Union Sanitary District's

Enhanced Treatment and Site Upgrade Program

woodardcurran.com

August 2019

ENHANCED TREATMENT & SITE UPGRADE PROGRAM

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COMMITMENT & INTEGRITY DRIVE RESULTS

Union Sanitary District
August 2019

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Union Sanitary District's

Executive Summary

Union Sanitar y District's
Enhanced Treatment and
Site Upgrade Program

EXECUTIVE SUMMARY

The goal of this Enhanced Treatment & Site Upgrade (ETSU) Program is to provide Union Sanitary District (USD) with a technically and fiscally sound, practical plan for the District's Wastewater Treatment Plant (WWTP) located in Union City, CA for the next 20 to 40 years. The ETSU Program is intended to be a roadmap, outlining key decisions to be considered in the future. The roadmap will allow USD to implement critical near-term projects over the next 5 to 10 years while maintaining compatibility and flexibility with the long-term vision for the WWTP, thereby avoiding stranded assets and undesirable space planning ramifications. This ETSU Program is not intended to approve any individual phase or project, but to identify the proposed plan and projects USD intends to pursue, subject to further review during a formal decision-making process.

Enhanced Treatment & Site Upgrades Program Drivers

The key drivers of the ETSU Program for the WWTP are:

1. Secondary treatment process performance requiring immediate upgrades and a plan for increasing solids treatment capacity and meeting anticipated nutrient regulations;
2. The need for new effluent management options with the anticipated shutdown of the Hayward Marsh;
3. Buildings/facilities in need of seismic upgrade and repair; and
4. Limited land available onsite for addressing these priorities.

The ETSU Program is designed to incorporate near-term capital improvements projects (CIP) with the secondary process upgrades as the WWTP transitions to a new era of managing nutrients, biosolids, effluent/recycled water, all while anticipating sea level rise. Factors that will drive when projects need to occur or need to be accelerated are:

- Nutrients requirements within the Regional Board's evolving Nutrients Watershed Permit
- Senate Bill 1383 organics diversion requirements that will modify current processing and reuse/disposal of organic wastes including biosolids. If implemented at USD's discretion, an onsite organics processing facility may drive the need for additional digestion and solids processing capacity.
- Increasing flows and especially loads associated with growth in the service area and the potential importation of additional organic waste
- Future demand for recycled water from Alameda County Water District (ACWD) and potential regional partners, which might drive siting of advanced water treatment facilities at or near the WWTP

Key Projects

The following key projects will be required to address USD's goals for the WWTP.

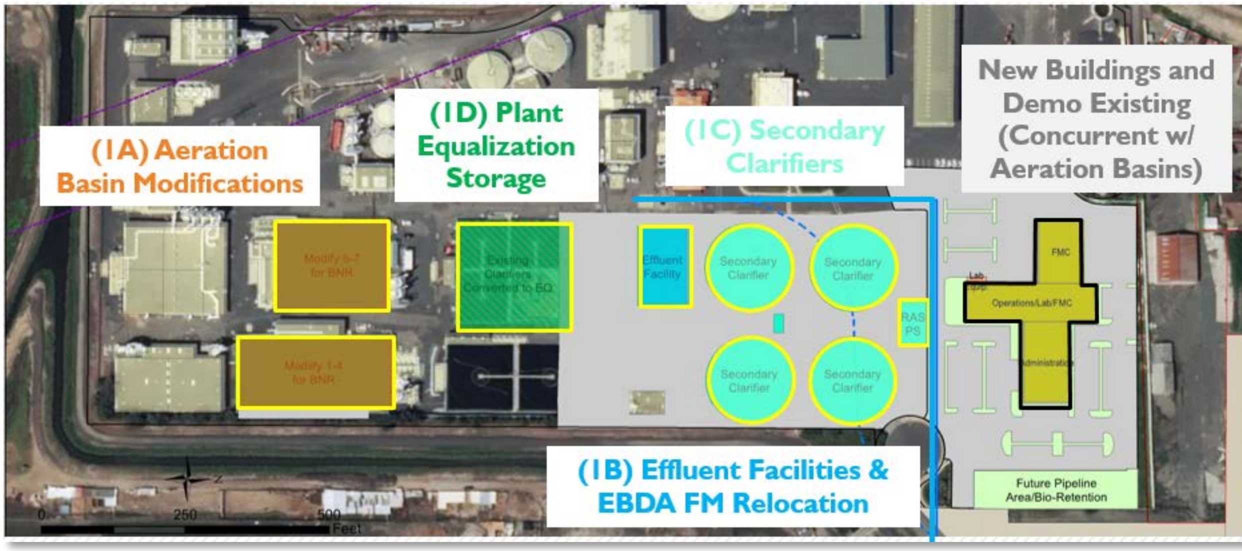
Secondary Treatment Process Improvements (including Early Action Nutrient Removal)

