CITY OF CUPERTINO

PUBLIC WORKS DEPARTMENT

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CITY COUNCIL INFORMATIONAL MEMORANDUM

Date: February 13, 2025

To: Cupertino City Council
From: Pamela Wu, City Manager

Re: City of Cupertino Recycled Water Feasibility Study

Executive Summary

This Recycled Water Feasibility Study evaluates the viability of providing recycled water to Blackberry Farm Golf Course. The primary objective is to assess the technical, economic, regulatory, environmental and infrastructure associated with delivering recycled water for irrigation use at the golf course.

Two options were determined for assessment where option 1 is to extend the existing recycled water pipeline from the intersection of Homestead Road and Wolfe Road to the golf course and option 2 is to construct an on-site Satellite Water Recycling Facility at or near the vicinity of the golf course. While both options are solutions for recycled water, there are significant impacts in regard to construction, permitting and cost that make the options infeasible.

The cost for Options 1 and 2 is as follows:

Options	Cost	Number of Years
Option 1	$ 53,640,000.00	596
Option 2	$ 9,540,000.00	106

Based on the cost evaluation, the upfront costs for implementation of the recycled water system are very high and the initial investments may never offset the long-term potable water cost for the Blackberry Farm Golf Course. Assuming the annual water cost is approximately $90,000, it would take approximately 596 years and 106 years for Options 1 and 2 respectively to recover the overall project cost.

Background

The Fiscal Year (FY) 24-25 City Work Program allocated a budget of $200,000 for a Recycled Water Feasibility Study to evaluate the potential for delivering recycled water to the Blackberry Farm Golf Course. Rather than contracting with an external firm to conduct the full feasibility study, City of Cupertino Public Works staff conducted an initial, high-level assessment to determine whether the installation of a recycled water system could be a cost-effective alternative.

The use of recycled water as an alternative to potable water for non-potable uses, such as landscape and turf irrigation, has a long history of safe and effective applications throughout the State of California. However, several technical, financial, environmental, and operational factors must be evaluated. By examining these factors in detail, the result can provide a comprehensive understanding of whether a recycled water system is a practical, cost-effective, and sustainable solution for the Blackberry Farm Golf Course.

<u>Discussion</u>

Recycled Water Source and Infrastructure

The City does not own, operate, or maintain the local wastewater infrastructure or treatment facilities. Instead, the Cupertino Sanitary District is responsible for operating and maintaining the City's wastewater collection system. Therefore, securing a reliable source of wastewater is a key factor in implementing the recycled water system within the City. Currently, there are two viable options to provide recycled water: (1) extending existing recycled water infrastructure to the Blackberry Farm Golf Course property; or (2) installing a small-scale, on-site wastewater treatment facility at or near the Blackberry Farm Golf Course property.

Option 1 – Extend Recycled Water Infrastructure

For the first option, the City of Sunnyvale produces recycled water at the Water Pollution Control Plant located at 1444 Borregas Avenue. The plant produces and delivers about 300 million gallons of recycled water per year. The recycled water is primarily used for non-potable purposes such as irrigation of landscaping, park and golf courses and flushing of toilets. The City of Sunnyvale, in partnership with the Santa Clara Valley Water District and California Water Company (CalWater) extended the recycled water pipeline to serve the Apple Park campus. This recycled water pipeline currently extends to the intersection of Homestead Road and Wolfe Road.

Extending the recycled water pipeline from the intersection of Homestead Road and Wolfe Road poses some challenges since the pipeline will need to cross Interstate 280 (I-280), and Highway 85. One potential route would be to install a pipeline crossing at I-280 near Blaney Avenue, where the boring and receiving pits for trenchless installation can be positioned for the crossing. The pipeline would continue along Blaney Avenue towards the intersection of Stevens Creek Boulevard and Blaney Avenue and then traverse westerly along Stevens Creek Boulevard (See Attachment A). Like the I-280 crossing, two additional trenchless pipeline crossings will be required before reaching the golf course: one under Highway 85 and another under the Union Pacific Railroad tracks, near Bubb Road (See Attachment A). Additionally, a new dedicated recycled water pump station may be necessary to ensure sufficient pressure for the irrigation system at the golf course.

While this option offers a solution for getting recycled water to the golf course, it involves planning, collaboration with permitting agencies and significant construction through City streets.

Option 2 – Onsite Recycled Water Plant
The second option involves generating recycled water through the development of a Satellite Water Recycling Facility (SWRF), which would treat wastewater from the existing sewer pipelines to produce recycled water in compliance with the California Department of Public Health (CDPH) and the State of California's Title 22 regulations. However, because the City does not own nor operate the wastewater collection system, formal approval from the Cupertino Sanitary District would be required to access and utilize the wastewater flow.

The SWRF would rely on the existing 10-inch diameter pipeline that traverses the golf course as its primary source of wastewater. According to the hydraulic model data provided by Cupertino Sanitary District, the flow rate from this pipeline varies between 57 and 83 gallons per minute depending on the time of day. While this flow rate is sufficient for smaller-scale applications, it may fall short of the volume needed to meet the significant recycled water demand required for large-scale irrigation of the golf course. The variation in supply versus demand would necessitate the installation of additional infrastructure, such as a new storage tank and a pump station, to ensure consistent and reliable recycled water delivery. The storage tank would help mitigate the risk of recycled water shortages during periods of low flow, ensuring that the golf course's irrigation system operates efficiently year-round.

The SWRF would either need to be situated at or near the golf course, above the floodplain level or be properly floodproofed to protect the facility from potential flood events. However, after evaluating available space, there is limited room on the golf course itself for the construction of a SWRF, presenting a logistical challenge. Additional planning would be required to identify a feasible location for the facility.

In terms of water quality, the recycled water produced by the SWRF would need to meet the criteria for use in irrigation, particularly for sensitive turfgrass and tree species on the golf course. The water must be disinfected and undergo tertiary treatment, ensuring it is free from harmful pathogens. Tertiary recycled water refers to treated wastewater that has undergone advanced filtration and disinfection processes to remove contaminants. It is classified as one of the highest standards of recycled water treatment, suitable for irrigation and other non-potable uses.

Furthermore, the recycled water must have low concentrations of sodium and chlorides to prevent soil salinization and damage to plant health. This high-quality recycled water would need to be closely monitored and consistently meet the irrigation tolerance levels required by the golf course's landscaping and vegetation. Any residual waste or byproducts from the SWRF treatment process would need to be effectively managed, with the waste being discharged back into the Cupertino wastewater collection system for further treatment and disposal in accordance with environmental regulations.

While this option offers a sustainable solution for recycled water and reducing dependence on potable water sources, it involves significant planning, regulatory and environmental compliance, collaboration with permitting agencies and Cupertino Sanitary District, and infrastructure development to ensure that the system operates effectively and efficiently for the golf course's irrigation needs.

Recycled Water Customers
While the primary objective of the Recycled Water Feasibility Study is to assess the viability of delivering recycled water to the golf course, it is equally important to identify additional potential users within the City to maximize the return on investment. Expanding the customer base for recycled water will not only help offset the costs of infrastructure development and operation but also contribute to the broader sustainability goals of the community.

In addition to the golf course, several other potential recycled water customers could benefit from the project. Key potential users within the City include:

- **Schools**: with their large landscapes and fields, they present a significant opportunity for recycled water use, particularly for irrigation of school grounds, playing fields, and landscaping. Schools are often high-demand users of potable water for irrigation, and recycled water would provide a cost-effective and environmentally friendly alternative for potable water.
- **Parks**: City parks require substantial water for irrigation, especially during hot summer months. Utilizing recycled water for park landscapes would significantly reduce reliance on treated drinking water while helping to preserve local water supplies.
- **Medians and Streetscapes**: The City's medians, streetscapes, and other public landscaping areas represent another potential customer base. These areas often require consistent irrigation to maintain the aesthetic, making them ideal candidates for recycled water.
- **Homeowner Associations (HOA)**: Residential communities, especially those with large communal landscapes and shared outdoor spaces, could be an important user group. Many HOAs manage sizable green spaces, including lawns, trees, and recreational areas, which could benefit from a reliable source of recycled water for irrigation purposes.
- **Commercial Properties**: Businesses with large landscaping features, such as shopping centers, office complexes, and hotels, often have substantial water needs for maintaining attractive grounds. Recycled water can be a cost-effective

solution for businesses seeking to reduce their water consumption and operating costs, while also demonstrating environmental responsibility.

- **Orchards and Community Gardens**: Areas with orchards and community gardens, can also benefit from recycled water for irrigation. Orchards and community gardens often require consistent and efficient irrigation systems and using recycled water can help alleviate pressure on potable water sources.
- **Cooling Towers**: Commercial and industrial facilities with cooling towers, such as large office buildings, are significant water consumers for cooling purposes. Recycled water can be a suitable alternative for cooling tower systems, helping reduce the demand for potable water while also minimizing the environmental impact of cooling processes.

By expanding the recycled water distribution system to include other users, the City could achieve greater water conservation. However, inclusion of additional users will require more capital investment.

Recycled Water Quality

When utilizing recycled water for irrigation at a golf course or for landscaping, it is essential to address recycled water quality concerns to ensure the health of the turf, plants, trees, and the surrounding environment. Recycled water, while an effective and sustainable resource, differs significantly from potable water. One of the primary concerns is the higher levels of sodium chloride (salt) present in recycled water. Elevated salinity can be harmful to sensitive plants, trees, and grass, as it interferes with their ability to absorb water and nutrients. Over time, the salt can lead to issues such as reduced growth, leaf burn, and in severe cases, plant, or tree death. For golf course irrigation, the City must carefully assess the salt tolerance of its turfgrass and landscaping to ensure these areas can withstand recycled water use without significant damage.

