructure

Analysis” (2017) and Strategic Economic’s “Nexus Study” (2019) do not include recycled water utilities as an element of basic infrastructure (no associated impact fee). While there is no documentation that the City will be extending the recycled water main, the City has expressed interest in doing so during in-person meetings. Google could propose to pay for an extension of the existing recycled water pipeline to serve the Project area and future non-Google properties. Under this proposal, the recycled water supply and quality would be dictated by the City’s system and Google would not be responsible for the operations or maintenance of a water reuse facility or recycled water distribution system.

As detailed here, a district water reuse system is proposed for the Project because it offers sustainability, economic, and leadership benefits. Google is proposing a private recycled water supply and distribution system to distribute recycled water to all Project development parcels. The recycled water distribution system would be routed through a utility corridor (“utilidor”) and connect to all proposed building sites to supply interior non-potable plumbing and landscape irrigation. The recycled water supply would also be sent to the proposed thermal heating and cooling plant as a source of makeup water supply for the cooling towers.

The Project will meet CalGreen requirements for plumbing and irrigation. CalGreen is California’s mandatory green building standards code, which specifies maximum flow rates for indoor plumbing fixtures and fittings and provides guidelines for water use in outdoor landscape areas. The Project’s design team also intends to achieve Leadership in Energy and Environmental Design (LEED) for Neighborhood Development Gold Certification, and is pursuing designation as an environmental leadership development project under California Assembly Bill 900 (AB 900). Using non-potable water to reduce potable water consumption allows the Project to meet the indoor and outdoor water efficiency credit requirements for LEED certification. It also aligns with the City of San José’s goals of reducing potable consumption and recycling 100% of wastewater. As outlined in the water balance analysis below, replacing potable water with recycled water for non-potable uses (toilet flushing, cooling, irrigation) reduces the Project’s water demand by 98 million gallons per year (MGY) (approximately 27% of the Project’s total water demand).

2.0 WATER BALANCE ANALYSIS

A planning-level monthly water balance model was developed for the Project to account for all water and wastewater flows to and from the site. Further refinement of the water balance model will be required as the design progresses.

A preliminary estimate of water use at the Project has been developed by applying water unit demands (water use per person or activity) to the expected development program as provided by the Project team. Other site demands including irrigation and mechanical makeup have also been quantified. Building facades, photovoltaic panel arrays, and hardscape will also require periodic washing that could be performed with recycled water; a preliminary water demand estimate for those uses has been included. Alternative water sources at the Project include wastewater (including both graywater and blackwater) and rainfall. Rainwater capture and stormwater management will be evaluated at a parcel by parcel level and is not included here as a project-wide supply for water reuse.

A comparison of the site water demands and alternative water sources are presented below. The design team considered multiple water reuse scenarios at the Project including the following:

1. Treat all wastewater generated by all buildings in the DSAP area (including properties not owned by Google).
2. Treat all wastewater generated by Google-owned buildings only.
3. Treat enough wastewater to meet non-potable demands for all buildings in the DSAP area.
4. Treat enough wastewater to meet non-potable demands for Google-owned buildings only.

A water balance analysis was completed for each scenario and an estimate of the footprint of each treatment train was presented to the design team to determine which scale of water reuse to pursue. Ultimately, Scenario 2 was selected as the basis of design for the water reuse facility at the Project because in theory, under this scenario, no additional wastewater flows would be added into the City of San José’s aging and potentially undersized collection system. This eliminates or at least delays the need for improvements to the City’s system. An analysis of the anticipated flows and associated loads to the wastewater treatment system was conducted to refine the system’s required capacity. Under Scenario 2, additional non-potable demands will need to be identified in order to beneficially reuse all of the wastewater generated by Google-owned buildings.

Non-potable demands for all buildings in the DSAP, including Google buildings, were estimated at approximately 180 MGY. Potable demands for all buildings in the DSAP, including Google buildings, were estimated to be 475 MGY. Anticipated wastewater supplies from Google parcels were estimated to total 285 MGY. Non-Google wastewater was estimated to be about 230 MGY per year, with all of that wastewater being sent to the SJ-SC RWF. Lastly, consumption and evaporative losses were estimated to be approximately 135 MGY.

These estimates show that a consistent supply would be available to be treated for non-potable demands, but that the supply would exceed non-potable demands significantly during the winter season, as further discussed in [Section 3. Figure 1](#) (below) visually presents the water demands and wastewater supplies at the Project, and shows the flow path for how Google wastewater could become a non-potable supply for all buildings in the DSAP.

Annual Flows millions of gallons per year

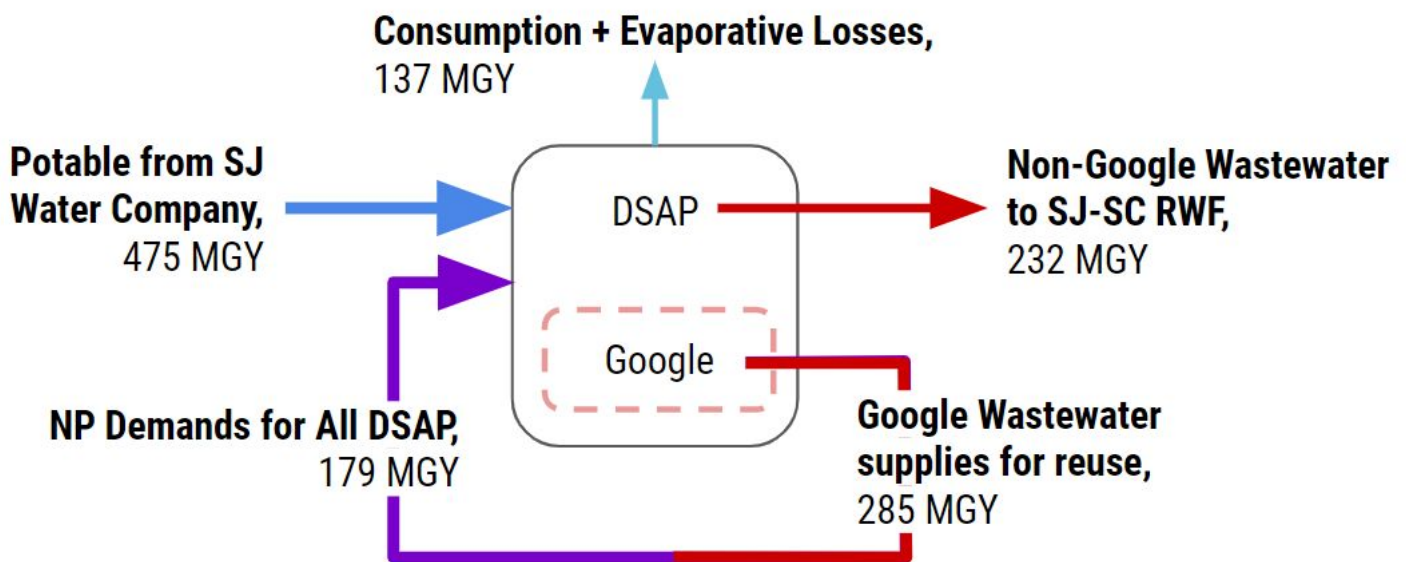


Figure 1: System diagram showing annual flows in million gallons per year (MGY).

DSAP - Diridon Station Area Plan
MGY - million gallons per year
NP - non-potable

RWF - Recycled Water Facility
SC - Santa Clara
SJ - San Jose

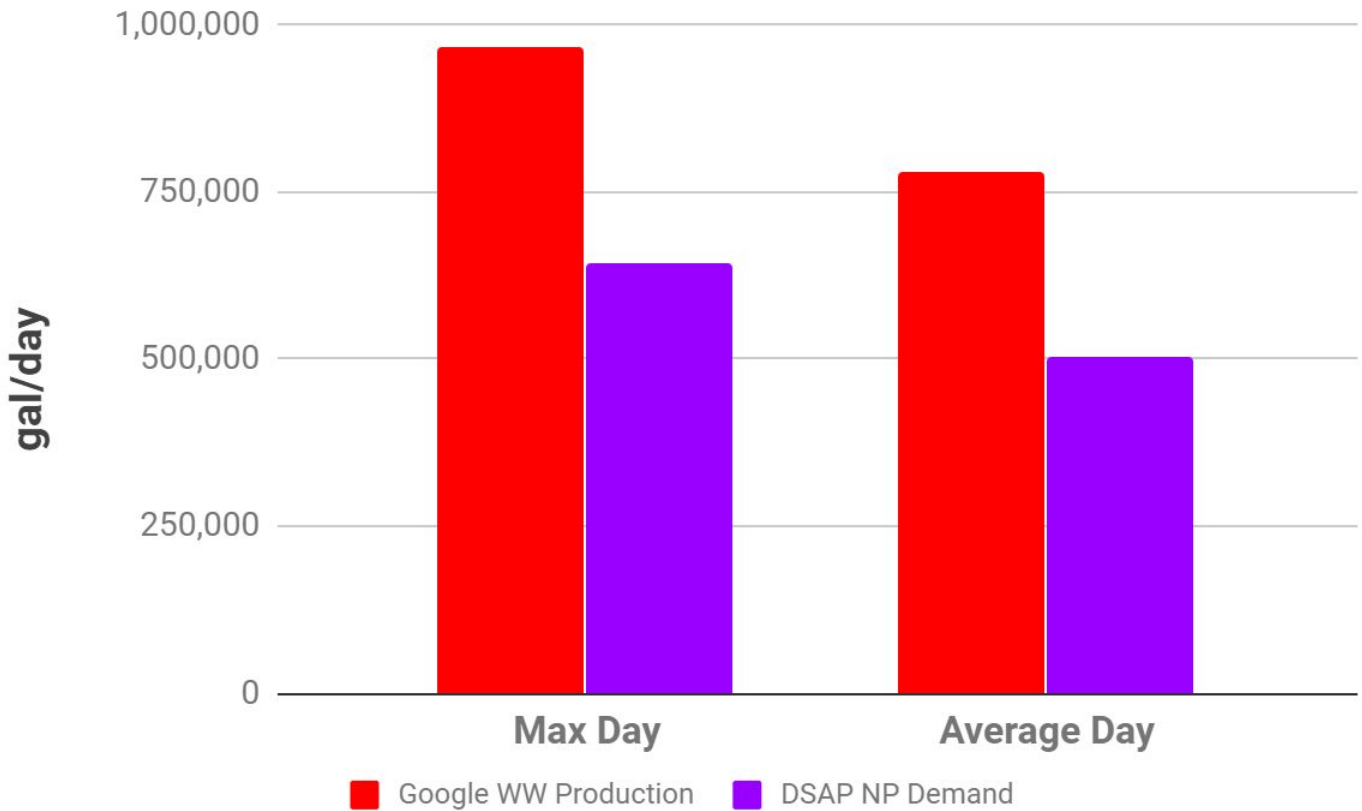


Figure 2: Peak and average day comparison of Google wastewater (WW) production and non-potable (NP) demand for all proposed development in the DSAP (including non-Google buildings).