The most immediate priority for the WWTP is to implement the first phase of Secondary Treatment Process Improvements. The recommended project consists of the following:

- Upgrading aeration basins to incorporate:
    - Improved process control/settling
    - Nutrient removal
    - Wet weather step-feed mode
- Replacing existing secondary clarifiers with 4 new circular clarifiers to enable:
    - The secondary process to fully function in year-round ammonia/nutrient removal mode
    - More stable mixed liquor solids concentration to enhance biological treatment and nutrient removal
    - Improved effluent quality through greater total surface area and enhanced return activated sludge (RAS) control

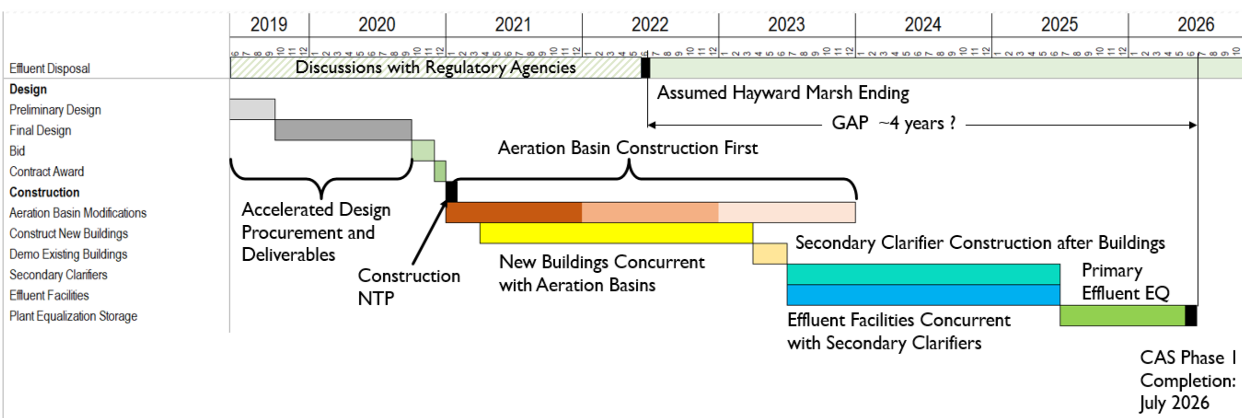
The construction of new secondary clarifiers would necessitate the removal of the existing Administration and Control Buildings (which had been slated for major rehabilitation or replacement and seismic upgrade) and replacement of those buildings in a new campus layout on the USD-owned property to the north of current active plant site (parking). Phase I would also include a new effluent/reclaim pump station (PS), new chlorine contact tank (CCT), new dechlorination facility, and conversion of existing square secondary clarifiers to primary effluent (PE) flow equalization. The proposed layout for Phase I is shown in **Figure ES-1**.

Figure ES-1: Layout of Phase I Facilities and Buildings



The implementation schedule for Phase I is presented in **Figure ES-2**, demonstrating how the improvements would be sequenced to bring the plant processes on line as soon as possible to minimize the time when effluent disposal capacity during wet weather will be limited by the combination of Hayward Marsh and Old Alameda Creek intermittent shallow water discharge. Implementation would consist of environmental review as required by the California Environmental Quality Act ("CEQA") and consideration of individual projects as they proceed to development.

Figure ES-2: Sequence of Phase I Activities



Phase II of the Secondary Treatment Process Improvements at the WWTP is intended to address potential future numerical nutrient limits and provide capacity for projected flows and loadings for 2040. They include maintaining existing permitted aeration basin treatment capacity, a new intermediate PS for primary effluent, new blower building, sidestream treatment, and additional ancillary facilities. These proposed improvements are shown in blue in **Figure ES-3**. Phase III of the Secondary Treatment Process Improvements, if necessary, would provide additional capacity to handle flows and loads beyond 2040 to buildout. It is currently estimated that buildout capacity at the WWTP will not exceed 38 million gallons per day (MGD). Phase III facilities are shown in purple in **Figure ES-3**.