Another concern associated with recycled water is the potential presence of trace amounts of heavy metals, such as lead, copper, zinc, or cadmium. These metals, though typically found at low concentrations, can accumulate in the soil over time, especially with repeated use of recycled water. As these metals build up, they can pose a toxic risk to plant roots, impacting nutrient uptake and inhibiting healthy growth. Additionally, heavy metals can disrupt soil health, damaging microbial activity and further hindering plant development. In the long term, the accumulation of these metals can degrade soil quality, making it more difficult for plants to thrive and potentially affecting the broader ecosystem, including beneficial organisms and wildlife such as federally threatened steelhead trout which are hosted in Stevens Creek situated adjacent to the site.

To ensure the safe and effective use of recycled water for golf course irrigation, a comprehensive assessment must be conducted to evaluate the potential impacts on turf quality, landscaping, and surrounding habitat and wildlife. This assessment should focus on several key areas, including the effects of salinity buildup in the soil, the risk of clogging in the irrigation systems, and the overall health of the plants and trees. A thorough understanding of how recycled water will interact with the existing plants and trees is crucial, particularly since the golf course is home to several large redwood trees, which are especially sensitive to high levels of salt in the water. These trees are at risk of suffering from salt toxicity, which can impair their growth and long-term health. As such, the impact of recycled water on these trees must be studied to determine whether any additional mitigation measures, such as soil amendments or specialized irrigation techniques, are necessary.

In addition, the golf course may need to replace certain plants that are particularly sensitive to higher salinity levels. For example, species that are more tolerant of the salinity of recycled water should be introduced in a place of less salt-tolerant plants. This shift will help to ensure that the landscaping remains healthy and vibrant, without compromising the overall aesthetic of the golf course. Selecting salt-tolerant species and carefully designing the irrigation system to minimize salt buildup will be key strategies in maintaining the integrity of the golf course's turf and landscaping.

Golf Course Irrigation

The existing golf course irrigation system was evaluated by National Golf Foundation Consulting in 2021. Based on their assessment, the entire irrigation system was deemed to be in need of full replacement since the system is over 60 years old and has outlived its useful life. The recommendation included installing a newer technology system that saves water and provides more efficient coverage and delivery of water to irrigate the turf.

Irrigation improvements will be needed to ensure compatibility with recycled water and maintain system efficiency. The material selected for the new irrigation system shall be suitable for recycled water due to the potential of irrigation facilities to degrade when exposed to the higher chemical content present in recycled water, such as salts, trace metals, and other impurities. This ensures the longevity and integrity of the irrigation infrastructure.

Another consideration is the difference in water pressure between recycled water and potable water. Recycled water may be delivered at a pressure that is different than potable water, which could impact the performance of the irrigation system. To accommodate these variations, the addition of a hydropneumatic tank or pressure-regulating valves will be necessary. This will help stabilize the pressure, ensuring that the water flows at the appropriate rate for efficient irrigation and prevent damage to sprinkler heads and other system components.

Moreover, the irrigation system for the golf course's fairways and greens may require modifications to optimize the application of recycled water. One of the key challenges when using recycled water is minimizing runoff and overspray, which can lead to water waste, excessive salinity in the soil, and potential harm to the surrounding environment.

To address this, adjustments to sprinkler heads, nozzles, and irrigation patterns may be needed. The system will need to be fine-tuned to ensure more precise water application, reducing the risk of overspray onto non-landscaped areas or sensitive vegetation, in particular, areas with more delicate plants, such as the redwood trees.

Recycled Water Infrastructure Maintenance and Operation

To ensure the long-term success and reliability of the recycled water system for the golf course, having dedicated staff for ongoing maintenance and operation of the infrastructure will be crucial. Proper maintenance and operation practices will help mitigate risks, reduce downtime, and prolong the lifespan of the system, ensuring a sustainable and cost-effective water source for the golf course and other potential users.

1. Regular System Inspections and Monitoring

A key element of maintaining the recycled water infrastructure will be the implementation of routine inspections and monitoring. This includes checking the condition of valves, pressure-regulating devices, and sprinklers to ensure they are functioning correctly and not subject to wear or damage from the chemical content of the recycled water. Inspections should also focus on the performance of the storage tank and pump station to ensure that they are operational. The system should be monitored regularly for leaks in the recycled water system.

In addition to physical inspections, water quality monitoring will be essential. The salinity levels, pH, and concentrations of heavy metals in the recycled water must be regularly evaluated to ensure that the water remains within safe parameters for irrigation. This will help prevent salt buildup in the soil and protect the health of sensitive plant species, including the golf course’s turf and trees.

2. Cleaning and Flushing of Irrigation Lines

Over time, recycled water can lead to the accumulation of minerals, biofilms, and particulates in the irrigation lines, which can clog sprinkler heads and nozzles. To maintain system efficiency and avoid clogs, regular cleaning and flushing of the irrigation lines will be required. Flushing the system periodically helps clear out any sediment, debris, or biofilm that may have built up, ensuring that water flows freely through the system and that sprinkler heads deliver water uniformly.

Areas with high salinity or high mineral content may require more frequent flushing to remove accumulated salts and prevent them from building up inside the pipes. If salt is left unchecked, it can cause scale deposits that obstruct water flow, reducing the system's overall efficiency.

3. Maintenance of Pump Stations and Pressure-Regulating Devices

The pump stations, hydropneumatics tanks, and pressure-regulating valves that control the flow and pressure of recycled water will require regular inspection and maintenance. Pumps should be checked for proper operation, with attention to ensuring that they are not overworking or becoming inefficient due to wear. The seals, motors, and bearings in the pump stations will also need to be periodically lubricated and replaced as necessary to avoid system failure.

Similarly, hydropneumatic tanks and pressure-regulating valves will need regular testing and calibration. Improperly calibrated valves can lead to inconsistent water flow, resulting in irrigation inefficiency and increased risk of runoff or overspray. Ensuring that these components are maintained will help keep the system operating at optimal performance.

4. Soil and Turf Health Monitoring

Over time, the use of recycled water may lead to changes in soil composition, particularly regarding salinity levels. Therefore, regular soil testing will be required to assess salt buildup and its potential effects on plant health. Soil amendments may be needed to mitigate high salinity levels and restore balance in the soil's chemistry.

5. Adjustments to Irrigation Schedules and Application Techniques

Over time, the irrigation system may need adjustments to account for changes in the water quality or shifts in environmental conditions. Seasonal variations in temperature, rainfall, and plant water requirements may also affect how much water the turf and landscaping need. As such, the irrigation schedule should be reviewed regularly and adjusted to optimize water use and prevent waterlogging or overspray. Smart irrigation technology, such as weather-based controllers, can be integrated into the system to further improve water efficiency.

Additionally, if salt accumulation or clogging becomes an issue, adjustments to the irrigation system may be necessary, such as altering nozzle types or reducing water pressure in certain areas to minimize overspray and runoff. Monitoring and adjusting application techniques will ensure that water is being applied in the most efficient and effective manner, preserving both the health of the golf course and the surrounding environment.

6. Staff Training and Education

A key aspect of maintaining recycled water infrastructure is ensuring that the staff are properly trained in the requirements of working with recycled water systems. The successful operation and maintenance of a recycled water system at the golf course will require a comprehensive and proactive approach. Regular inspections, cleaning, and water quality monitoring will be essential to keeping the system running smoothly, while ongoing adjustments to irrigation schedules and techniques will help maintain turf and plant health. These efforts will result in the need for additional staffing and maintenance resources or contract services, which will result in additional costs.

Permits

Implementing a recycled water system and a SWRF in California involves navigating a complex regulatory framework to ensure that the project complies with state and local environmental standards, water quality guidelines, and operational safety protocols. California has well-established procedures for permitting the use of recycled water for non-potable purposes such as irrigation. This section outlines the key permitting requirements that must be addressed to implement a recycled water system and SWRF.

1. State Water Resources Control Board (SWRCB) Approval

The California SWRCB plays a vital role in regulating water recycling projects. The SWRCB is responsible for protecting and managing California's water resources, including surface water, groundwater, and wastewater. The SWRCB provides guidance on the use of recycled water for various purposes, such as irrigation, industrial use, and potable water augmentation. It works in collaboration with other agencies to establish standards and ensure safe practices.

The implementation of the recycled water project will need to meet the guidelines set forth in Title 22 of the California Code of Regulations (CCR), which governs water recycling in the state. Title 22 establishes standards for various levels of recycled water treatment, including tertiary treatment, which is required for irrigation and other non-potable uses. The project will need to demonstrate that the recycled water produced by the SWRF meets these strict standards, including criteria for disinfection, salinity, turbidity, and other contaminants. Once the design and water quality criteria have been met, the SWRCB will issue approval for the use of recycled water in the irrigation system.

2. California Department of Public Health (CDPH)

The California Department of Public Health (CDPH) plays a critical role in regulating the use of recycled water in the state, particularly in ensuring that recycled water meets public health standards. For the implementation of a recycled water system in California, CDPH approval is required, especially for systems that involve the direct or indirect reuse of wastewater for non-potable purposes such as irrigation.

The CDPH, through its Division of Drinking Water, is responsible for reviewing and approving the use of recycled water for various purposes, including irrigation, industrial uses, and cooling towers. For projects that involve the treatment and distribution of recycled water, the CDPH ensures that the water quality meets California’s strict health and safety standards. This is particularly important for systems that use treated wastewater for irrigation, as the water quality must adhere to the guidelines set forth in Title 22 of the California Code of Regulations (CCR).