As the Project design progresses, program decisions will result in further water balance refinements. Programmatic factors and adjustments, such as accounting for buildings that are tenant improvement only (not producing wastewater), have not yet been accounted for and will be included in the next round of updates.

2.1 Water Demands

2.1.1 Interior Water Demands

Each program type has different water demand requirements. These requirements were estimated using unit demand values (gallon per occupant per day) or spatial demand factors (gallon per square foot per day) as outlined in the Appendix. Unit demands are also referred to as “demand factors” in some analyses including Water Supply Assessments conducted by City of San José and San Jose Water Company. Interior water demands are modeled using unit demands for each program type and anticipated occupancy throughout a typical year. These modeled water demands are then used to calculate wastewater generation (flows and volumes), as well as non-potable water demands for the Project. Both wastewater generation and non-potable water demand drive the wastewater treatment plant sizing.

The Project plan proposes 4,700 residential units encompassing approximately 4 million gross square feet. Office space is anticipated to occupy 6.4 million gross square feet with occupancy ranging from 23,000 to 35,000 seats. Amenity programs include a hotel, retail/commercial, restaurant, logistics/warehouse space, and district systems allocation. Total program area for the Project is estimated to be 11.6 million gross square feet. Refer to [Table 6](#) in the Appendix for a summary of the program used for the basis of design water balance. Note that the maximum expected occupancy (35,000 seats) was used for the water balance calculations presented in the Planning Application analysis to be conservative.

Potable and non-potable water demands for all programs were estimated using the given programmatic unit demand value. Potable interior demands include kitchen and lavatory faucets, showers, laundry and dishwashers. Non-potable interior demands include toilet flushing and urinal flushing. Toilets in restaurant spaces will use potable water for toilet

flushing to eliminate any risk of cross-connection of non-potable water in kitchens. Total interior demands for the Project are estimated to be 311 MGY. Potable demands represent 85% of the total demand (263 MGY) and are estimated at 720,000 gal/d on average. Non-potable demands are estimated at 48 MGY, a daily average of 131,000 gal/d.

2.1.2 *Diurnal Flows and Demands*

At a mixed-use development, wastewater has a relatively consistent flow and characteristics that make it an optimal alternative water supply for non-potable reuse. Daily variations in wastewater flow and recycled water demand are expected as occupancies vary at the Project throughout the day. An increase in wastewater flow is expected from residential spaces early in the morning while residents shower for the day and at night when they arrive home from work and prepare dinner among other water-consuming activities. There will also be an associated recycled water demand for the residential program (toilet flushing) in the morning and evening times. At the office, a peak in recycled water demand is expected to occur at mid-day, when occupancy is at its highest, accounting for toilet flushing and cooling demands. Irrigation systems are typically programmed to operate at off peak hours. The daily offset of peak supplies and demands experienced at mixed-use developments is beneficial for water reuse systems as it minimizes the need for storage by providing diurnal equalization of wastewater flows through the treatment system.

2.1.3 *Cooling*

The makeup water supply for the Project will be provided via a central utility plant (CUP) where cooling towers will be used to produce chilled water for circulation. Estimates for cooling demand assumes the system will employ geothermal heat exchange, as implemented on previous projects, which will reduce the required water makeup demand by an estimated 25%. Evaporative cooling losses are expected to be, on average, 100,000 gallons per day (gal/d), or 36 MGY, based off of average monthly temperatures for the area and the projected number of days requiring cooling. The maximum daily water demand for cooling is estimated at 115,000 gal/d.

2.1.4 *Irrigation*

There will be an estimated 16 acres of landscaped space. To be conservative, 100% of non-paved open space was considered to be irrigated landscape. The landscaped areas will include turf, shrubs and trees, and riparian corridors. Riparian corridor areas within setbacks from Los Gatos Creek will not be irrigated after establishment. Irrigation demands are estimated using the Maximum Applied Water Allowance (MAWA) method as put forward by the California Model Water Efficient Landscape Ordinance. The MAWA method estimates the irrigation demand using (1) the site evapotranspiration (ET_o) rate and (2) an adjustment factor that accounts for irrigation efficiency and typical California vegetation (ET_o adjustment factor of 0.7). ET_o data was not readily available for San Jose, thus monthly values were interpolated from Gilroy and Union City data (California Irrigation Management Information System [CIMIS]). Annual ET_o for the project is estimated to be 46.9 inches. Preliminary average daily irrigation is estimated to be 38,700 gal/d or 14 MGY with maximum daily demand calculated to be approximately 63,000 gal/d.

2.2 *Alternative Water Supplies*

The projected wastewater volume is calculated by assuming 90% of potable water demands become wastewater (10% of the volume is consumed) and 100% of non-potable water demands become wastewater (e.g. from toilet flushing). Wastewater will be collected from every Google parcel and conveyed via the collection system to the water reuse facility for treatment and reuse as outlined below. Wastewater production is estimated to be 780,000 gal/d on an average day, 967,000 gal/d on a maximum occupancy day, and 285 MGY.

2.3 *Water Balance Results*

A monthly water balance analysis was carried out for the Project to estimate water supply and demand variations anticipated throughout the year. Seasonal demands (for cooling water and irrigation) typically reach their maximum value during the summer and treated non-potable water produced at the water reuse facility must be available to meet those conditions; otherwise potable water would need to be used as a makeup supply. [Table 1](#) summarizes the interior and seasonal (cooling and irrigation) demands and the expected wastewater volume that can be collected and treated at the water reuse facility during peak and average conditions. The maximum daily demand is estimated by modeling the peak conditions for interior non-potable demands coinciding with peak occupancy conditions. Taking a full inventory of all interior non-potable demands, seasonal water needs (including cooling and irrigation), and wastewater generated and collected, demonstrates that all non-potable water demands for the Project can be met through wastewater reuse during

average and peak conditions. Further, the water balance results show that collecting from all Google buildings and only supplying water for Google's non-potable demands would result in an average surplus of 187 MGY of wastewater.

Table 1: Water balance summary at the Project

Flows	Maximum Day (gal/d)	Average Annual (gal/d)	MGY
Demands			
Total Interior Demands	1,055,000	852,000	311
Potable	884,000	721,000	263
Non-potable	171,000	131,000	48
Total Seasonal Demands (all non-potable)	179,000	95,000	50
Cooling	115,000	82,000	36 ¹
Irrigation	64,000	13,000	14
Total Demands (potable plus non-potable)	1,234,000	947,000	361
Total Non-potable Demands (interior non-potable plus seasonal)	350,000	226,000	98
Percentage of Non-potable Demands to Total Demands (%)	28%	24%	27%
Wastewater Generation (supply)	967,000	780,000	285
Surplus (supply minus non-potable demands)	617,000	554,000	187

Notes:

1. On November 26, 2019, Arup provided an annual cooling demand estimate of 27 MGY. The cooling demand estimate used in the Planning Application (36 MGY) is retained here to provide consistency with City documents.

[Table 2](#) presents three scenarios that illustrate the surplus wastewater volumes in the water balance. The minimum excess wastewater volume will exist when there is a peak seasonal demand (summer) and average occupancy in the buildings (Scenario 1). On the weekends or holidays, when occupancy in the office buildings is expected to be minimal, but residential and retail spaces are expected to be near full occupancy, surplus wastewater could be up to 455,000 gal/d (Scenario 2). During the winter months, when seasonal demands are lowest, on an average winter day there could be a surplus of 554,000 gal/d (Scenario 3). Lastly, in the situation where the Project experiences peak occupancy at the same time as minimal seasonal demands, there could be a surplus of up to 700,000 gal/d (Scenario 4).

Table 2: Daily non-potable demands and wastewater supplies at the Project

Occupancy / Seasonal Scenario	Daily Surplus (gal/d)
1 Minimum Excess Wastewater: average annual occupancy and peak seasonal demands	430,000
2 Wastewater Surplus: on weekends	455,000
3 Winter Day Surplus: average occupancy and winter demands	554,000
4 Maximum Excess Wastewater: peak occupancy and winter demands	701,000

As the design for the water reuse facility at the Project progresses, strategies to allocate additional uses for the excess treated non-potable water will be studied and included. The following section discusses some of these initial strategies and potential uses for surplus treated non-potable water.