The Secondary Treatment Process Improvements would be programmed in a phased approach in order to meet both near-term needs and future challenges posed by capacity limitations, future nutrient removal, and effluent discharge. The roadmap showing program drivers and triggers for implementation of theses phases is presented in **Figure ES-4**. Implementation would consist of environmental review as required by the California Environmental Quality Act ("CEQA") and consideration of projects during the timelines discussed in this Program.

Nutrient Removal

Through the Secondary Treatment Process Improvements, USD would achieve nutrient removal in phases to match the anticipated regulatory schedule, including "early action" removal of nutrients ahead of that required in the anticipated Nutrients Watershed Permit issued by the Regional Board every 5 years. The second Nutrients Watershed Permit, effective July 1, 2019, identified dry season average targets for nutrient loading established on a baseline loading from 2014, plus a 15% increase to account for growth since then. These targets are presently non-binding but signal potential nutrient loading caps in the next round of permitting in 2024. With the implementation of the Phase I Secondary Treatment Process Improvements, USD would be reducing ammonia and total inorganic nitrogen (TIN) levels. This would allow for increasing shallow water discharges during wet weather to be transitioned proportionately from the Hayward Marsh, where ammonia removal occurs within the Marsh, to Old Alameda Creek where there is no ammonia removal, but some dilution (see Effluent Management below). Phase I improvements would also meet anticipated load caps, potentially coming in 2024, and the "Level 2" nutrient benchmarks developed by the Bay Area Clean Water Agencies (BACWA) for much of the year. The "early action" element of Phase I would be used by USD to provide the basis for a request to the Regional Board for more time to meet future nutrient limits than the agencies within the same sub-embayment who do not implement "early action".

To fully meet concentrations reflective of BACWA Level 2 year-round, and to account for increasing flows and loads, Phase II would need to be implemented sometime between 2026 and 2040 (depending upon the timing of the regulatory trigger) as presented in the timeline on **Figure ES-4**.

The Phase III improvements (shown in purple in **Figure ES-3**) would be triggered if more stringent BACWA "Level 3" nutrient benchmarks are imposed by the Regional Board. As subsequent nutrients watershed permits roll out, USD will continue to update its road map to determine the timing and extent of the improvements to match the needs. If Level 3 benchmarks are never adopted as requirements, elements of Phase III would be implemented at the appropriate time to address the flows and loads experienced beyond 2040.

Effluent Management

USD has effectively used the Hayward Marsh as a wet weather discharge outlet for flows in excess of its capacity to discharge to the East Bay Dischargers Authority (EBDA) conveyance and outfall system. Flows in excess of the combination of EBDA and the Hayward Marsh discharges can be conveyed to the shallow water outfall to Old Alameda Creek adjacent to the WWTP. The capacity of the Hayward Marsh has been affected over the years by siltation and its berms have deteriorated due to wave action and differential settlement. The East Bay Regional Park District (EBRPD), the agency that owns and operates the Hayward Marsh, has indicated that it will not be repairing the Hayward Marsh in its current configuration and will not be accepting USD treated effluent in the near future. The timeframe for this conversion of marsh operations has not been finalized, but USD needs a wet weather effluent discharge alternative to the Hayward Marsh in the next several years.

Within the programming process, numerous alternatives for partial and complete management of wet weather discharges have been evaluated. The recommended alternative includes the increased shallow water discharge to Old Alameda Creek (it is currently permitted for limited frequency wet weather discharges), which will be facilitated by Early Action Nutrient Removal (Phase I of the Secondary Treatment Process Improvements).

The Secondary Treatment Process Improvements affords USD the opportunity to address aging infrastructure (aeration basins and clarifiers) while improving treatment performance and effluent management. By implementing Phase 1 of the Secondary Treatment Process Improvements, the water quality of USD effluent, especially with respect to ammonia concentrations will be improved to the extent that discharges can occur with greater frequency and greater quantities than currently permitted. Permitting is currently being developed for increased discharge to Old Alameda Creek during wet weather periods.