Once a recycled water system is operational, the CDPH monitors the system's compliance with water quality standards. Regular water quality testing is required, and the system must report results to the CDPH to ensure that the water being distributed for irrigation or other uses remains safe and compliant with the standards. Failure to maintain compliance with the regulatory requirements may result in penalties or suspension of the approval to use recycled water.

3. Permit from Cupertino Sanitary District

The SWRF will also generate wastewater byproducts during the treatment process. The SWRF may need to obtain a wastewater discharge permit to ensure that any residual waste or treated effluent is effectively managed. This permit will outline the requirements for discharging wastewater back into the Cupertino Sanitary District's wastewater collection system or another designated disposal point.

The sanitary district will likely conduct a review of the proposed design for the SWRF, including its impact on the overall wastewater collection system and its capacity to manage the waste produced from the SWRF that will be discharged back into their wastewater infrastructure. The wastewater discharge permit will specify how the facility must manage residual solids, such as sludge, and may include requirements for the treatment, storage, and disposal of these materials in accordance with environmental standards. It will also require ongoing monitoring and reporting to ensure that no hazardous materials or contaminants are released into the environment. Furthermore, the district may require specific operational and maintenance procedures for the SWRF to minimize any negative effects on their wastewater system.

4. Permit from CalTrans for Crossing of Interstate 280 and Highway 85

The crossing of Interstate 280 and Highway 85 will require approval from the California Department of Transportation (CalTrans). The jurisdiction oversees all interstates and highways in California, and an encroachment permit application needs to be submitted for approval prior to constructing pipeline infrastructure across their right-of-way. The application includes detailed project plans, construction methods, and timelines for the installation of the pipeline. The application should also specify the exact location of the proposed crossing, the type of work to be performed, and how the pipeline will be installed (e.g., trenching, boring, or other methods).

5. Permit from Union Pacific Railroad for Crossing of Railroad Tracks

Similar to the CalTrans encroachment permit application process, the City will need to obtain an encroachment permit from UPRR for crossing of the railroad tracks. UPRR requires a Right-of-Way Encroachment Permit for any construction or installation of utilities, such as a recycled water pipeline, which will cross or be located within its tracks' right-of-way. The applicant must submit an application, detailing the scope of the project, including the pipeline's route, construction methods, and impact on UPRR's operations.

One consideration when crossing railroad tracks is minimizing disruption to UPRR's operations and ensuring safety during the construction process. UPRR requires that the pipeline be installed using trenchless methods, such as horizontal directional drilling (HDD) or boring, to avoid digging directly under or near active rail tracks. This method reduces the risk of disturbing the tracks, ensures worker safety, and minimizes traffic disruptions.

6. Cross-Connection Control and Backflow Prevention Permits

A critical part of ensuring the safe and effective operation of the recycled water system is preventing the unintended mixing (or "cross-connection") of recycled water with the potable water supply. To mitigate this risk, the installation of backflow prevention devices is mandatory. Cross-connection control measures, including backflow prevention devices such as air gaps or reduced pressure zone (RPZ) valves, must be incorporated into the system to ensure that recycled water cannot contaminate the potable water system in case of pressure fluctuations.

The City will be required to coordinate with the water retailer and County of Santa Clara for any permits for the backflow prevention devices and their installation. Regular testing will be needed to ensure compliance.

7. Building and Construction Permits

In addition to environmental and water quality permits, the installation of a SWRF will require standard building and construction permits. These permits will cover aspects such as construction safety, electrical systems, structural integrity, and fire safety measures for the facility. The City of Cupertino Building Department will issue the permit after reviewing the project's design plans to ensure compliance with local building codes.

8. Ongoing Reporting and Compliance

Once the recycled water system is operational, it will be subject to ongoing monitoring and reporting requirements. This includes periodic water quality testing, regular system inspections, and the submission of reports to the SWRCB, local health authorities, and the Cupertino Sanitary District. Compliance with water quality standards must be continuously demonstrated through routine testing for key parameters such as salinity, chemical contaminants, and disinfectant residuals. Failure to meet these standards could result in fines or penalties, or in some cases, suspension of the recycled water system's operation.

The permitting process for implementing a recycled water system and SWRF in California involves multiple regulatory agencies at both the state and local levels, including the SWRCB, CDPH, Cupertino Sanitary District, and other environmental review bodies. Each stage of the project, from design to construction to operation, requires careful compliance with water quality standards, environmental protection regulations, and public safety protocols.

Environmental, California Environmental Quality Act (CEQA)
In accordance with the CEQA, any new construction or significant changes to land use, including the installation of a SWRF, may require an environmental impact review (EIR) to assess the potential environmental impacts of the project. An EIR will evaluate issues such as potential water quality impacts, impacts on surrounding vegetation and wildlife, soil erosion, traffic disruptions, noise, and other environmental factors.
If the project involves construction on previously undeveloped land or near environmentally sensitive areas (such as wetlands, creeks, protected wildlife habitats), a more thorough environmental assessment may be required. The EIR process helps to identify potential environmental impacts early on and establishes measures to mitigate adverse effects prior to performing any construction.

Project Impacts
The implementation of a SWRF or extending the existing recycled water pipeline from the City of Sunnyvale at the intersection of Homestead Road and Wolfe Road to serve the golf course and other potential users in the area brings several benefits, particularly in terms of water conservation and sustainability. However, there are also potential environmental, operational, and regulatory impacts that must be considered.

The SWRF's proximity to a creek adds an additional layer of complexity, as the facility must be designed and constructed above the floodplain elevation or be properly floodproofed and operated to mitigate any adverse effects on the surrounding ecosystem. The facility must incorporate stringent safeguards to prevent any contaminants from entering the creek, such as untreated wastewater, chemicals, or byproducts from the treatment process. This includes monitoring systems and fail-safes to detect and prevent any contamination of the creek through runoff or accidental discharge.

The construction of the new recycled water pipeline presents several significant challenges. One of the primary obstacles is the need for multiple trenchless crossings that include Interstate 280, Highway 85, and UPRR railroad tracks. These crossings cannot be avoided since there are no other feasible pipeline routes that avoid these crossings. Trenchless construction methods, such as horizontal directional drilling (HDD) or boring, are required for these crossings. While trenchless methods are less disruptive, they are notably more expensive than traditional open trench construction techniques due to the specialized equipment as well as the complexities involved in working under highways and railroad tracks.

Moreover, obtaining the required permits for these crossings introduces additional challenges and costs. Both CalTrans and Union Pacific Railroad (UPRR) have rigorous permitting processes, which involve detailed reviews of construction methods, safety plans, and environmental impact assessments. CalTrans' review process for work within their right-of-way can be time-consuming, with approval timelines potentially extending to several months. Similarly, UPRR's approval process requires thorough evaluation of the potential risks to railroad operations and the safety of workers, which can also take a prolonged period to finalize.

The cost of trenchless crossings adds a significant financial burden to the project. The complexity of working under major infrastructure and the need for specialized contractors contributes to higher costs associated with these crossings.

The construction of a new recycled water facility, whether it is SWRF or extending the existing pipeline system, will require CEQA compliance. As previously noted, an EIR to assess the potential environmental impacts of the project may need to be completed. The issues such as potential water quality impacts, impacts on surrounding vegetation and wildlife, soil erosion, traffic disruptions, noise, and other environmental factors should be considered as part of the project undertaking.

Once any necessary draft EIR is prepared, it must undergo a public review process. This process allows local stakeholders, community members, and regulatory agencies to review the document and provide feedback. Public meetings, workshops, and comment periods are typically held to solicit input from affected parties, including environmental groups, residents, local businesses, and other stakeholders.

Public comments would be reviewed and addressed in any final EIR, with responses provided to any concerns raised during the review process. This feedback can lead to modifications to the project plan or additional mitigation measures to address concerns related to environmental impacts. A final EIR will incorporate these comments and provide a comprehensive analysis of all potential impacts and the measures that will be taken to mitigate them.

After the final EIR is completed, it will be presented to the City Council for approval. The City Council would review the EIR and its findings, and based on this analysis, make a determination regarding the environmental impact of the project. If the project is deemed to have significant environmental impacts, the City Council may require additional mitigation measures or request project modifications. Once the City Council has approved an EIR and any necessary mitigation measures, the project could proceed to the next stages of permitting, design, and construction.

The timeline for completing an EIR process can vary based on the complexity of the project, the scope of the environmental review, and the level of public and agency involvement. On average, the process typically takes 12 to 18 months from the start of the environmental review to the approval of the final EIR.

Project Cost
Implementing a recycled water system for irrigation, particularly for applications such as golf courses and other landscape areas, involves significant upfront investment and ongoing operational costs. While recycled water systems provide long-term benefits such as water conservation, reduced dependence on potable water sources, and environmental sustainability, there are several cost factors that need to be carefully considered to assess the financial feasibility of the project. The costs associated with the system can be categorized into capital costs, operation, and maintenance costs, and permitting costs.

1. Capital Costs

    a) Recycled Water Pipelines

The estimated cost for trenchless pipeline construction, particularly for crossings under major infrastructure like freeways, can vary significantly based on factors such as the location, length of the crossing, depth of the pipeline, soil conditions, and the specific trenchless method used. For crossing Interstate 280 or Highway 85, the cost will depend on these factors. The rough order of magnitude (ROM) for trenchless construction typically ranges from $2,000 to $4,000 per linear foot.