3.0 STRATEGIES FOR ALLOCATING SURPLUS TREATED NON-POTABLE WATER

As highlighted in [Table 1](#) and [Table 2](#), the proposed water reuse scenario (scenario 2) of collecting wastewater from all Google buildings for treatment and reuse on Google parcels yields a surplus of wastewater year round. Assuming

average occupancies, the daily surplus ranges from 455,000 gallons to 554,000 gallons depending on seasonal demands. This surplus is approximately half of the treated non-potable water produced at the water reuse facility (WRF). This surplus non-potable water produced at the WRF will either need to be beneficially reused after treatment or can be sent as overflow to the City's sanitary sewer. Alternatively, the WRF could only treat as much wastewater as needed for district demands and divert surplus wastewater to the City sanitary sewer (water reuse scenarios 3 or 4 as described in [Section 2.0](#)). Refer to [Section 5.4](#) below for details on connecting to the City's sanitary sewer network. Additional strategies for reusing site-produced non-potable water within the Google development are outlined below; these are presented in addition to the "baseline" demands already discussed (Google toilet flushing, irrigation and cooling).

Sherwood requests that Google provide direction on which non-potable water application strategies to pursue further; noting that when Project demands are low (e.g. irrigation and cooling in the winter), similar demands from adjacent properties are most likely low as well.

In addition to Google non-potable demands, there are water demands at the Project site and within the DSAP area that could be met with non-potable water from the Google WRF. One expected Project non-potable demand is irrigation for living roofs (green roofs) on Google buildings. As this is a dense urban project, it is expected that there will be minimal available space for stormwater management (e.g., bioretention) at grade, and that up to 17 acres of living roof may be needed to meet code requirements. A preliminary estimate for green roof irrigation is 15 MGY, with a peak day demand of 68,400 gallons based on MAWA calculations.

Another expected Project non-potable demand is for maintenance activities such as photovoltaic (PV) panel array cleaning, which, based on previous Google projects, uses 1-4 gallons of water per square foot (sf) of panel during each wash event, which occur as frequently as twice a year. Total potential water use for PV washing on Google buildings could range from 4 to 9 MGY. Other maintenance activities that could use recycled water include hardscape maintenance (street cleaning) or potentially transit washing and maintenance of Google-owned maintenance equipment and vehicles (e.g. shuttle buses). Any runoff generated from these maintenance activities would need to be closely controlled to avoid runoff into the storm drain system. Co-mingling of recycled water with stormwater is typically not allowed by the State Water Board. However, there may be potential to reach a mutually agreeable solution to allow for this use. Further coordination with the San Francisco Bay Regional Water Quality Control Board, Santa Clara Valley Water District, and/or City of San José is merited to validate this end use of recycled water. In addition, more work is needed to refine the potential volume of use and its impact on the seasonal water balance.

Streamflow augmentation in the adjacent creeks (directly or through infiltration) could warrant further investigation; although this is likely not a reliable wet season solution. Groundwater recharge could also be investigated but would require additional treatment, permitting, and agency coordination.

Treated non-potable water could also potentially be "exported" to non-Google-owned parcels in the DSAP area (water reuse scenario 1 from [Section 2.0](#)). Exporting would require Google, or a third party operator contracted by Google, to form and/or operate as a water utility, e.g., as an investor-owned utility or a mutual water company. Additionally, recycled water distribution infrastructure beyond Google's private utility corridor ("utilidor") and distribution network would need to be constructed to provide supply to these neighboring parcels. Further, connection and use agreements would have to be established with the non-Google owners. Refer to the [Water Utility Formation TM](#) for additional details on the ownership and management options for the Project's district water reuse system. Non-potable demands for non-Google buildings in the DSAP were estimated using the program presented in the DSAP and per the City of San José's "Major Development Projects" [website](#). Occupancy for the non-Google office, residential and retail properties was estimated using the same density factors as Google properties. Demands and supplies were estimated using the same high efficiency unit demands as Google properties. As this is an urban site, it was assumed that 10% of the non-Google properties are pervious, and to be conservative, 100% of pervious area is irrigated (8 acres, 8 MGY). Cooling demands were estimated assuming all office, residential and retail spaces are air conditioned (10.4M GSF, 32 MGY). These export volumes are approximately equivalent to the Google non-potable demands, at 73 MGY, with a peak day demand of 217,500 gal/d.

After estimating these potential additional non-potable demands, the water balance still shows an excess wastewater supply of up to 357,000 gal/d in winter months, as shown in [Figure 3](#). It is suggested that Google investigate other adjacent neighboring properties which would benefit from a non-potable water reuse supply, specifically in winter months (e.g., toilet flushing in dual plumbed buildings).

One potential solution that merits further investigation would be to work with a horticulturalist to plant vegetation that thrives with abundant water supply in the winter. Vegetation with a water supply in the winter can continue to grow year round. Trees, for example, can grow their canopy during the winter months, increasing the site’s resilience to urban heat island and providing year-round benefits for ecology and wellbeing. Additionally, the Project could be to partner with a well-established, local urban agriculture organization to create year-round gardens that could benefit from the application of winter water and/or to supply winter water to existing local gardens.

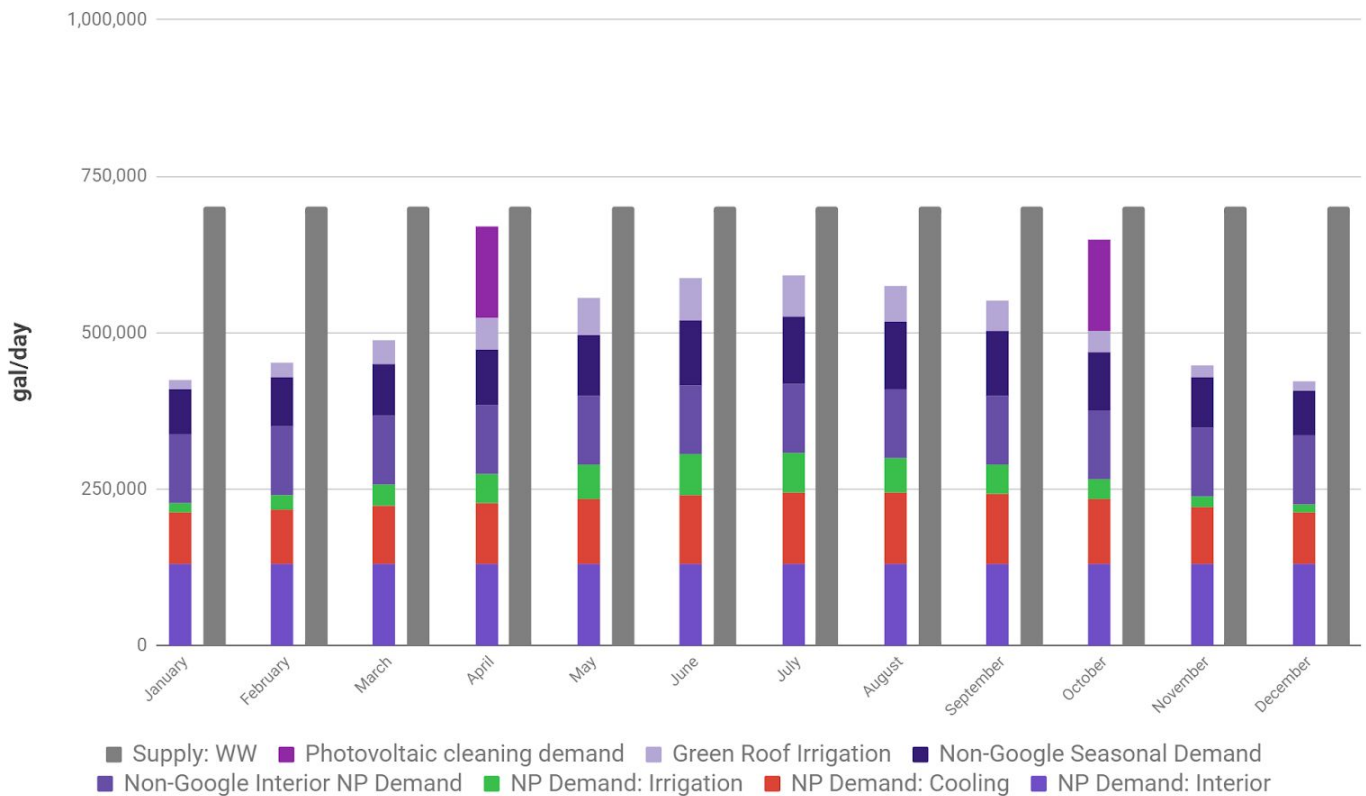


Figure 3: Average monthly water balance at Downtown West accounting for wastewater (WW) supply, non-potable (NP) demand at adjacent properties, and other estimated Project non-potable demands.

Table 3: Strategies for allocating surplus treated non-potable water

	Average Winter Day (gal/d)	MGY
Initial Surplus (supply minus “baseline” non-potable demands)	553,700	187
Additional Non-potable Demands (allocation strategies)		
Irrigation for living roofs (green roofs) on Google buildings	14,300	15
Photovoltaic panel array cleaning on Google buildings	<i>n/a</i>	4 to 9
Hardscape maintenance (street cleaning)	<i>tbd</i>	<i>tbd</i>
Transit washing and maintenance	<i>tbd</i>	<i>tbd</i>
Streamflow augmentation in the adjacent creeks	<i>tbd</i>	<i>tbd</i>

Groundwater recharge	<i>tbd</i>	<i>tbd</i>
“Exported” to other buildings in the DSAP area	182,200	73
Plant vegetation that thrives with abundant water supply	<i>tbd</i>	<i>tbd</i>
Remaining Surplus (initial surplus minus additional non-potable demands)	357,300	89

4.0 WASTEWATER SYSTEM IMPROVEMENTS

4.1 Wastewater Production

The Project’s wastewater production is relatively consistent throughout the year and varies only based on building occupancy. The total recycled water produced reflects losses anticipated in the wastewater treatment process (e.g., solids wasting). A design flow rate of 1,000,000 gal/d (1 million gallons per day [MGD]; 3,785 m³/d) is used throughout the wastewater analysis to ensure the system can meet the maximum day wastewater production (967,000 gal/d).