USD also continues to be open to collaborate with ACWD to ensure that secondary effluent may be made available if sufficient demand for recycled water is established. ACWD, in collaboration with SFPUC, is currently evaluating the feasibility and cost of a regional potable reuse project. This study commenced in July 2019; sizing and timing of this facility has yet to be determined.

Figure ES-3: USD Plant Layout at Builout (2058)

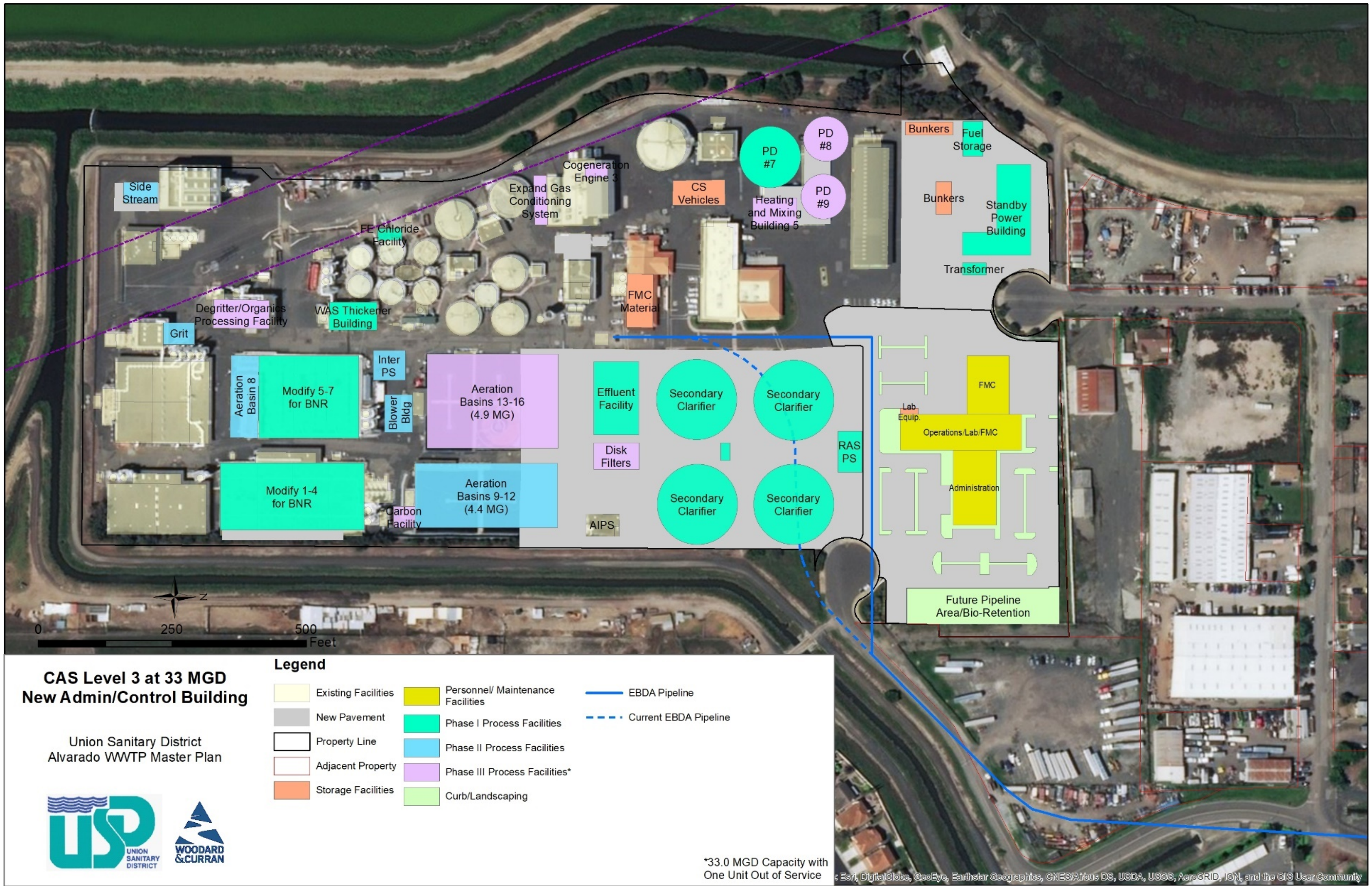
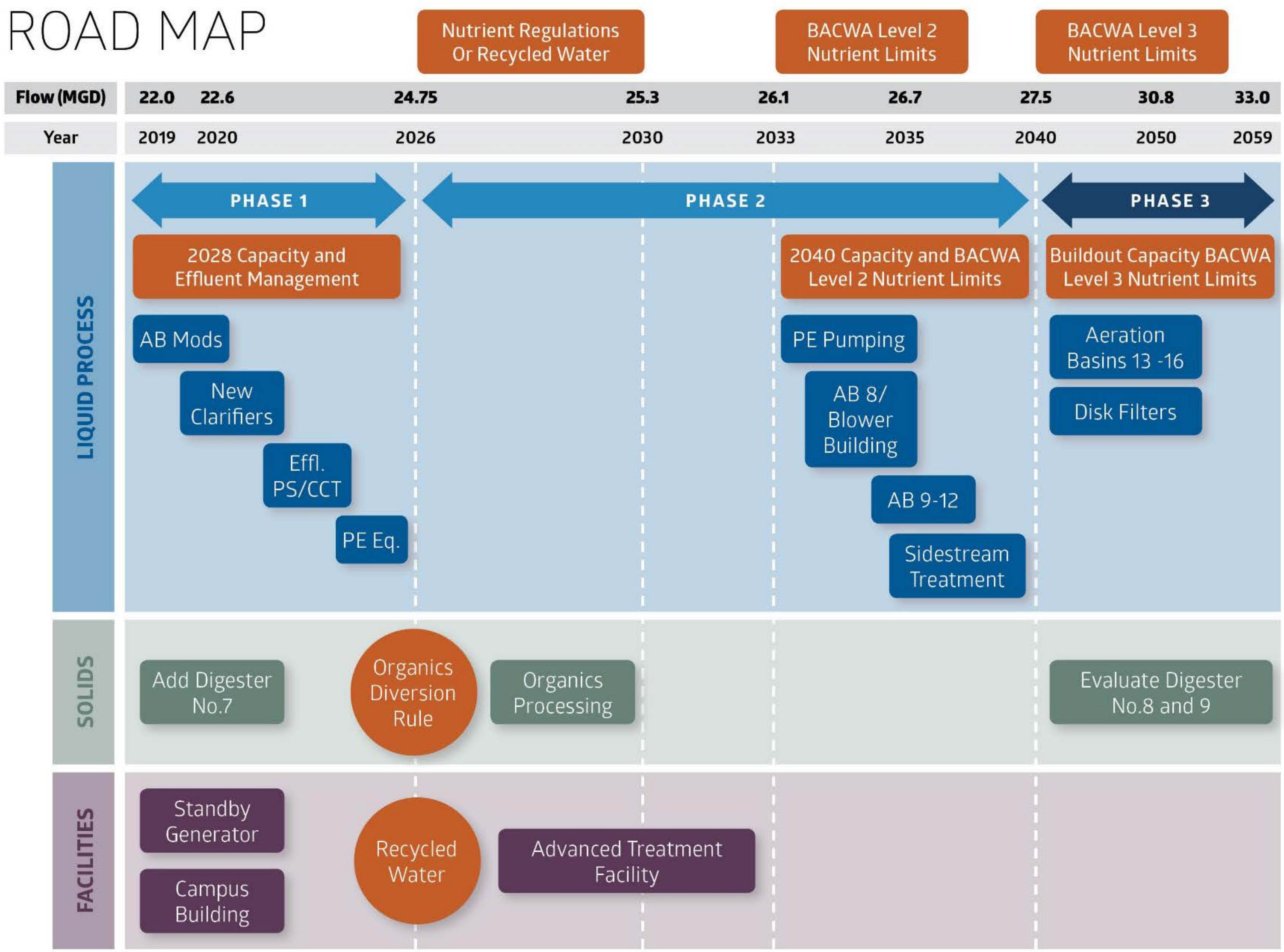