The estimated cost for open trench pipeline construction is dependent on the length and depth of pipeline, pipe material, soil conditions and size of pipeline. In addition, the pipeline needs to be designed to minimize traffic impact and utility conflicts. While less expensive than trenchless methods, open trenching still comes with its own set of challenges and costs, especially in urban or difficult terrain. The ROM for open trench construction typically ranges from $500 to $1,000 per linear foot.

    b) Recycled Water Storage Tank

The recycled water storage tank plays a crucial role in the efficient distribution and management of recycled water. Having a storage tank ensures that recycled water is available when needed, especially during times of high demand or when supply from SWRF is low. Storage helps balance the inconsistency between the production of recycled water and its demand, ensuring a steady, reliable supply.

The construction will require the selection of a suitable site, preparation of foundation and above ground storage tank. The ROM for fully constructed storage tank ranges from $5 to $10 per gallon.

    c) Pump Station and Hydropneumatic Tank

A pump station and hydropneumatic tank will be required to convey the recycled water for irrigation at the golf course. The pump system is needed to move the recycled water from the storage tank and the hydropneumatic tank will help maintain a steady and reliable water pressure in the recycled water system, ensuring that recycled water is delivered at a consistent flow rate, regardless of fluctuating demand.

The construction of both the pump station and hydropneumatic tank will require the selection of a suitable site, preparation of foundation and building. The ROM for fully constructed pump stations ranges from $15,000 to $25,000 per horsepower (HP) and ROM for hydropneumatic tank ranges from $50 to $100 per gallon.

d) Irrigation Upgrade

As previously noted above, the existing irrigation system will require complete replacement as it has outlived its useful life. For the new irrigation system to function optimally with recycled water, it is crucial to select materials that ensure the longevity and integrity of the irrigation infrastructure. Some adjustment of irrigation techniques may be required to effectively deliver recycled water and minimize environmental and plant life impacts.

2. Operations and Maintenance Costs

With the implementation of a recycled water system, it is crucial to allocate appropriate staffing and budget for ongoing operation and maintenance of the infrastructure to ensure its reliability and efficiency. The staff may include engineers and operators who have the experience and qualifications to manage the complexities of recycled water systems, including monitoring water quality, maintaining treatment processes, and ensuring that the distribution system functions properly.

In addition to the regular maintenance activities of tanks, pumps, and pipelines, the SWRF treatment and disinfection processes must be continually monitored to ensure that the recycled water meets safety and regulatory standards. Budget for ongoing maintenance for labor, ongoing permitting, replacement parts, chemicals for treatment, energy, and monitoring systems, as well as emergency contingencies need to be considered.

3. Permitting Costs

Permits from both state and local jurisdictions are essential for the successful implementation of a recycled water system and the construction and operation of a SWRF. These permits are required to ensure that the project complies with a variety of regulatory standards related to water quality, public health, environmental protection, and safety. Permits are often necessary to demonstrate that the recycled water will meet the required quality standards for its intended non-potable uses, such as irrigation, industrial cooling, or landscaping. The permitting process may involve environmental reviews, such as Environmental Impact Reports (EIRs), to evaluate and mitigate potential risks.

The permitting cost for implementing a recycled water system and constructing a SWRF will vary significantly depending on the scope of the project, location, and specific regulatory requirements at both state and local levels.

4. Estimated Project Cost

Below are estimated costs for the two options that were evaluated for the feasibility study: 1) extending the existing recycled water pipeline from the intersection of Homestead Road and Wolfe Road, and (2) installing a small-scale, on-site wastewater treatment plant at Blackberry Farm Golf Course to treat wastewater to meet recycled water standards.

Description	Quantity	Unit	Unit Cost	Total Cost
Option 1 - Extending Existing Recycled Water				
Capital Cost				
Pipeline (Assume 12" Diameter)	22,000	LF	$1,000	$22,000,000
Trenchless Crossings				
Interstate 280	400	LF	$4,000	$1,600,000
Highway 85	400	LF	$4,000	$1,600,000
UPRR Railroad Tracks	200	LF	$4,000	$800,000
Operation and Maintenance Cost (Annual)[1]		LS	$600,000	$600,000
Irrigation Upgrade[2]		LS	$700,000	$700,000
Pump Station (Assumed necessary)	100	HP	$20,000	$2,000,000
Hydropneumatic Tank	1,000	Gallons	$100	$100,000
Permitting Coordination & Cost				
UPRR		LS	$50,000	$50,000
CalTrans		LS	$50,000	$50,000
Environmental (CEQA)		LS	$250,000	$250,000
State of California (SWRCB, CDPH)		LS	$50,000	$50,000
Construction Cost Subtotal				**$29,800,000**
Market Adjustment Factor (10%)				$2,980,000
Construction Contingency (40%)				$11,920,000
Construction Cost Total				**$44,700,000**
Engineering and Admin Services (Design) (15%)				$4,470,000
Construction Management (10%)				$2,980,000
Engineering Services During Construction (5%)				$1,490,000
Total Capital Cost				**$53,640,000**

Description	Quantity	Unit	Unit Cost	Total Cost
Option 2 - Satellite Water Recycling Facility				
Satellite Water Recycling Facility		LS	$1,500,000	$1,500,000
Site Preparation for SWRF		LS	$500,000	$500,000
Operation & Maintenance Cost (Annual)[1]		LS	$600,000	$600,000
Permitting				
Cupertino Sanitary District		LS	$50,000	$50,000
Environmental (CEQA)		LS	$250,000	$250,000
State of California (SWRCB, CDPH)		LS	$50,000	$50,000
Storage Tank (Assume 100,000 Gallons)	100,000	Gallons	$5	$500,000
Pump Station (on site near SWRF)	40	HP	$20,000	$800,000
Pipeline (assume 8" Diameter)	500	LF	$600	$300,000
Hydropneumatic Tank	500	Gallons	$100	$50,000
Irrigation Upgrade[2]		LS	$700,000	$700,000
Construction Cost Subtotal				**$5,300,000**
Market Adjustment Factor (10%)				$530,000
Construction Contingency (40%)				$2,120,000
Construction Cost Total				**$7,950,000**
Engineering and Admin Services (Design) (15%)				$795,000
Construction Management (10%)				$530,000
Engineering Services During Construction (5%)				$265,000
Total Capital Cost				**$9,540,000**

Notes:

1. Cost includes 2 FTE, materials, testing, and reporting. Agreements with other agencies for maintenance and operation of the recycled water system will need further evaluation.
2. Based on cost estimate from National Golf Foundation Consulting in 2021.

Conclusion

Although the implementation of a recycled water facility could be an alternative resource to not having to use potable water for irrigation, there are many factors that need to be considered, such as recycled water customers, maintenance, and operation, permitting, environmental impacts, and cost. Ensuring that multiple recycled water customers can be served with any new system is essential to realize a return on investment. Additionally, the infrastructure required for distributing recycled water must be carefully planned to ensure it meets the demand of these users. Regular maintenance and operation are essential to guarantee the system’s reliability and safety over time. Permitting and regulatory approval processes can also pose significant hurdles, as they often involve environmental review. The environmental impacts, such as potential effects on the nearby creek, should be evaluated.

The following table shows the annual water use and cost of water at the golf course over the last decade.

Year	Million Gallons	Cost
2015	9.22	$ 57,648.26
2016	9.35	$ 60,143.57
2017	8.19	$ 64,712.87
2018	8.14	$ 62,750.54
2019	7.83	$ 61,779.31
2020	8.67	$ 64,950.93
2021	8.79	$ 70,176.32
2022	8.61	$ 74,197.13
2023	8.33	$ 88,597.97

Assuming the annual water cost is approximately $90,000, it would take approximately 596 years and 106 years, for Options 1 and 2 respectively, to realize a return on initial infrastructure investment without accounting for inflation.

Options	Cost	Number of Years
Option 1	$ 53,640,000.00	596
Option 2	$ 9,540,000.00	106

Based on the cost evaluation, the upfront costs for implementation of the recycled water system are very high and the initial investments may never offset the long-term potable water cost for the Blackberry Farm Golf Course.

City Work Program (CWP) Item: Yes, FY 24-25

CWP Item Description: Recycled Water Feasibility Study - Develop Recycled Water Feasibility Study. Include Blackberry Farm focus and extension of recycled water from SCVWD.

Council Goal: Sustainability and Fiscal Strategy

Sustainability Impact

No sustainability impact

Fiscal Impact

There are no fiscal impacts with the preparation of the Recycled Water Feasibility Study memorandum. Staff proceeded with performing an in-house study to provide a high-level analysis to Council to save consultant fees. If no further investigation is requested, the City Work Program funding ($200,000) provided for this study will be returned to the general fund.