4.2 Wastewater Collection

The proposed system will collect wastewater from all of the Project’s proposed development parcels via a Google-owned private collection network that will convey wastewater to the water reuse facility. The private, low-pressure sanitary sewer collection network will be integrated into the proposed utility corridor (“utilidor”) alignment. Refer to Sheet 3.21 in the Planning Application for the Conceptual Sanitary Sewer Plan.

Sanitary waste will be collected in pump stations located in the basement level of individual developments. Each pump station will include a collection tank and a pump system to convey the wastewater into a low pressure force main, which will be routed within the proposed utilidor and ultimately to the water reuse facility. It is assumed that each building will have a basement with sufficient space allocated for the sanitary waste pump station.

A low pressure collection system (also known as a pressure sanitary sewer, PSS) is advantageous for this site as it allows for the controlled transfer of sewage in a far more efficient footprint than conventional gravity systems. A pressurized system would allow for wastewater collection along the utilidor whereas a gravity system would require that a dedicated trench be constructed with larger diameter pipes to achieve adequate slope for flow. Expansion of a PSS typically involves upsizing the accessible lift stations rather than upsizing a gravity main. Further, a PSS operates through a sealed system, eliminating leakages (exfiltration) and stormwater inflow and infiltration (I/I) while also reducing odor issues. A PSS also allows for system optimization, as the operator can program operating periods and stagger peak loads, which could potentially reduce overflow volume that would be sent to the City.

4.3 District Water Reuse Facilities: Benefits and Considerations

As demonstrated by similar existing water reuse systems, district systems are viable and reliable engineering solutions during both normal operations and extreme weather events (e.g., [Battery Park City’s system during Hurricane Sandy](#)). District and decentralized systems can be placed at higher elevations, lifting this critical infrastructure out of the floodplain. In addition, these small systems are straight forward to operate when designed with simplicity in mind and do not require 24/7 staffing. These systems utilize state-of-the-art remote monitoring and real-time controls that increase performance predictability and allows immediate response for both routine operations and during an emergency.

The team considered two options to accommodate the Project phasing: one water reuse facility (WRF) serve the entire Project area or two facilities that would treat smaller volumes, minimize collection and distribution across the site and allow for phased capital investment. In addition, in the case where the current surface parking parcels around the SAP center are not incorporated into the development, it may not be desirable to connect the northern parcels across W Santa Clara Street. At this time, the design intent is to have one WRF, situated in the south end of the site on parcel G1, potentially expanding across Park Ave onto parcel F5. The selected location is within Phase 1 of the development area, which allows for wastewater treatment as of the first day of business. Dependent on negotiations for the current SAP Center parking lots A, B, & C and related construction phasing implications, flows may need to be divided to two WRFs, where the second WRF would be located on the north end of parcel B1. Each WRF is situated adjacent to an existing public sanitary sewer main to minimize connection distance, if required.

The WRFs would be co-located with the mechanical and thermal equipment in the central utility plant (CUP). Space has been reserved at the South WRF for it to house the full treatment plant if the Project pursues one WRF.

If two WRFs were to be required, it is assumed that all of the sanitary sewer network south of W Santa Clara Street would flow to the South WRF (65% of total wastewater flows), and the remaining 35% of flows would go to the North WRF. Flows from each parcel were estimated using program information outlined in [SiteLab's Framework Overview presentation \(May 29, 2019\)](#). Dividing the flow into two locations reduces the maximum flows through the network, and potentially reduces the size of upgrades that may be required for the receiving sewer pipes.

4.3.1 *Massing Model*

Sherwood has worked with SiteLab and Arup to produce a consolidated massing model of the CUPs including the WRFs. Refer to the [KPF Kickoff presentation](#) for visual representation of the massing model. This process assured design coordination and ensured that the access requirements for the routine maintenance of the WRF were incorporated into the design of the CUP.

4.4 Non-Potable Water Quality Objectives & Regulatory Requirements

As stated previously, the anticipated end uses for the non-potable water produced at the WRF(s) are landscape irrigation, toilet flushing and mechanical cooling. The treatment train as conceived does not anticipate additional non-potable demands. Inclusion of some end uses may require additional treatment. For the currently proposed end uses, unrestricted reuse standards must be met. As such, all wastewater will be treated to meet disinfected tertiary recycled water requirements as set forth in California Code of Regulations (CCR) Title 22. This use level requires tertiary wastewater treatment that includes: oxidation, tertiary filtration, and disinfection. In addition, certain unregulated constituents will be targeted for treatment and monitoring as required to meet non-regulated water quality objectives (e.g., nitrogen) and for plant operation

4.4.1 *Permitting Pathway*

To permit the WRF, coordination with multiple regulatory agencies and stakeholders will be required. The San Francisco Bay Regional Water Quality Control Board ("Regional Board") will issue the operational permit, or Order. The State Water Resource Control Board ("State Water Board") Division of Drinking Water (DDW) will review the engineering report and provide technical comments on tertiary filtration and disinfection unit processes. The Santa Clara County Department of Public Health (DPH) may act in an advisory role. The City of San José will act as a permit stakeholder and will issue the building permit.

The timeline for the permitting process will be contingent on meeting the requirements and deadlines put forward by the relevant regulatory agencies and stakeholders. Agency coordination is expected to take 2 years, the operational permit and state process 1 year, and the engineering reports and CCR Title 22 permit 6 months.

The permit and approval requirements for the WRF will include meeting:

- California Water Code, Section 7 (Porter-Cologne Act)
- California Health Laws Related to Recycled Water ("The Purple Book")
 - California Code of Regulations (CCR), Title 22
- California Plumbing Code (CPC)
- Industrial pretreatment permit and requirements for the discharge of sludge, solids, etc.

4.4.2 *Future "Risk-Based Framework" Regulations*

Senate Bill 966 (SB 966), signed into law in September 2018, requires the Water Board to adopt regulations for risk-based water quality standards for the onsite treatment and reuse of non-potable water by December 2022. The bill would also require local jurisdictions that elect to establish a program for onsite treated non-potable water systems to adopt a local program that includes the risk-based water quality standards established by the Water Board. The goal of SB 966 is to increase recycled water use in California by helping local jurisdictions implement onsite water reuse and by streamlining the existing permitting process.

SB 966 changes the way that onsite non-potable water systems will be regulated in the future. Instead of permitting these systems via the CPC Chapter 15 or CCR Title 22, which was written with municipal-scale facilities in mind, SB 966

requires “local programs” to be formed and adopted. The local programs championed by SB 966 will be formed by cities, counties, and utilities and will be required to utilize a “risk-based framework” that establishes treatment performance targets (pathogen log reduction targets) based on the alternate water source and end use of the non-potable water. Design criteria and requirements are included in this framework to establish a basis for the reduction and inactivation of bacteria, viruses, and protozoa that could be present in wastewater.

Any permitting for the WRF that occurs prior to January 2025, would be under the current California Water Code and the CCR Title 22 regulatory structure, which is administered locally by the SF Bay Regional Board. Therefore, depending on the timeline for the Project, this shift in regulatory framework may affect design requirements for the treatment system. It is not clear whether, given the scale of this WRF, if the system will be regulated as an “onsite” system or not. It is recommended that the Project’s treatment system be designed to meet the risk-based framework requirements in preparation for future regulatory enforcement.

Refer to the [Water Utility Formation TM](#) for additional details on the permitting pathway and future “Risk-Based Framework” regulations for the Project’s district water reuse system.

4.4.3 Wastewater Characterization

Water use activities at the Project produce wastewater with distinct characteristics that have been approximated using the available literature and professional experience. Constituents used for the loading analysis include: 5-day biochemical oxygen demand (BOD₅), total suspended solids (TSS) and total nitrogen (TN). Constituent loads that each wastewater-generating activity contributes are outlined in [Table 8](#) in the Appendix. Loading for the majority of the Project development is calculated using per capita (ca) constituent loads. Daily constituent loads are available in the literature (e.g., Metcalf & Eddy, 2014) and provide good benchmarks for estimating wastewater characteristics at a mixed-use development. Restaurant loading was calculated using typical concentrations from the literature and multiplying by the daily flow rate. Total loading is outlined in the following [Table 4](#).

Table 4: Expected wastewater characterization at the Project

Constituent	Load (lb/d)		Concentration (mg/L)	
	Max day	Avg Day	Max Day	Avg Day
BOD	4,060	3,150	503	484
TSS	4,130	3,340	511	513
TKN	630	500	78	76

5.0 PROPOSED WASTEWATER TREATMENT SYSTEM

A variety of alternative wastewater treatment systems were evaluated for the Project including package plants and landscape-integrated solutions such as open water wetlands. Based on the high density development and the limited space available for the Project, a compact membrane bioreactor system was selected at this time. Other compact technologies will be evaluated as the Project moves into the design phase.

The WRF will include a multi-stage treatment system for primary treatment, secondary treatment, tertiary filtration, and disinfection. Secondary treatment processes are usually the most energy intensive and take up the largest area in a wastewater treatment plant. Membrane bioreactors (MBRs) are a proven treatment technology implemented successfully in a variety of scales and scenarios. One treatment train sized for 1 MGD is proposed for the WRF. In the future, two parallel treatment trains could be considered to optimize operations based on flows. For example, a 500,000 gal/d system could operate normally with the second treatment train coming online when the system has a peak flow of 1 MGD. Multiple parallel trains are also desirable from an operability standpoint and will be evaluated during the design phase.