Figure ES-4: Road Map for ETSU Program Implementation



Vulnerable Buildings

Prior to the programming process, USD had identified the need for a new Facilities Maintenance (FMC) Building. More recently, the Administration Building and Control/Lab Building have been slated for repair and rehabilitation projects. The Administration and Control/Lab Buildings are currently located in the area suitable for secondary treatment process expansion. Rehabilitating these existing buildings was determined to entail higher life cycle costs than constructing new facilities, due to extensive renovations required for seismic retrofit, repair to address water intrusion, and the upgrades and expansion to address long-term needs and to meet the required California energy requirements. As part of the ETSU Program, the team of architects, engineers and staff evaluated how to best place future buildings to optimize space for the treatment process, minimize operational costs, and maximize the useful life of USD's buildings. Of the two new building alternatives, the single campus alternative (incorporating Administration, Control/Lab and FMC) provides the ideal building footprint at no additional expense compared to the separate building concept. Therefore, the campus alternative is recommended for implementation. Early implementation of this project in combination with Phase I of the Secondary Treatment Process Improvements would be necessary to accommodate the required WWTP improvements, eliminate the need for moving staff to temporary facilities while facilities are retrofitted, or new ones are built, and minimize impacts to USD's customers.

Organics Processing

SB-1383 establishes targets for reducing landfill disposal of organic materials, including biosolids, based on the 2014 levels of organic waste disposal in California, achieving 50% reduction by 2020[1] and 75% reduction by 2025. Driven by community needs to reduce diversion of organics to landfills, USD may consider an organics processing facility as a result of the organics diversion requirements. This project could have impacts on solids processing, gas conditioning, energy generation, tipping fees, and nutrient loadings if implemented.

Addressing Sea Level Rise and Future Land Requirements

To protect land, infrastructure, and facilities at the WWTP from erosion, inundation, and flooding in the future, the levees surrounding the plant need to be raised to an elevation of 13.00 ft plus freeboard to withstand a 100-year storm by year 2050. The western levee will need to be raised 1 ft and the southern and eastern levees will need to be raised 5 ft. As part of this ETSU Program, a capital plan has not yet been developed to address the levee issues. This program endeavored to ensure that real estate is set aside for proposed future projects without constraining a future levee footprint.

[1] SB 1383 states January 1, 2020 is the target date for a 50% reduction in organic waste disposal. Enforcement and penalties with the regard to this reduction are scheduled to begin on January 1, 2022.

Further, to ensure that USD has sufficient land in which to accommodate additional needs not yet identified, the programming team investigated real estate purchase options offsite and adjacent to the WWTP. Other than land to the east that was considered for possible effluent equalization, the only land suitable for plant footprint expansion was determined to be to the north and northeast. The price of land, based upon comparable prices for similar land in the area, was not determined to be an unreasonable constraint, but the landowner's lack of interest in selling the larger parcels of property compelled the team to propose all planned facilities within the current USD footprint.

Resources Needed

The costs of the key projects recommended in this ETSU Program are summarized in **Table ES-1**, including the Secondary Treatment Process Improvements.