Prepared by: Jimmy Tan, P.E., Assistant Director of Public Works
Approved for Submission by: Pamela Wu, City Manager
Attachments:
A – Recycled Water Alignment
B – Satellite Recycled Water Facility

Attachment A

Figure 1

Figure 2

Trenchless crossing of HWY 85 (approx. 400 LF)
Connect to Recycled Water System from Figure 1
Trenchless crossing of railroad tracks (approx. 200 LF)
Stevens Creek Blvd
Stevens Creek Elementary School
Varian Park
Mary Avenue Dog Park
University Way
Woodbury Dr
Dana Pt Ln
Kinderland Child Development Center
Abundant Life Assembly of God
Cupertino Memorial Park
Cupertino Sports Center
Registration & Student Services
William Faria Elementary School
De Anza College
De Anza College Stadium & Track
Joyful Melodies Music School
Nina Piano Lessons
Enjoy Dance Studio
N De Anza Blvd
Lazaneo Dr
Alves Dr
Granada Ave
Hermosa Ave
Pasadena Ave
Bubb Rd
Campus Dr
S Stelling Rd
Pepper Tree Ln
Sunrise Dr
Rodrigues Ave
Shelly Dr
Blackberry Farm
Google
Data attribution
3/11/2022
300 m

BUDGETARY ESTIMATE

MEMPAC-X, MEMBRANE BIOREACTOR PACKAGE

PROJECT NAME	**CUPERTINO, SCALPING**	**ESTIMATE DATE**	**6-3-2024**
CONTACT NAME	**Jimmy Tan**	**PROJECT NUMBER**	**CL24-**
CONTACT EMAIL	**jimmyt@cupertino.gov**	**REVISION NUMBER**	**1**
CONTACT NUMBER	**(408) 777-3248**	**REVISION DATE**	**N/A**

MEMPAC-X DESCRIPTION

The **MEMPAC-X** is a pre-engineered, package membrane bioreactor. A factory built base unit will be supplied with all necessary pumps, blowers, membranes, sensory, electrical and control equipment. To expand the hydraulic or organic capacity, the base unit can be field integrated with exterior process tanks. The Client can choose to have Cloacina provide "formal" factory build stainless steel tanks or provide "informal" process tanks, typically vertical, polyethylene water storage tanks.

When applicable, Cloacina will provide the required process tank volumes and costs for both options in this estimate.

1. PROCESS FLOW

The following describes the typical process flow of the MEMPAC-X unit:

1.1 HEADWORKS

The influent flow will pass through an influent flow meter prior to discharge into a 2MM perforated screen. Screened solids will be discharged into an endless bagger unit to be dumped into a client provided receptacle. Screened influent will discharge into the transfer chamber where it will be pumped to the anoxic chamber at a calibrated rate. If required, the transfer chamber is provided with a connection at the bottom to allow the storage volume to be expanded by attaching an exterior tank. The transfer pump will be controlled by an installed level transducer in the transfer chamber.

1.2 BIOLOGICAL NUTRIENT REMOVAL

Screened influent will mix with return activated sludge (RAS) which has gravity-returned from the MBR chamber(s) to form "mixed liquor." Nitrates conveyed by RAS flow to the oxygen-lean anoxic process serve to oxidize some of the influent biological oxygen demand (BOD) by which process these nitrates are converted to nitrogen gas, ultimately lowering effluent total nitrogen (TN). If required, the anoxic volume can be expanded by attaching an exterior tank. The anoxic process will be mixed by an integrated recirculation pump and static eductors.

1.3 SECONDARY TREATMENT

Mixed liquor proceeds from the anoxic process to the aeration process by gravity where nitrification by which process BOD is oxidized and ammonia is converted to nitrates, ultimately lowering their respective effluent concentrations. This is achieved by introducing compressed air through fine bubble diffusers. If required, the aeration volume can be expanded by attaching an exterior tank. Cloacina will provide a properly sized blower installed on the base unit to provide air to the external tank.

1.4 MEMBRANE CLARIFICATION

At the end of the activated sludge process, wastewater is pumped from the aeration process to a membrane cassette chamber using forward activated sludge (FAS) pumps supplied on the base unit. The membrane cassette has a vacuum applied across them by the permeate pump, pulling clear water "permeate" through the membranes and leaving solids behind. The permeate pump will convey the permeate to an attached "clear well" reservoir of water used for periodic membrane cleaning, i.e. "backpulsing," and clean-in-place (CIP) procedures which are fully automated. Effluent will discharge from the clear well by gravity.

1.5 WASTE SLUDGE

To maintain proper solids concentration, Cloacina provides a sludge wasting pump that operates based on flow and loading to the treatment system. Waste sludge will discharge to the sludge storage chamber in the base unit. The sludge storage volume can be expanded by attaching an exterior tank. Cloacina will provide an aeration blower installed on the base unit sized for the tank volume.

2. FLOW DEFINITIONS

Wastewater flow can be described in a multitude of ways, related to varied time periods, wet and dry weather, seasonal populations, and permit definitions. To ensure that the estimated package meets the project needs, the following terms **shall** be used to define the capacity of the proposed system:

Term	Definition
Average Annual Flow (AAF)	The average flow over a 24-hour period, which is the total influent volume in one year divided by the number of days in that year. AAF is typically the nominal capacity of a plant
Maximum Month Flow (MMF - i.e. "Design Flow")	The daily average flow during the maximum consecutive 30-days of daily flow in a year. MMF is the maximum daily flow that Cloacina's MBR can treat biologically.
Peak Day Flow (PDF)	The single greatest flow over a 24-hour period in a year. PDF serves as the plant hydraulic capacity design point. Flow rates greater than PDF, including Peak Hour Flow (defined below), are to be equalized to PDF via influent storage (by others or by Cloacina) that augments the treatment plant
Peak Hour Flow (PHF)	The highest flow rate over a 60-minute period in the Peak Day. For applications in which influent is screened prior to equalization, screens shall be sized for PHF. In the absence of a PHF specified by the Client, PHF will be calculated as a function of the plant's service population per "Metcalf & Eddy".

3. INFLUENT LOADING

The following outlines the organic loading used to develop this estimate.

Term	Definition
Maximum Month Flow (MMF) Loading	It is assumed that the influent concentrations outlined below are applied 100% to the Maximum Month Flow (MMF), unless otherwise indicated.
PEAK Daily Flow (PDF)	It is assumed that no additional influent constituent loading is contributed by flows more than MMF. Loading defined for MMF is assumed to be diluted at PDF such that PDF loading shall equal MMF loading multiplied by the ratio of MMF to PDF.
PDF Equation	• $BOD_{\mathrm{PD}} = BOD_{\mathrm{MMF}} \times \frac{MMF}{PDF}$ • $TSS_{\mathrm{PD}} = TSS_{\mathrm{MMF}} \times \frac{MMF}{PDF}$ • $TKN_{\mathrm{PD}} = TKN_{\mathrm{MMF}} \times \frac{MMF}{PDF}$

4. DESIGN PARAMETERS

4.1 INFLUENT PARAMETERS

Total Daily Flow (Q)	Average Annual (AAF)	Maximum Month Flow (MMF)	Peak Day (PDF)	Peak Hour (PHF)
Peaking Factor	1.0	1.5	N/A*	N/A*
Gallons per Day	25,000	40,000		
Gallons per Minute	10.2	15.3		

*Peak Day and Peak Hour flows do not apply for a scalping application.

Organic Concentration	BOD5*	TSS*	TKN*	NH3*	TP*	ALK*
Standard Influent (mg/L)	360	350	60	37	10	300
Design Influent (mg/L)	360	350	60	37	10	300
Screen Removal (%)	4%	9%	2%	0%	2%	0%
Screened Influent (mg/L)	346	319	59	37	10	300

Total Organic Loading	BOD5*	TSS*	TKN*	NH3*	TP*	ALK*
lbs/day at AAF	72.1	66.4	12.3	7.7	2.0	62.6
lbs/day at MMF	115.3	106.3	19.6	12.3	3.3	100.1

*Influent concentration was not provided and therefore was assumed from Cloacina's standard influent concentration values.

4.2 EFFLUENT PARAMETERS

Effluent Limitations	BOD5*	TSS*	TN*	NH3*	TP*
Limit	10	10	10	5	N/A
Unit	mg/L	mg/L	mg/L	mg/L	mg/L

*Effluent limit was not provided and therefore was assumed from Cloacina's standard effluent limits or identified as not applicable to the project.

4.3 TYPICAL PROCESS PARAMETERS

The following are the standard parameters used in the design of the MEMPAC-X unit, including required external process tank volumes provided by the client.

Parameter	Range
MLSS Concentration (mg/L)	6,000-9,500
F:M Ratio	.06-.12
MCRT (Days)	21-35
Hydraulic Residence Time (Hrs)	12-24

4.4 PROCESS VOLUMES

The following are the estimated volumes necessary for the client to supply to meet required process volumes.

Process	Base Unit Integrated Volume (gallons)	Minimum External Volume Required (gallons)	Operating Depth of External Tank
Anoxic	2,400	3,608	8.5’
Aeration	4,000	3,608	8.5’

5. SCOPE OF SUPPLY (BY PROCESS)

5.1 TRANSFER PROCESS

The MEMPAC-X transfer process includes an aerated transfer chamber that provides a small volume of equalization storage allowing screened influent to be pumped to the downstream process at a consistent flow rate. The transfer chamber is supplied with a flanged fitting for the field connection of an external tank that will rise and fall with the chamber to increase equalization capacity.

5.2 BASE TRANSFER CHAMBER EQUIPMENT

Factory installed standard equipment provided with the MEMPAC-X Base Unit:

Equipment	Description	Quantity
Transfer Chamber	Integrated chamber with 1,360-gallon capacity	1
Influent Flowmeter	Factory installed flowmeter	1
Aeration Blower	Air pump sized for 1.25 cfm per 1,000 gallons of storage	1
Aeration Diffusers	12” fine bubble disc diffusers	1
Influent Screen	2 mm perforated mechanical screen	1
Level Transmitter	Hydrostatic sensor will control pump and monitor level of chamber and exterior tank if applicable	1
Transfer Pump	Stainless steel self-supporting submersible pump	1

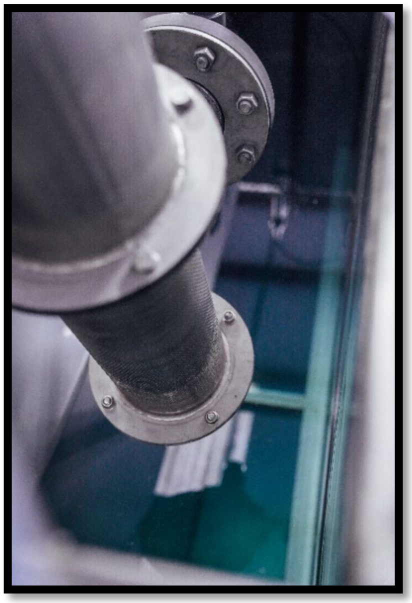
5.3 ANOXIC PROCESS

The MEMPAC-X anoxic process includes a mixed anoxic chamber sized to ensure hydraulic residence time necessary for nutrient reduction. The anoxic chamber is supplied with a flanged fitting for the field connection of an external tank that will increase capacity if necessary to meet required residence time.