5.1 Wastewater Treatment Processes

5.1.1 Primary Treatment

At the initial stage of treatment, raw wastewater is screened to remove inorganic solids, which are collected in a roll-off bin and periodically hauled off-site. Odor control measures will be provided at this initial stage of treatment by housing primary

screenings in a ventilated enclosure at the water reuse facility (WRF). Pre-screened wastewater will be transferred to the primary settling process, where a solids settling tank will reduce biochemical oxygen demand (BOD) and total suspended solids (TSS) by 30% and 50%, respectively. An effluent filter will be provided at the solids settling tank outlet to further reduce suspended solids and BOD downstream. If the effluent filter is blinded due to lack of maintenance, the settled effluent overflows into the tank outlet.

5.1.2 *Secondary Treatment & Tertiary Filtration*

The MBR will reduce concentrations of organic and inorganic compounds present in the primary effluent. Staged MBR systems are commonly used where nitrogen removal is desired. The configuration selected for the Project is a 3-stage process where the treatment system is divided into compartments of varying oxygen content. The first reaction chamber is the aerobic tank, where oxygen is transferred to the wastewater via diffusers to enable biological aerobic reactions initiated by microorganisms suspended in the wastewater. In addition to the aerobic tank, there is an anoxic tank reactor, where oxygen levels are minimized to achieve ideal biological conditions that enable nitrogen removal reactions. Internal recycle loops are incorporated between reactor zones to utilize all nutrients and products derived from these treatment processes.

The final reactor zone in the MBR system is the membrane tank, where either a microfiltration or ultrafiltration membrane module is housed to achieve tertiary filtration of the wastewater. Membrane modules or cassettes can also be incorporated within the aerobic tank to avoid the addition of a third reactor. Membrane filtration, although energy-intensive in this application, provides consistently low effluent turbidity, which can be beneficial to downstream unit process performance. The incorporation of tertiary filtration within the main MBR reactor zones is one of the space-saving advantages attributed to MBR systems. Following filtration, MBR effluent is directed to advanced treatment and disinfection processes.

5.1.3 *Advanced Treatment*

Advanced treatment may be included to achieve color removal and to reduce the risk of microorganism re-growth in the distribution system. This advanced treatment can be achieved via ozonation and/or granular activated carbon (GAC) contact. Ozone is a powerful oxidant that is commonly used for color removal and breakdown of recalcitrant organics. Ozonation, when followed by contact with a GAC bed, would provide removal of trace organics made bioavailable by the ozonation process and further reduce color. As a pre-treatment stage to disinfection, ozonation followed by GAC contact would reduce the required disinfection dose. Further research would be needed to determine the necessary advanced treatment process, if required.

5.1.4 *Disinfection*

Disinfection is typically the final stage in wastewater treatment to reduce the presence of pathogens in treated effluent. Chlorine contact is the conventional means of achieving disinfection as set forth in Title 22. Ultraviolet (UV) irradiation is an alternative disinfection process that has advanced technologically and gained popularity since the drafting of Title 22. UV disinfection is the preferred disinfection unit process for the Project because (1) chlorination adds salts to the treated effluent, which negatively impacts desired water quality, and (2) it reduces chemical use. However, additional testing is required to utilize UV disinfection under current regulations (Title 22). Regardless of which disinfection unit process is selected, a dilute chlorine solution is commonly used to maintain a disinfection residual through the distribution network to limit pathogen regrowth in the recycled water distribution system.

5.1.5 *Storage*

Water that has been tertiary filtered and disinfected will be stored in a non-potable storage tank prior to distribution. Storage volume should be minimized to allow for adequate tank turn over, but large enough to ensure consistent distribution pump operation. The basis of design treated non-potable water end uses include toilet flushing, cooling, and irrigation. Treated non-potable water for each respective end use will be distributed via a pressurized distribution network, within the private utility corridor (“utilidor”).

5.1.6 *Site Layout*

A preliminary footprint analysis for a single water reuse facility estimates that the area required for the plant is approximately 40,000 square feet. This estimate includes at-grade and buried equipment to optimize available building space. The water reuse facility can also be split into two different sites and preliminary estimates for those scenarios are

outlined in the Appendix. The best solution for the Project will be finalized as the design progresses and ideal conditions for construction and long-term conditions are identified.

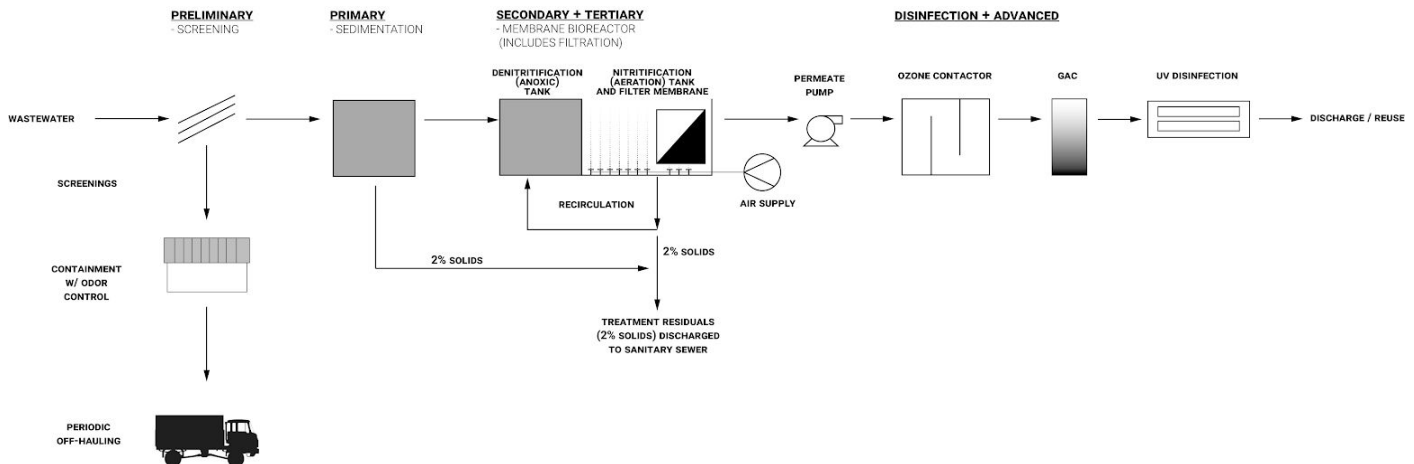


Figure 4: Wastewater treatment example process flow diagram. ([Click here to enlarge figure.](#))

5.2 Potential Environmental Impacts

5.2.1 Odor & Noise Control

The WRF will be housed within the central utility plant (CUP) which will be soundproofed to alleviate potential noise issues and have appropriate odor controls to manage any objectionable odors. If needed, air blowers and odor control units (e.g., carbon filters) may be incorporated into the wastewater treatment design. Additional noise attenuation measures can be added, such as individual equipment enclosures, to meet area noise requirements. Specific solutions will be developed as the project moves into design.

5.2.2 Treatment Chemicals

The operation of the WRF may require treatment and cleaning chemicals to be stored on-site. Citric acid, which is used for MBR cleaning, and is a skin and eye irritant. Sodium hypochlorite, which is used for MBR cleaning and disinfection, and is a corrosive irritant and dangerous if ingested. Methanol, which is used as a carbon source for nutrient removal, and is a moderate irritant and harmful if ingested or inhaled. Sodium bicarbonate, which is used as alkalinity for nutrient removal, and is a mild irritant and can be harmful if ingested. Polymers, which are used for solids dewatering, and can be skin irritants and harmful if ingested. Ferric chloride, which is used for chemically-enhanced primary treatment or other flocculation process, and is a skin and eye irritant and can be harmful if ingested.

5.3 Treatment Residuals

Treatment residuals (also referred to as sanitary solids) are produced as a by-product from wastewater treatment at both the primary and secondary treatment stages. First, a preliminary screen removes large solids and trash that have made it into the wastewater collection system. These screenings are washed and compacted before being collected in a bin and hauled off intermittently by trucks. Primary and secondary solids may be managed onsite through anaerobic digestion, contributing to the Project's waste-to-energy solutions. Alternatively, these solids can be pumped into the City's sanitary sewer network. Refer to the [Wastewater Treatment Residuals Management TM](#) for more details.

5.4 Connection to City System

Wastewater from the Project area is currently collected by the City's existing sanitary sewer network. The existing network collects wastewater via four (4) main sewersheds that flow from the south west of the site to the north east. Referring to the City of San José published GIS data, there are five (5) existing sanitary sewer inverted siphons that transfer wastewater from the west to east side of Guadalupe River, Guadalupe Creek and Los Gatos Creek by gravity. Flow then continues north to the San José-Santa Clara Regional Wastewater Facility (SJ-SC RWF). Refer to the [Infrastructure Narrative](#) and [Planning Application](#) for more information on the existing sanitary sewer and creek siphons.

The water reuse facility will need to tie into the City's sanitary sewer network to provide collection of any overflows. The basis of design is that there will be no overflow volumes to the City's system and it will be for emergency situations only. As described, these district systems are extremely reliable and discharge to the City's system is unlikely. Should the Project decide not to collect and treat all of the wastewater for onsite reuse or if all of the treated non-potable water is not able to be reused, then discharge would be frequent and, most likely, daily.

Per the 2017 Infrastructure Analysis, the City of San José does not typically allow flow rates to increase through these siphons due to capacity issues at peak flows during wet weather events. Adding flow to these siphons could potentially trigger one, if not multiple, siphon upgrade projects within Los Gatos Creek, Guadalupe Creek and/or Guadalupe River, which would require approvals from multiple federal, state and local agencies.