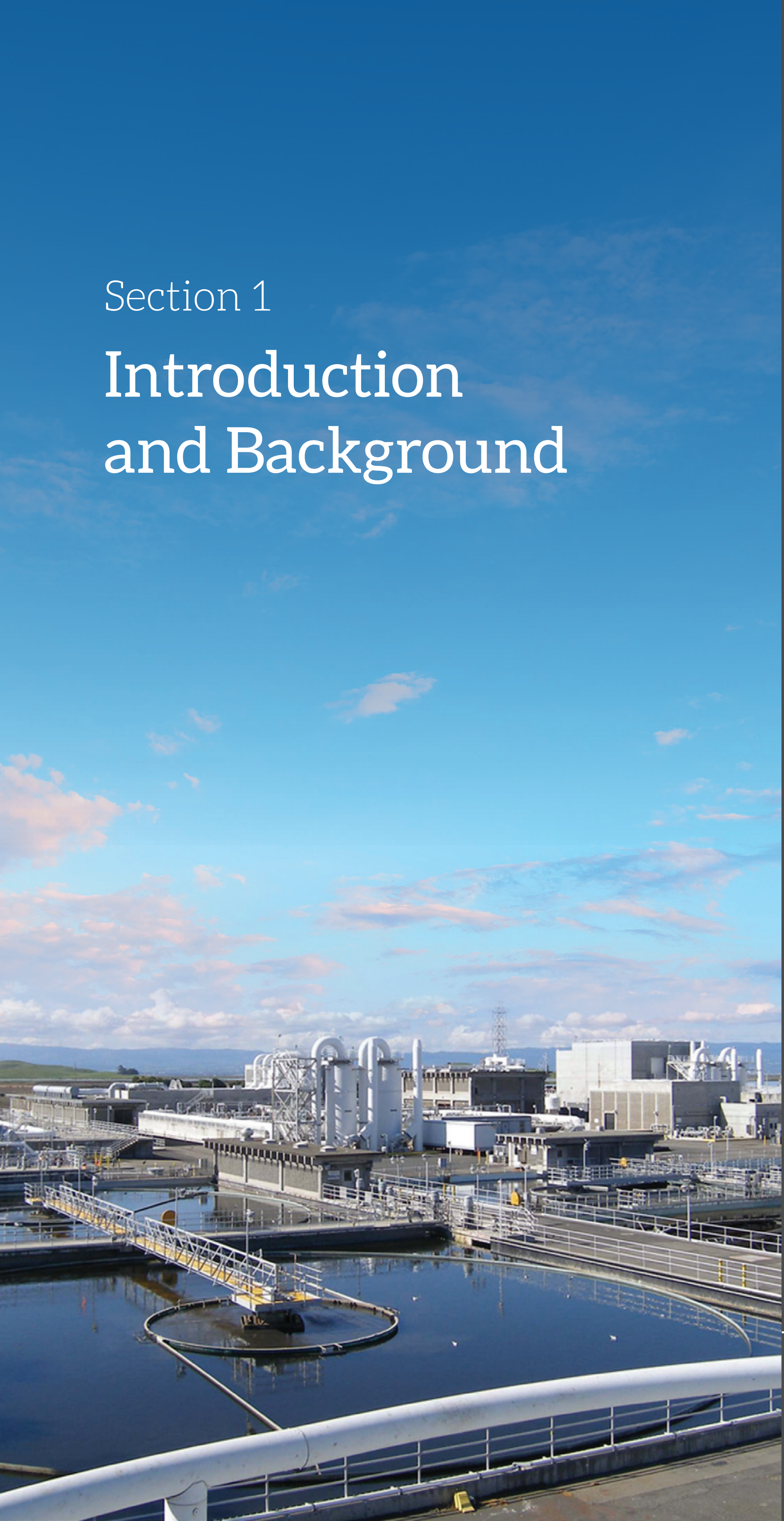
Table ES-1: Estimated Costs for Secondary Treatment Process Improvements (Phase I and Phase II) and Campus Building

Project	Cost (1)
Campus Building	$ 72.4 M
Secondary Treatment Process Improvements Phase I	$ 231.8 M
Secondary Treatment Process Improvements Phase II (2)	$ 253.5 M
TOTAL PROJECT COST	**$ 557.7 M**

Notes:

1. Costs include inflation to midpoint of anticipated construction.
2. Assumes preliminary design for Phase II improvements to begin in July 2035.

The proposed Campus Building combines a new Administration Building, new Control/Lab Building, and a new Facilities Maintenance (FMC) building, with shared parking, elevators, lockers, common space, etc. to maximize efficiency and collaboration of staff. The Secondary Treatment Process Improvements, Phase I, include the upgrades to improve plant process performance immediately, improve effluent quality for increased shallow water discharge to Old Alameda Creek, and early action nutrient removal. Phase II includes improvements to meet nutrient requirements equivalent to BACWA Level 2 benchmarks and project flows and loads through 2040.



Section 1

Introduction and Background

1

Union Sanitary District's
Enhanced Treatment and Site Upgrade Program

1. INTRODUCTION AND BACKGROUND

1.1 Introduction

The goal of this Enhanced Treatment & Site Upgrade (ETSU) Program is to provide Union Sanitary District (USD) with a technically and fiscally sound practical plan for the District's Wastewater Treatment Plant (WWTP) located in Union City, CA for the next 20 to 40 years. The ETSU Program is intended to be a roadmap, outlining key decisions to be considered in the future. The roadmap will allow USD to implement critical near-term projects over the next 5 to 10 years while maintaining compatibility with the long-term vision for the WWTP, thereby avoiding stranded assets and undesirable space planning ramifications.

1.2 Goals and Approach

The following key tenets were considered as part of the ETSU Program:

1) The program must provide cost effective solutions
2) Impacts to ratepayers will reflect the values of the community and be fair and reasonable
3) USD will continue to be a good neighbor
    a) Odor control is critical
    b) Visual appearance to surrounding neighbors is considered

1.3 Challenges and Drivers

Over the planning period, USD is faced with a growing service area population, changing influent characteristics, increasingly stringent regulations, an unpredictable biosolids management environment, sea level rise, and aging infrastructure.