5.3.1 BASE ANOXIC CHAMBER EQUIPMENT

Factory installed standard equipment provided with the MEMPAC-X Base Unit:

Equipment	Description	Quantity
Anoxic Chamber	Integrated chamber with 2,400-gallon capacity	1
Mixer	Factory installed tank mounted lightening mixer	1



5.4 AERATION PROCESS

The MEMPAC-X aeration process includes an aerated aeration chamber sized to ensure proper volume of process biology. The aeration chamber is supplied with a flanged fitting for the field connection of an external tank that will increase capacity if necessary to meet required process volume.

5.4.1 BASE AERATION CHAMBER EQUIPMENT

Factory installed standard equipment provided with the MEMPAC-X Base Unit:

Equipment	Description	Quantity
Aeration Chamber	Integrated chamber with 4,000-gallon capacity	1
Aeration Blower	Factory installed regenerative blower sized for process volume	1
Aeration Diffusers	Factory installed 2-meter Sock style fine bubble diffusers	3
Level Transmitter	Hydrostatic sensor will control pump and monitor level of chamber and exterior tank if applicable	1
Dissolved Oxygen Sensor	Factory installed dissolved oxygen sensor on Cloacina slide rail	1
Chemical Pump	General chemical pump for alkalinity or anti-foam	1

5.5 MEMBRANE PROCESS

The MEMPAC-X membrane process includes a dedicated chamber for each supplied cassette. The standard supply is a simplex membrane cassette with dedicated equipment, the base unit includes a duplex membrane chamber for installation of an optional duplex membrane cassette.

5.5.1 MEMBRANE CHAMBER EQUIPMENT

Factory installed standard equipment provided with the MEMPAC-X Base Unit:

Equipment	Description	Quantity
Membrane Feed Pump	Stainless steel self-supporting submersible pump sized for necessary return activated sludge rate	1
Membrane Chamber	Dedicated chamber for membrane cassette	1
Membrane Cassette	Simplex hollow fiber cassette sized for Peak Day Flow	1
Permeate Pump	Positive Displacement Rotary Lobe Pump	1
Permeate Flowmeter	Electromagnetic flowmeter	1
Permeate Pressure Sensor	Pressure sensor	1
Air Scour Blower	Regenerative blower	1
Blower Pressure Sensor	Pressure sensor	2

5.5.2 CLEAN IN PLACE (CIP) EQUIPMENT

The MEMPAC-X base unit includes factory installed equipment necessary to perform automated membrane flush and clean in place.

Equipment	Description	Quantity
Clear Well Tank	Factory installed plastic tank with lid to store sufficient volume of effluent to perform routine cleaning	1
Level Transmitter	Hydrostatic sensor	1
Chemical Pump	Peristaltic Metering Pump	2

5.6 WASTE SLUDGE PROCESS

The MEMPAC-X waste sludge process includes an aerated sludge storage chamber that provides a small volume of integrated sludge storage. The sludge storage chamber is supplied with a flanged fitting for the field connection of an external tank that will rise and fall with the chamber to increase storage capacity.

5.6.1 SLUDGE STORAGE CHAMBER EQUIPMENT

Factory installed standard equipment provided with the MEMPAC-X Base Unit:

Equipment	Description	Quantity
Sludge Storage Chamber	Integrated chamber with 1,907-gallon capacity	1
Wasting Pump	Factory installed progressive cavity pump	1
Aeration Diffusers	12” fine bubble disc diffusers	2
Level Transmitter	Hydrostatic sensor will control pump and monitor level of chamber and exterior tank if applicable	1

5.7 ELECTRICAL AND CONTROL EQUIPMENT

Factory installed standard equipment provided with the MEMPAC-X Base Unit:

Equipment	Description	Quantity
Electrical Panel	U.L. Listed, NEMA 4X, panel sized for all base, external and optional supplied equipment	1
HMI	Touch screen interface	1
Control Transmitter	Endress+Hauser Liquiline, digital transmitter	1
Licensing and Support	Rockwell Automation	1

6. PROJECT SUPPORT

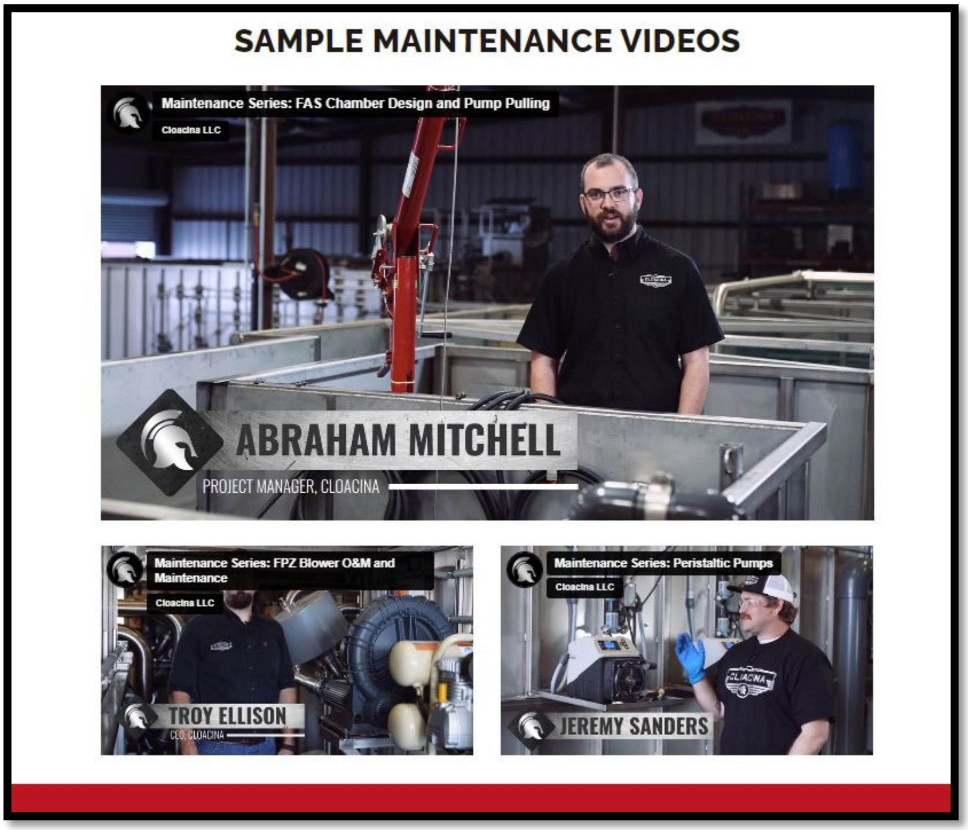
The following will be included in the cost of the MEMPAC-X unit.

6.1 DOCUMENTS

Document	Description	Quantity
Electrical Control Panel	Equipment drawings	1
Project Submittals	Detailed information for all supplied equipment	1
Factory Acceptance Testing	Detail of all equipment tests prior to shipping	1
Equipment Manual	Detailed Operations and Maintenance Manual	1

6.2 LABOR

Scope	Description	Hrs
On-site Startup	On-site startup and commissioning	20
Operator Training	On-site Operator training	16
Remote Support	Phone and web support after completion of startup	20



7. OPTIONAL EQUIPMENT

The package outlined above can be supplied with the following optional equipment.

7.1 PACKAGE LIFT STATION

Cloacina will provide a packaged lift pump station. The fiberglass pump station will be supplied complete with pumps, slide rails, attached valve vault and controls.

Cloacina can provide the following as part of the package lift station:

EQUIPMENT	DESCRIPTION	Quantity
Fiberglass Vessel	48” Diameter X 120” Deep pump well	1
Valve Vault	48” X 48” attached valve vault	1
Attached Pipe and Valves	3” PVC piping, check valves and isolation valves	2
Hardware	316 SS studs, hardware, rails and brackets	2
Connection	3” inlet hub (link seal)	1
Non-Traffic Rate Lid(s)	Attached aluminum lid with access hatches	2
Lift Pump	Non-clog pump rated at 60 gpm @ 45’ TDH	2
Pump Base	Attached pump base	2
Controls	Level Floats	4
Panel	NEMA 3R Panel with Remote Monitoring	1

Note: Assumes lift station will be installed within 200ft of screen inlet.

Note: Lift Station estimate is not project specific and needs to be further evaluated per site requirements.

7.2 DUPLEX MEMBRANE

Cloacina can provide the above unit with completely redundant membrane equipment. This option is recommended for permanent residence and/or the flow cannot be shut off in an emergency situation.

The following will be supplied with the duplex membrane:

Equipment	Description	Quantity
Membrane Feed Pump	Stainless steel self-supporting submersible pump sized for necessary return activated sludge rate	1
Membrane Chamber	Dedicated chamber for membrane cassette	1
Membrane Cassette	Simplex hollow fiber cassette sized for Peak Day Flow	1
Permeate Pump	Positive Displacement Rotary Lobe Pump	1
Permeate Flowmeter	Electromagnetic flowmeter	1
Permeate Pressure Sensor	Pressure sensor	1
Air Scour Blower	Regenerative blower	1
Blower Pressure Sensor	Pressure sensor	2

7.3 UV DISINFECTION SYSTEM:

As an addition to this proposal, Cloacina can provide a validated, in-pipe UV unit.