Two alternatives are proposed to connect to the City sanitary sewer system. To avoid increasing flows to the existing siphons and potentially result in siphon upgrades, overflow could be pumped over the Los Gatos Creek via the proposed utilidor and Guadalupe Creek via the West San Fernando bridge. An existing 33" RCP City sanitary sewer trunk line has been identified running within Almaden Boulevard where a connection is proposed. Alternatively, the engineer's preferred solution would be to gravity tie into the existing sanitary sewer network. This would not require pumping the overflow but as stated above, could require upgrading the siphons. The following section outlines the sanitary sewer modeling that will be completed. Results from this modeling work will provide direction on which connection should be pursued.

5.4.1 Sanitary Sewer Modeling

The City has begun to model the capacity of the existing sanitary sewer network to serve the Project flows. As a baseline, the City modeled a business-as-usual scenario using the Project's wastewater flows, but with no WRF; meaning each parcel would connect to the nearest public sanitary sewer under this scenario. The initial results from the City modeling presented in the December 12, 2019 meeting are summarized in the following points:

- Using the City's conservative demand factors, the average dry weather flow (ADWF) for the Project's wastewater was calculated to be 1.6 MGD.
- Google's design increases the wastewater flows expected for the area by 150% compared to the General Plan.
- The preliminary results indicate that if the wastewater is pumped via the West San Fernando Bridge and tied in to the sanitary sewer at W. San Fernando Street and Almaden Boulevard, then the existing system has adequate capacity to serve the Project flows.
 - However, a deficiency does exist in the sanitary system downstream of the Project site at N. 7th Street and E. Empire Street where there is an existing interceptor that is at capacity. The City's Interceptor Phase VII project will increase the capacity of the sanitary sewer at this location. An analysis of required interceptor upgrades was not included in the DSAP.
 - The City modeled the Project's impacts on the downstream sanitary sewer Interceptor Phase VII project. As modeled, the Project would contribute an additional 5% of flow into the Interceptor Phase VII project.

Sherwood has requested that the City of San José's Public Works Department conduct hydraulic modeling of the sanitary sewer system to evaluate the potential capacity of the existing sanitary sewer under the following conditions:

1. Gravity discharge of all Project wastewater into the Lincoln Line (under Park Avenue, 100% of flows), with one point of connection to the sanitary sewer.
2. Gravity discharge of proportional Project wastewater into the Lincoln Line (under Park Avenue, 65% of flows) and the Sunol Line (under West Julian Street, 35% of flows), with two points of connection to the sanitary sewer.
3. Pumped overflow of all Project wastewater via the West San Fernando Bridge (100% of flows), with one point of connection to the sanitary sewer at W. San Fernando Street and S. Almaden Boulevard.

Results from this modeling effort are expected in January 2020 and will inform the optimal connection configuration.

As outlined in discussions between the City and the Project team, modeling considerations and inputs include:

- These scenarios are intended to model the "worst case" in which the water reuse facility is offline. While this scenario is not anticipated to happen, it is still necessary to understand the potential impact.
- The model's long-term loads are based on the General Plan 2040 growth projections for downtown. For parcels within the Project area, loads are based on land use information provided by the Project team to the City.

- The City confirmed during a meeting on January 15, 2020 that a wet weather peaking factor will not need to be included in these modeling scenarios as the Project has proposed a low-pressure sanitary sewer line within a sealed utilidor, so inflow and infiltration (I/I) will not be applicable in this case.
- The City assumes a 1.5 peaking factor to account for peak hour dry weather flows and a 2.0 peaking factor to account for wet weather flow.
 - It was noted that the gravity discharge scenarios do have an advantage over the pumped scenario of greater reliability as a gravity connection would still be able to overflow in the event of a power outage.

5.5 Corrosion Potential

The City has expressed concerns of corrosion within the sanitary sewer network should the only flows from the Project be treatment residuals from the wastewater treatment system. It is important to note that the majority of the treatment plant residuals will be predominantly liquid with a very low percentage of solids. Sherwood does not expect that this discharge will create a high corrosion potential in the sewer lines.

The San Francisco Public Utilities Commission (SFPUC) has invested in a sewer system model that can predict hydrogen sulfide formation in sewer networks. As described by the model creators' in their [Description of the WATS Model](#):

WATS is a concept for modeling biological, chemical, and physical processes in sewer systems. It is developed concurrently with new research on sewer systems and processes. As such it forms the conceptual backbone of a numerical sewer process model – the WATS model – which can be used to simulate a wide range of processes in sewer systems.

In brief, modeling with WATS typically aims at solving the following in-sewer problems, in practice often related to an analysis of these problems and potentially including corresponding process controls and management strategies:

- *Concrete corrosion caused by hydrogen sulfide*
- *Hydrogen sulfide impacts on human health*
- *Odor nuisance caused by hydrogen sulfide and VOCs being emitted from the wastewater and following vented into the urban atmosphere*
- *Hydrogen sulfide and VOC controls*
- *Analysis of wastewater quality at inflows to wastewater treatment plants*

The City of San José has asked the Project team to evaluate what would be required to model corrosion potential. The first consideration is sewer pipe material type; concrete and ferrous metal pipes are both subject to corrosion by hydrogen sulfide. In a review of the City's Public GIS Viewer, it appears that there are some sections of the existing sewer pipe made from these materials. Specifically, the inverted siphons below the creeks appear to be ferrous iron. There are also other sections made of both unreinforced and reinforced concrete both onsite and along the offsite path of flow toward Interceptor VII located at 7th and Empire streets. The Public GIS Viewer notes that the length of sanitary sewer along Autumn Street from Park Avenue to St. John Street is "unknown." The remaining sanitary pipe onsite appears to be made of vitreous clay, which is not subject to corrosion. Moving forward, pipe materials should be verified by the City to confirm susceptibility to corrosion.

A flow study from 2012 was also provided by the City. During the monitoring period, dry weather flow along St. John Street appears to be over 3.5 MGD. Future flows with a treatment residuals flow from the proposed WRFs should be estimated to understand the dilution available from other sewer flows in the receiving pipelines.

The characteristics of the wastewater treatment residuals streams are described in the [Wastewater Treatment Residuals Management TM](#).

5.6 Energy Demands

The energy demand for the Project's WRF was calculated using site specific parameters (e.g. elevation changes across the site impacting pumping) and energy demand values for wastewater treatment processes from literature (Kavvada, 2016). The energy intensity (kWh per million gallons of treated water) is presented in [Table 5](#), rather than the total energy demand, to easily compare a unit value to the City's much larger regional system. An energy intensity was calculated and

compared for each component of the systems, including pumping required to collect the wastewater, treat it and distribute the recycled water to end uses.

Recycled water distributed by the City of San José is produced at both the San José-Santa Clara Regional Wastewater Facility (SJ-SC RWF) and the adjacent Silicon Valley Advanced Water Purification Center (SVAWPC). Using published water quality data on the [SVAWPC website](#), it was estimated that 68% of the City’s total recycled water volume is produced at the RWF and is blended with 32% water from the SVAWPC to improve water quality. Recycled water produced at the SVAWPC is estimated to have an energy intensity for treatment of 6,700 kWh/Mgal based on energy data for reverse osmosis treatment of brackish water (Electric Power Research Institute [EPRI] + Water Research Foundation [WRF], Electricity Use in Municipal Water, 2013). Treatment at the SJ-SC RWF uses an average 2,312 kWh/Mgal, per email provided on September 10, 2019 from the City’s operations manager. Blending the two water supplies, the overall energy intensity for producing recycled water at the City’s facilities is estimated at 3,720 kWh/Mgal. A theoretical pipeline was mapped to estimate the energy that would be required to distribute recycled water to the Project from the SJ-SC RWF. It was estimated to be a 11.5 mile long, 12 inch diameter pipe pumping up 80 feet of elevation head. Assuming the pumps operate for 8 hours per day, it was estimated that recycled water conveyance to the Project would require 4,090 kWh/Mgal. Accounting for recycled water distribution to the Project site, the total energy intensity for recycled water from the City is 7,800 kWh/Mgal.

In the onsite scenario, wastewater will be collected via a low pressure system. Assuming ~20 lift stations to collect wastewater from across the site, sanitary waste collection will require 690 kWh/MgGal. The energy intensity for a treatment at a 1 MGD decentralized water reuse facility is estimated at 3,400 kWh/MGal using energy intensity values published for MBR systems (Kavvada, 2016). Onsite recycled water will be routed to serve all parcels within the project (~5,800 LF). Assuming the recycled water is delivered over 8 hours a day, pumps will use 1,250 kWh/MGal. In total, an onsite reuse facility at the Project is estimated to use 5,350 kWh/Mgal.

Therefore, at the specific location and scale of the Downtown West system, the WRF will have a 31% efficiency savings compared to the City’s regional system. Note that the energy intensity for treatment of the water is comparable for both systems but pumping the treated recycled water back to the Project site from the centralized plant requires approximately three times the amount of energy to that of water treated locally at the WRF.

It is worth noting that 100% of the energy used at the WRF will be supplied by an onsite renewable energy source to meet Google’s zero carbon goal. Performance information provided by the operations manager at the SJ-SC RWF indicates that 40% of the yearly average energy demand at the RWF is imported by PG&E. The remaining energy at the RWF is supplied by an onsite cogeneration system which uses digester gas and natural gas.

Table 5: Estimated energy intensities for regional wastewater treatment compared to the WRF at Downtown West

Treatment System	Energy Intensity (kWh/MGal)			Total Energy Intensity	Energy Supply
	Treatment	Recycled Water Distribution	Sanitary Sewer Collection		
Regional Non-Potable (SJ-SC RWF + SVAWPC)	3,720 ¹	4,090	0 ²	7,800	40% PG&E / 60% onsite cogeneration with natural gas back-up ³
Downtown West Water Reuse Facility (WRF)	3,410	1,250	690	5,350	100% onsite renewables

kWh - kilowatt hour
MGal - million gallons
PG&E - Pacific Gas and Electric

SJ-SC RWF - San José-Santa Clara Regional Wastewater Facility
SVAWPC - Silicon Valley Advanced Water Purification Center
WRF - Water Reuse Facility

Notes:

1. Assumes a blend of 68% water produced at SJ-SC RWF and 32% water produced at SVAWPC.

2. For this analysis, it was assumed that wastewater flows to the SJ-SC RWF by gravity. The City mentioned in the December 12, 2019 meeting that a transfer station at 7th & Empire station is under consideration to be built.
3. Energy supply information for the SJ-SC RWF. Assumed similar supply for the SVAWPC.