Design Parameters for Each Reactor:

CONSTITUENT	CONCENTRATION LIMIT	UNIT
PEAK Daily Flow Rate	.04	MGD
%UVT	65	
Dose	>80	mj/cm2
Lamp	380	W

Equipment:

EQUIPMENT	DESCRIPTION	Quantity
UV Reactor	In-pipe UV reactor	1
UVT Analyzer	Turbidity Probe, UVT analyzer, analyzer pump and cleaning system	1 (lot)
Cooling Loop	Recirculation Pump and necessary plumbing	1 (lot)
Turbidity	Effluent Turbidity monitoring	1

7.4 MEMPAC-X EXTERNAL TANKS

The MEMPAC-X base unit is designed to easily expand using external tanks. The below equipment can be supplied by Cloacina to connect to a *client supplied* tank. Upon further request, Cloacina can consider a stainless-steel tank option.

7.4.1 EXTERNAL TRANSFER TANK EQUIPMENT

The transfer chamber is supplied with a flanged fitting for the field connection of an external tank that will rise and fall with the chamber to increase equalization capacity. If it is necessary to increase the capacity of stored screened influent, Cloacina can provide the following equipment for integration with a client supplied external tank. The external tank volume will be the required project equalization storage time, determined by the client.

The external transfer storage tank will have a maximum operating depth of 8.5'.

Equipment	Description	Quantity
External Tank*	10' Tall tank with minimum working water surface elevation 8.5' **(*Provided by client)***	1
Aeration Blower	A dedicated blower will be supplied, factory installed on the MEMPAC-X Base Unit sized for 1.25 cfm per 1,000 gallons of storage	1
Aeration Diffusers	12" fine bubble disc diffusers with stainless steel weighted bases	1 (lot)
WAS Pump	An integrated WAS pump to pump to a client supplied tank	1
Connection Fittings	Necessary hydraulic and aeration connections for field installation by Contractor.	1 (lot)

*Tank can be above or below ground. If above, tank should be at same grade as MEMPAC-X. If below, extra pumping will be required to lift flow back into MEMPAC-X base unit.

7.4.2 EXTERNAL ANOXIC TANK EQUIPMENT

If it is necessary to increase the capacity of the anoxic process (per Section 2.3 above) to ensure hydraulic residence time, it will be accomplished by the field integration of an exterior tank. Cloacina can provide the below equipment to field integrate into *a client supplied* anoxic tank.

Equipment	Description	Quantity
External Tank*	10’ Tall tank with working water surface elevation 8.5’	1
Tank Mixing	The external tank will be mixed by a centrifugal pump factory installed on the MEMPAC-X Base unit.	1
Tank Mixing	Header with necessary static eductors for field installation into client supplied tank	1
Connection Fittings	Necessary hydraulic connections for field installation by Contractor.	1 (lot)

*Anoxic tank required to be placed at the same grade as the MEMPAC-X base unit.

7.4.3 EXTERNAL AERATION TANK EQUIPMENT

If it is necessary to increase the capacity of the aeration process (per Section 2.3 above) to increase organic loading capacity, it will be accomplished by the field integration of an exterior tank. Cloacina can provide the below equipment to field integrate into a *client supplied* aeration tank. The client provided aeration process tank will have a maximum operating depth of 8.0’.

Equipment	Description	Quantity
External Tank*	10’ Tall tank with working water surface elevation 8.5’	1
Aeration Blower	A dedicated blower will be supplied, factory installed on the MEMPAC-X Base Unit sized for process volume at maximum daily flow	1
Aeration Diffusers	12” fine bubble disc diffusers with stainless steel weighted bases	1 (lot)
Connection Fittings	Necessary hydraulic and aeration connections for field installation by Contractor	1 (lot)

*Aeration tank required to be placed at the same grade as the MEMPAC-X base unit.

7.4.4 EXTERNAL SLUDGE STORAGE TANK EQUIPMENT

If it is necessary to increase the capacity of sludge storage, Cloacina can provide the following equipment for integration with a client supplied external tank. The external tank volume will be the desired sludge storage volume, determined by the client. **The sludge tank can be any capacity/dimension, and the volume of the tank will determine sludge hauling frequency.**

Equipment	Description	Quantity
External Tank*	10’ Tall tank with operating depth of 8.5’ ***(Provided by client)***	
Aeration Blower	A dedicated blower will be supplied, factory installed on the MEMPAC-X Base Unit sized for 4.0 cfm per 1,000 gallons of storage	1
Aeration Diffusers	12” fine bubble disc diffusers with stainless steel weighted bases	TBD
Connection Fittings	Necessary hydraulic and aeration connections for field installation by contractor.	1 (lot)

*Client must supply and control a sludge transfer pump if sludge tank is placed above grade level of Base

7.5 ADVANCED NUTRIENT TREATMENT

Cloacina can provide the following process flow (Bardenpho) and chemical addition should advance nutrient treatment be required for the project. The Bardenpho process consists of the following equipment:

7.5.1 INTERNAL RECYCLE PUMP

a. (1) Additional recirculation pump (matching FAS pumps for spare purposes) placed at the end of the aerobic process.
    i. Capable of returning up to 4Q, either manually or automatically adjusted (hooked to influent flowmeter).
    ii. Slide rail system and T-slot base elbow tank connections, same as FAS Chamber arrangement.

b. Post Anoxic chamber
    i. Installation of a baffle with a flow through weir in the Aeration chamber upstream of the membranes. This will compartmentalize tankage into aeration and anoxic.
    ii. Installation of Anoxic Mixer and SS slide rail system.

c. Panel upgrades to include spare/equipment for the above.

d. Programming modifications for the above.

7.5.2 CHEMICAL FEED PUMP

Cloacina can provide an integrated chemical feed pump to dose the required concentration of carbon or alkalinity if required for the project.

7.6 OFF-SPEC EFFLUENT DIVERSION

Cloacina can provide the following scope to address Off-spec effluent diversion:

Scope	Description	Hrs
Auto-Valve	Auto-valve on the effluent line downstream of UV Disinfection and cooling loop from the clearwell	1
Controls	Programming to close the auto-valve when turbidity is out of range	1
Return Line	There will be a gravity return line that overflows from the clearwell back to the transfer chamber.	20

NOTE: *The UV Disinfection and Expanded Controls Package options are required for this option.*

7.7 EFFLUENT TRANSFER PUMP SKID

In addition to the treatment package outlined in this estimate, Cloacina can provide integrated equipment necessary to pump treated effluent to irrigation storage tank.

Effluent Pump Design

Equipment	Description	Quantity
Effluent Pumps	Multi-Stage Centrifugal Vertical Pumps capable of 110gpm at 45' TDH	2
Instrumentation	Effluent Flow Meter	1
Instrumentation	Level Transducer	1
Effluent Pressure Sensor	Endress+Hauser Cerabar, pressure sensor	1
Associated Valves	Isolation Valves, Check Valves, and piping	1
Control Panel	U.L Listed 508A NEMA4X Stainless Steel Control Panel	1

7.8 REDUNDANT EQUIPMENT

Cloacina can provide the following redundancy options:

7.8.1 SHELF SPARES

The following items can be installed as online redundant equipment.

Equipment	DESCRIPTION	Quantity
Flow Meters	Influent and Effluent Flow Meter	2
Transfer/Sludge Blower	Submersible Pump	1
Anoxic Mixer	Tank-mounted Mixer	1
Level Transducers	Leve Transducer (Aeration Chamber and Clearwell)	2
Aeration DO	Dissolved Oxygen Probe	1
Aeration Blower	Regen blower matching installed units	1
Panel Parts	Universal Power Supply, HMI, and Relays	1
Probe Wash Compressor	Air compressor for probe wash	1

7.8.2 ONLINE EQUIPMENT REDUNDANCY

The following items can be installed as online redundant equipment.

Equipment	DESCRIPTION	Quantity
Catwalk	Secondary catwalk for access to redundant equipment	1 (lot)
Transfer Pumps	Submersible Pump	1
WAS Pumps	Progressive cavity pump	1
Aeration Blower	Regen blower matching installed units	1
FAS Pump	Submersible FAS pump for installation on supplied slide rails	1
Panel Upgrade	Additional electrical components for redundant equipment	1 (lot)

8. PRICING SUMMARY

Section	Equipment/Service	Required	Price
1-6	Base MEMPAC-X	Yes	**$809,460.26**
7.1	Package Lift Station	Optional	**$55,720.60**
7.2	Duplex Membrane	Optional	**$114,211.60**
7.3	UV Disinfection	YES	**$103,576.20**
7.4.1	External Transfer Equipment	Optional	**$20,595.20**
7.4.2	External Anoxic Equipment	Yes	**$16,270.82**
7.4.3	External Aeration Equipment	Yes	**$23,103.71**
7.4.4	External Sludge Storage Equipment	Optional	**$16,520.50**
7.5	Advanced Nutrient Treatment (Bardenpho)	Yes	**$109,935.60**
7.6	Off-Spec Effluent Diversion	Optional	**$8,135.00**
7.7	Effluent Pump Skid	Optional	**$54,228.20**
7.8.1	Shelf Spares	Optional	**$21,238.00**
7.8.2	Online Equipment Redundancy	Optional	**$79,823.60**

NOTE: Pricing is subject to Cloacina Terms and Conditions.