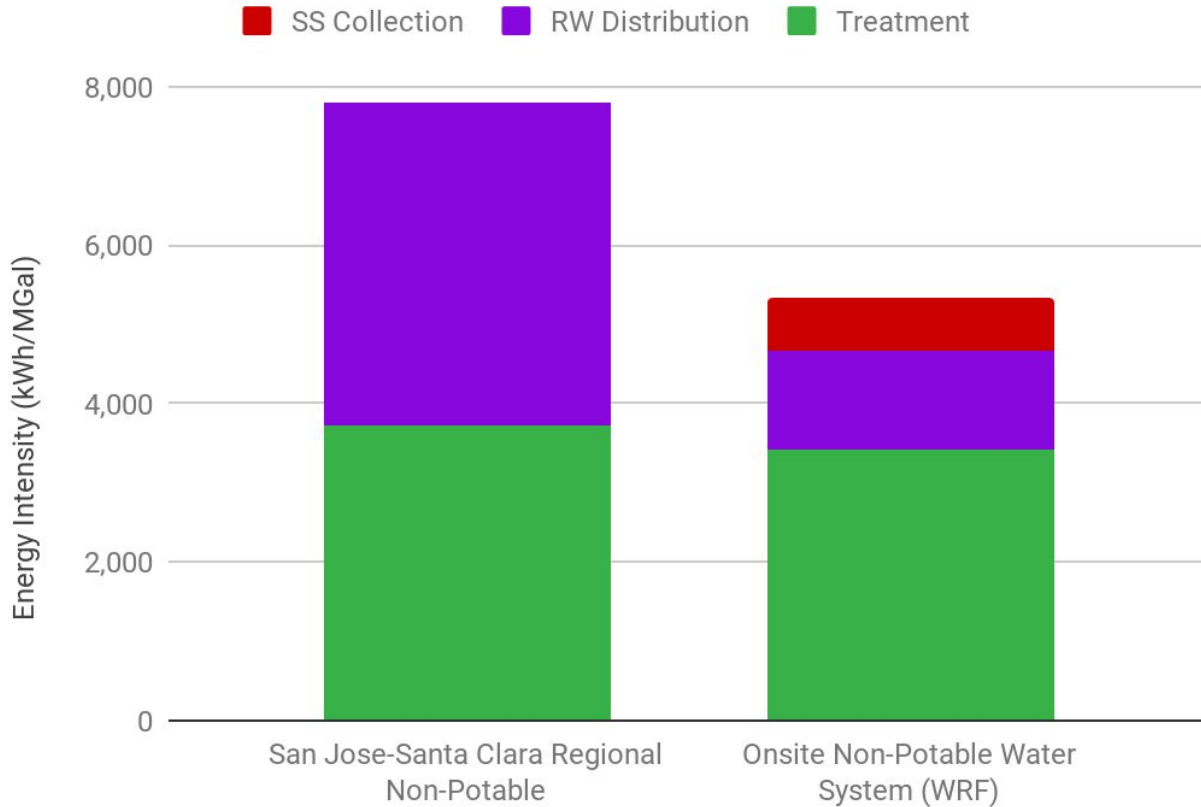


Figure 5: Energy intensity comparison between recycled water produced by San Jose’s Regional Wastewater Facility (RWF) system and the proposed Downtown West Water Reuse Facility (WRF).

6.0 COST ANALYSIS

A planning level cost estimate for the Project was conducted to estimate costs for major water and wastewater items. A comparative cash flow analysis was also performed, where capital and operational expenses for a baseline (business as usual) scenario were compared to a district infrastructure scenario where district-scale systems were implemented at the Project. For the purposes of this assessment, it was assumed that the Project would move forward with a single 1 MGD water reuse facility and include equipment for onsite anaerobic digestion as a potential solids management strategy.

A 50-year cash flow [model](#) was completed and submitted to Lendlease in September 2019. Cash flow model results were accompanied by a [summary document](#) describing all major factors and assumptions included in the model. Two cash flow models were included, one for business as usual conditions and one for the implementation of district infrastructure and onsite resources. Major cost drivers modeled included capital expenses (one-time investment costs required by the development) and operational expenses (annual utility costs and operations and maintenance costs for district systems). Capital and operational costs included in both cash flow models are listed below.

6.1 Capital Costs

6.1.1 Business as Usual

- Development Fees: DSAP “Basic” sanitary sewer impact fees, permit fees, area fee, and treatment plant fee
 - Sewer impact fees assigned for each development program were assessed separately as outlined in the City of San José Sanitary Sewer & Use Charges (2019)

- It is important to note that these “basic” fees were developed prior to the City’s review of Google’s development and it is expected for them to change
- Utility Improvements: City of San José recycled water extension and sanitary sewer siphon upgrades
- Water Reuse Facility: end-of-pipe treatment, building-based treatment systems, and blending

6.1.2 *Water Reuse Facility*

- Discounted Development Fees (50%, value can be adjusted in model): development fees from business as usual fees
- Utility Improvements: private sanitary sewer collection system (pump stations and sewer collection network), overflow pump station, and private recycled water network
- Water Reuse Facility: 1 MGD plant with opportunity to include onsite solids management (anaerobic digestion)

6.2 **Operational Costs**

6.2.1 *Business as Usual*

- Utility Usage Charges: as published by the City of San José for potable, sewer, and recycled water service

6.2.2 *Water Reuse Facility*

- Potable Water Usage Fees: identical to the business as usual scenario
- Recycled Water and Sewer Fees: none incurred once the WRF is commissioned and brought online to serve the entire Project
- Operations and Maintenance Costs: annual direct and indirect costs associated with a 1 MGD plant
 - Direct costs include annual fees needed to operate the plant and labor costs incurred
 - Utility (electricity) costs were modeled separately
- Residuals Management Costs
 - In the scenario of a WRF with onsite solids management, overflow volume would be as reflected in Table 2 above.
 - In the case where all wastewater is sent to the City sanitary sewer system, it is estimated to cost \$720,000/year for solids and volume treatment
- Revenue Streams
 - Charging a fee for wastewater and recycled water service was included as a revenue for the water reuse facility
 - It was assumed that utilities fees (sewer and recycled water) were charged at a 10% discount compared to City of San José rates

Preliminary results from both 50-year cash flow models indicate a net present value of approximately \$80M for the district water scenario. It is important to note that these results depend on the assumption that the proposed water reuse facility would avoid sewer and recycled water annual utility costs and only incur potable costs; as provided to the Project team by Lendlease on September 3, 2019. Direct engagement with the City of San José and relevant agencies is needed to verify that district systems could benefit from long-term operational savings, as requested in the Planning Application review comments.

7.0 **CONCLUDING REMARKS**

A water reuse facility is proposed at Google’s Downtown West Project in San Jose, California. As part of the design process, a water balance analysis was performed to determine baseline and peak water flows expected at the Project. Non-potable recycled water produced from Project wastewater at a district water reuse facility can meet indoor non-potable demands during average and maximum occupancy conditions and meet cooling and irrigation demands throughout the year, as well as during the summer peak months. Water balance results also indicate that there will be excess wastewater throughout the entire year. Additional on- and off-site uses have been identified to maximize the use of treated non-potable water as a valuable resource. Preliminary alternative uses for treated water include green roof irrigation, photovoltaic cleaning, recycled water export, and winter irrigation to support vegetative growth. It is imperative that all alternative uses for excess non-potable water be identified and allocated to ensure the Project meets all sustainability and environmental goals.

8.0 APPENDIX

8.1 Program & Unit Demands

Table 6: Summary of program and expected occupancy at the Project. Program information from Notice of Preparation/AB 900 process ([August 15, 2019](#)) and sheet 1.01 of the Planning App (October 10, 2019).

Program Type	Space (GSF)	# of Units	Occupancy per unit (ca/unit)	Max Day Occupancy	Avg Day Occupancy
Office	6,400,000 ¹	-	-	35,556	23,116
Event Space	100,000	-	-	452	311
Residential	3,864,000	4,712	1.5	7,068	6,361
Hotel	150,000	300	2	600	450
Corporate accommodations	400,000	800	1	800	600
Retail	200,000	-	-	Occupancy is not used as a basis for water demand. Water demands calculated using spatial demand factors (gal/gsf)	
Restaurant	300,000	-	-		
District Systems	100,000	-	-		
Logistics/Warehouse	100,000	-	-		
Total	11,614,000	-	-		

Notes:

1. A range of 5.5 to 7.3M GSF for the office was presented on August 15 which led to the use of 6.4M GSF. This is presented as 6.5M GSF in the Planning App. At this scale and stage of design, the difference of 100,000 GSF of office program does not provide a significant change in the water balance results.

Table 7: Summary of estimated Total DSAP Preliminary Maximum Program, per [April 4, 2019 Site Lab workshop](#).