9. STANDARD ASSUMPTIONS

9.1 DOMESTIC FACILITY

The system will be designed to receive only domestic wastewater, as outlined in Section 2, above.

9.2 UNNECESSARY WASTE

All unnecessary process waste will be diverted from entering the treatment system. Examples of unnecessary process waste are:

- Rainwater, excess flow during rain events should be prevented by identifying areas with potential for Infiltration and Intrusion (I & I).
- Industrial Dischargers, high strength dischargers should be identified, and associated waste streams should be evaluated for impact on the treatment facility. Industrial waste can increase the loading on the treatment facility and result in poor performance or reduction in hydraulic capacity.
- Inorganic Solids, efforts should be made to keep excess dirt and grit from entering the treatment facility.
- Fats, Oils and Greases (FOG) should be prevented from entering the facility by ensuring all restaurants have properly installed and maintained grease traps.

9.3 EFFLUENT DISPOSAL

Effluent will flow by gravity from Clear Well, the final disposal location is to be determined. Effluent pumps can be provided in addition to this package.

9.4 INSTALLATION LOCATION

The package will be installed outdoors on an engineered concrete slab. The site will have enough access to allow the delivery of the individual treatment tanks fully assembled.

10.EXCLUSIONS

10.1 TAXES ARE NOT INCLUDED

10.2 EQUALIZATION

Any diurnal flows needing to be attenuated are by others.

10.3 INSTALLATION

Treatment package quoted does not include installation costs.

10.4 CIVIL ENGINEERING

Site civil engineering is not provided as part of this budgetary estimate.

10.5 SLAB

Equipment slab design and construction is not included as part of this budgetary estimate.

10.6 PERMITTING

Permit costs of any kind are not included as part of this budgetary estimate

10.7 SECONDARY CONTAINMENT

Secondary containment is not included in this budgetary estimate.

10.8 THERMAL PROTECTION

Thermal protection of hydraulic piping is not included in this budgetary estimate.

10.9 PAINTING

No surface preparation and/or painting of any surfaces is included in above pricing unless specifically mentioned.

10.10 SECURITY

Safety and security items such as fencing, locking ladders, lighting etc. are not included in this budgetary estimate.

10.11 SHIPPING

Shipping and crane costs are not included in this budgetary estimate unless otherwise stated.

10.12 DISSOLVED SOLIDS (TDS)

The unit will not address dissolved solids through biological treatment. Dissolved Solids should be managed through source control.

10.13 INITIAL SEED SLUDGE

Adequate and acceptable seed sludge is the responsibility of the Client.

10.14 BONDING

No bonding is included in the estimate.

10.15 DISINFECTION

Disinfection is not included in the base pricing unless specifically stated or offered as an option.

11. ATTACHMENTS

11.1 MEMPAC-X GENERAL ARRANGEMENT DRAWING

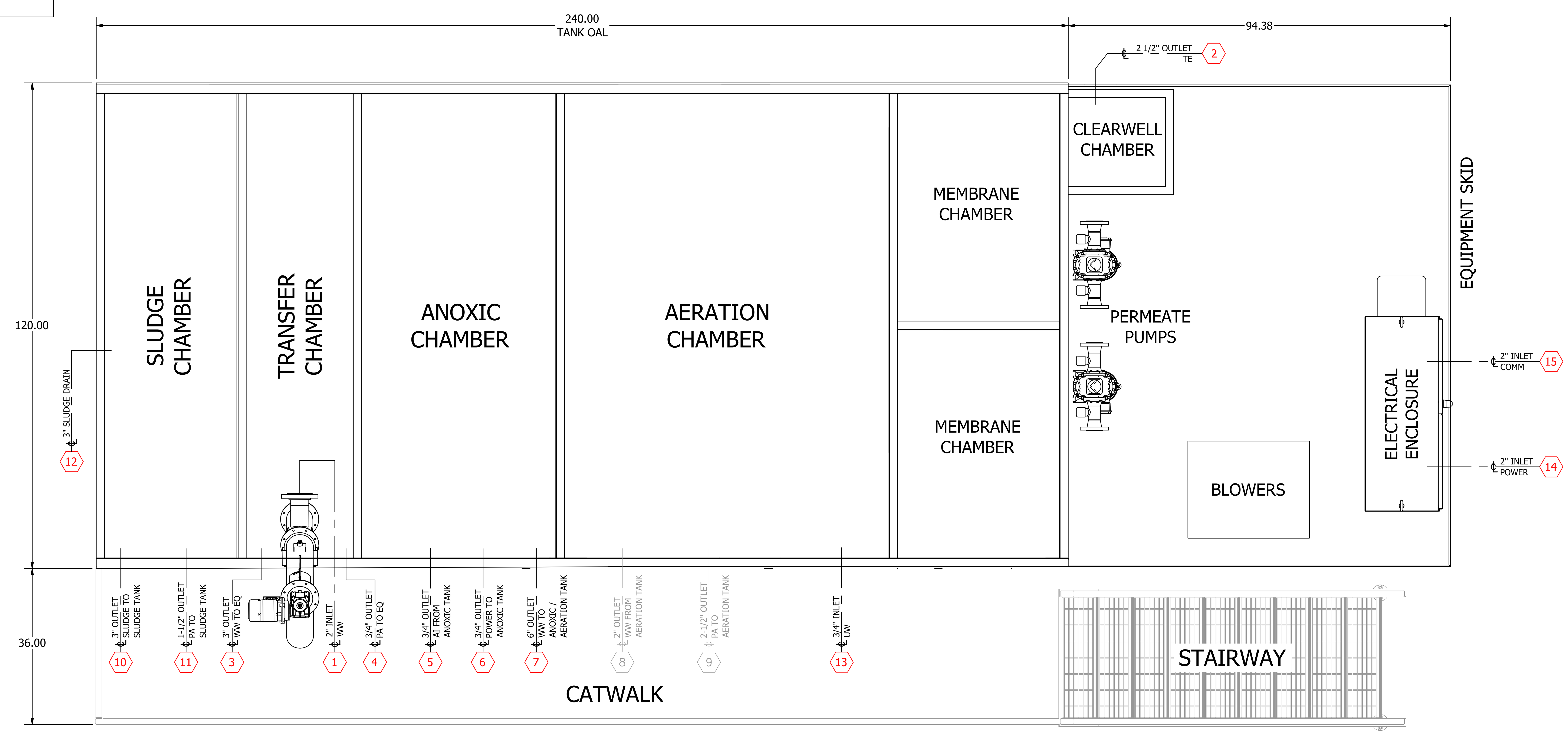
11.2 MEMPAC-X PROCESS FLOW DIAGRAM

11.3 DESIGNED BY OPERATORS FOR OPERATORS

11.4 MEMPAC-X PRODUCT PAGE

TIE IN LIST

TIE PT.	LINE IDENTIFICATION	FUNCTION
1	2"	INLET - WW
2	2 1/2"	OUTLET - TE
3	3"	OUTLET - WW TO EQ
4	3/4"	OUTLET - PA TO EQ TANK
5	3/4"	OUTLET - AI FROM ANOXIC TANK
6	3/4"	OUTLET - POWER TO ANOXIC TANK
7	6"	OUTLET - WW TO ANOXIC/AERATION TANK
8	6"	INLET - WW FROM AERATION TANK
9	2-1/2"	OUTLET - PA TO AERATION TANK
10	3"	OUTLET - SLUDGE TO SLUDGE TANK
11	1-1/2"	OUTLET - PA TO SLUDGE TANK
12	3"	OUTLET - SLUDGE TO DR
13	3/4"	INLET - UW
14	2"	INLET - POWER
15	2"	INLET - COMM



PLAN VIEW
MEMPAC-E14
3/4"=1'-0"

NOTES:

1. TIE-IN LOCATIONS AND EQUIPMENT LOCATIONS REPRESENTED IN THIS DRAWING ARE APPROXIMATE AND ARE SUBJECT TO CHANGE.

REFERENCE DRAWINGS	
COVER SHEET - DRAWING INDEX	SHT. - G-001

REVISIONS				
A	ISSUED FOR 70% COMPLETE	SEA	GJG	BDS
	2022-03-08			

SCALE: AS NOTED
DATE: 2022-03-08
DRAWN BY: OG
JOB #: CL21-017

P.O. BOX 1647
ARROYO GRANDE, CA
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FAX: 888.483.6134
info@cloacina.com

CLOACINA
FLUID RESOURCE MANAGEMENT

MEMPAC-X
WASTEWATER TREATMENT PLANT

GENERAL ARRANGEMENT

REV NO. A
SHEET: G-005
01 OF 01 SHEETS

LEGEND

PRESENT

FUTURE

NOTES:

1. THIS DRAWING IS A SCHEMATIC DIAGRAM. IT MAY NOT REFLECT TRUE ORIENTATION OR LAYOUT.
2. BY OTHERS.
3. TANK BY OTHERS.

REFERENCE DRAWINGS	
COVER SHEET - DRAWING INDEX	SHT. - G-001

REVISIONS					
A	ISSUED FOR 70% COMPLETE	IDV	AR	GJG	2023-04-25
B	ISSUED FOR 90% COMPLETE	JS	AR	GJG	2023-06-20
C	RE-ISSUED FOR 90% COMPLETE	IDV	AR	GJG	2023-09-30

SCALE: NOT TO SCALE
DATE: 2023-04-24
DRAWN BY: JS
JOB #: WTM1951

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MASTER SET
MEMPAC-X
WASTEWATER TREATMENT PLANT

PROCESS FLOW DIAGRAM

REV NO. C

SHEET: P-001

01 OF 01 SHEETS

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