DSAP Area

Total DSAP Preliminary Maximum Program

	Site Area (AC)	Office GSF	Residential GSF	Residential Units (@1000 units)	Retail/ Community GSF	Total GSF	
Google MP Ownership	62.67	6,300,000	4,000,000	4,000	250,000	10,550,000	Google Master Plan Total
Non-Google MP Ownership (PGE, Caltrain, VTA)	8.36	0	1,030,000	1,030	100,000	1,130,000	
Subtotal Master Plan Program	71.03	6,300,000	5,030,000	5,030	350,000	11,680,000	Master Plan Area Total
DSAP Building Review/Under Construction/Built	14.2	0	955,000	955	55,000	1,010,000	Excluded from District Systems DSAP total
DSAP Conceptual/Entitled	11.7	1,000,000	437,000	437	7,000	1,444,000	
DSAP Remaining	63.5	2,542,076	5,084,000	5,084	39,000	7,743,000	
Subtotal Non-Master Plan DSAP Program	89.4	3,542,076	6,476,000	6,476	102,000	10,197,000	
TOTAL DSAP Program	160.39	9,842,000	11,506,000	11,506	452,000	21,877,000	Total DSAP Program
Max District Systems DSAP Program	146.22	9,842,000	10,551,000	10,551	397,000	20,868,000	Max DSAP district systems total (Less Pre-Building Review, Max capacity District Systems)

NOTES:

- All numbers are approximate based on stated targets, early yield studies, and conceptual cad file.
- GSF Numbers rounded to the nearest 1000
- Residential GSF calculated on the basis of 1000 gsf/unit for proposed/under construction projects and for Program total.
- Proposed projects per City "Major Development Projects" [Website](#)

Note: The Google-owned program information has been revised (see [Table 6](#)). [Table 7](#) presents the values used for the non-Google buildings water balance.

8.1.1 Residential Space / Apartments

The Project plan proposes 4,700 residential units encompassing approximately 4 million gross square feet.

This value is roughly equivalent to the proposed, Project-specific demands calculated based on the frequency of use and fixture flow rates of high efficiency residential fixtures, as defined by LEED and in accordance with the 2019 CalGreen Building Standards Code, Section 4.303. Application of these standard residential fixture flows results in an interior demand of 48 gal/ca-d. In addition, projections for the proposed development indicate occupancy at the Project will be closer to 1.5 people per unit, resulting in a proposed demand factor of 72 gal/d per unit.

8.1.2 Office

The proposed office demand factor is about half of this value based primarily on high efficiency fixtures required to meet current code and LEED fixture flow rates for offices. Water demands for offices include restrooms, the occasional user of the shower and a small kitchen demand to account for office “micro-kitchens” with coffee/tea stations. Additional amenities are planned as part of the proposed office program including onsite cafe, private fitness center and onsite laundry for staff. The water use associated with these amenities has been estimated using data measured at similar facilities. Water demand at the cafes is built up based on meals per person per day and gallons of water use per meal as collected from previously built facilities. Water demand at the fitness center includes additional showering. Onsite laundry demands account for clothes washing machines within the office campus for employees. The resulting demand factor is 0.08 gal/sf-d including cooling and assuming office are continuously occupied including weekends and holidays. The projected average daily occupancy in the proposed offices is calculated by reviewing occupancy at the annual level to account for weekends, holidays and working from home. The resulting occupancy factor is 65%, or about 238 days of the year when offices are at full occupancy.

Event Center

Day long to multiple-day long events will be held at the proposed event center. The proposed demand factor is estimated by assuming those participating in events would use an equivalent amount of water per day to that of a full-time employee (restroom and food facilities). Additional water demands for those attending multi-day events are accounted for in the hospitality/corporate accommodations program categories. Over the course of a year, 185 total days of events are expected with attendance averaging 310 guests per event. The total annual water demand for the events center is divided across 100,000 gross square foot area to calculate a proposed water demand factor of 0.04 gal/sf-d.

Hospitality

A hotel demand factor was calculated using LEED residential fixture flows for only fixtures that are found in hotel rooms. LEED does not present values for commercial laundry in hotels; as such a demand factor for laundry was applied using another reference¹. These sources yield a demand factor of 39.9 gal/ca-d. Hotel occupancy in San Jose varies across the year, ranging from 40% occupancy in December to 75% in June². To be conservative when calculating the proposed demand factor, 75% occupancy was assumed throughout the year. Assuming double occupancy of the rooms, and 75% occupancy of the rooms over the year, a demand factor of 62.6 gal/d-room is proposed.

Corporate Accommodations

Corporate accommodations are similar to a hotel but are intended for longer stays for employees and include fixture demands for kitchen sinks, laundry and dishwashers. Using LEED residential fixture flows, the proposed interior demand factor for corporate accommodations is 41.0 gal/ca-d. It is assumed these units will be single occupancy as they will be housing employees while travelling and will have 75% occupancy over the year. This results in a demand factor of 35.0 gal/ca-d.

Retail / Commercial

Demands at retail/commercial spaces can vary depending on the type of establishment. Retail spaces are expected to have demands associated with restrooms for employees and transients. Restaurants have a much higher water demand

¹ 2000 Pacific Institute study “Commercial Water Use and Potential Savings: Appendix E”

² August 2012 SJ Monthly Hotel Occupancy Report: <https://www.sanjoseca.gov/DocumentCenter/View/1340>

for activities including cooking, cleaning and consumption. In reviewing LEED fixture flows and the literature on restaurant water demands³, 0.1 gal/sf-d is appropriate for the proposed retail spaces and 0.25 gal/sf-d is appropriate for the restaurants spaces.

Recycled water is not typically permitted for use in restaurants and therefore 100% of the restaurant demands need to be met with potable water.

8.1.3 Logistics/Warehouse

A warehouse and dedicated space for facility logistics, such as food storage, is proposed at the Project. There is no food preparation planned for in-site logistics facilities. There may be some light industrial activities such as maintenance shops.

8.2 Wastewater Characterization

Table 8: Unit loading used as a basis for wastewater characterization

Constituent	Mixed-use Development (Office, Residential, Retail) (g/ca-d)	Restaurants (mg/L)
BOD	90	544
TSS	78	900
TKN	13	108

³ 2000 AWWA study “Commercial and Institutional End Uses of Water”

8.3 Water Reuse Facility Footprint

8.3.1 Multiple WRF Locations

The water reuse facility could also be in two locations (North and South CUP), to better serve the phased construction as well as minimize large distribution pipes across the site.

Footprints for the different WRF scenarios are outlined in [Table 9](#). The division between the two WRF is based on flow rates estimated from the May 29, 2019 SiteLab presentation.

Table 9: Water Reuse Facility footprints for different scenarios

	2 Facilities: North WRF	2 Facilities: South WRF	1 WRF	Notes
At-grade (25' high)	7,500 SF (150' x 50')	11,000 SF (138' x 80')	15,200 SF (138' x 110')	Includes coarse screening, part of secondary treatment, tertiary treatment, distribution pumps and solids management
Buried (15' deep)	7,000 SF (140' x 50')	13,800 SF (138' x 100')	23,500 SF (138' x 170')	Includes sedimentation, equalization, part of secondary treatment, and treated water storage
Total Footprint	14,500 SF	24,800 SF	38,700 SF	

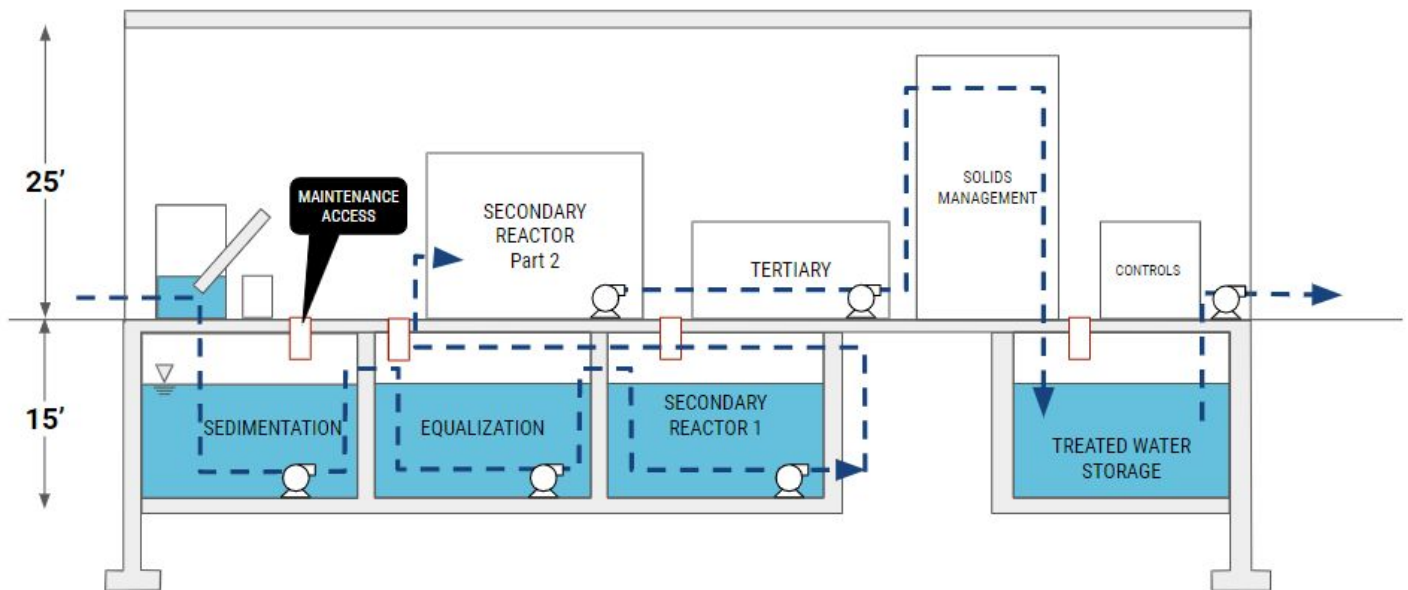


Figure 6: Example section showing how equipment could be stacked or buried within the Water Reuse Facility.