1.3.1 Secondary Treatment Process Capacity

The Solids System Capacity Assessment Report (*Carollo Engineers, August 2018*) documented that influent biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations have been increasing at the WWTP. In addition, population growth in the service area is projected to increase 1 percent per year during the planning period, with corresponding increases in flows and loads treated at the plant.

The WWTP average dry weather treatment capacity is limited due to poor settling of mixed liquor suspended solids, possibly resulting from the configuration of the existing aeration basin s and increased influent organic acid concentrations. This capacity limitation was corroborated in the Secondary Treatment Process Improvements Final Report (*Hazen and Sawyer, August 2019*). This report (included as **Appendix B**) evaluated a number of secondary improvements and recommendations have been incorporated into this ETSU Program. These improvements to the secondary system are required to more effectively treat the increased loading during both average and wet weather conditions as well as handling future service area population growth.

A major focus within the ETSU Program is to immediately upgrade the aeration basins and add new secondary clarification capacity.

1.3.2 Regulatory

Changes to the regulations governing both liquid and solids streams at the WWTP are expected. These include both nutrient removal requirements for treated effluent, and a shift towards beneficial reuse with regard to biosolids management.

1.3.2.1 Nutrients

Nutrients in the San Francisco Bay are becoming a major area of concern for the San Francisco Bay Area water quality community. A regional permit, *Waste Discharge Requirements for Nutrients from Municipal Wastewater Dischargers to San Francisco Bay*, was issued on April 9, 2014 by the San Francisco Regional Water Quality Control Board (RWQCB). This permit sets forth a regional framework to facilitate collaboration on studies that will inform future management decisions and regulatory strategies. The permit does not explicitly state nutrient removal goals, but future regulations will likely be more stringent than existing regulations. The second Watershed Permit became effective on July 1, 2019 and expires June 30, 2024. It has focused on an expanded science program, and the establishment of load targets which are set at 15% above 2014 base loads. It has also shifted focus from effluent Total Nitrogen (TN) to effluent Total Inorganic Nitrogen (TIN), which is defined as the sum of Total Ammonia (NH_3), Nitrate, and Nitrite as nitrogen. Timing of the RWQCB implementing specific nutrient limits is still unknown, although the next permit will likely include a dry season load cap.

As part of an ongoing nutrient management evaluation, the Bay Area Clean Water Agencies (BACWA) developed a work plan, including potential nutrient removal levels for treatment plants discharging to San Francisco Bay. The nutrient removal levels were established as reference points to develop treatment strategies and cost estimates and are not to be considered a basis for proposed permit limits. The evaluation plan, which was submitted to the RWQCB in November 2014, includes three potential levels of nutrient removal; one qualitative target based on optimizing nutrient removal and two quantitative total nitrogen and total phosphorus effluent limits. BACWA's reports were written prior to the July 1, 2019 Watershed Permit shifting focus from TN to TIN. Since the organic fraction of nitrogen found in wastewater is small compared to inorganic, these limits are still expected to be reasonable benchmarks for comparative analysis. For clarity, the rest of this document will refer to TN. These potential limits are summarized in **Table 1-1** below.

Table 1-1: Summary of BACWA Study Nutrient Removal Levels

Level	Units	Total Nitrogen (1)	Total Phosphorus
Existing Plant Optimization (2)	mg/L	---	---
Level 2	mg/L	15	1.0
Level 3	mg/L	6	0.3

Notes:
(1) Total nitrogen includes ammonia, nitrite, nitrate, particulate organic nitrogen, and soluble organic nitrogen.
(2) No specific discharge limits have been set for this phase. The focus here is to maximize existing treatment infrastructure to reduce nutrient loading in plant effluent.

The 15 mg-N/L limit is noted in the BACWA work plan as being achievable with conventional nutrient removal processes without adding an external carbon source or effluent filtration. The more stringent 6 mg-N/L limit would likely require an external carbon source for nitrogen removal and metal salt addition with filtration for most plant configurations[1]. The focus of this first phase on nutrient limits is nitrogen; regional permitting of phosphorus is possible in the future but does not appear likely at this time.

The average total nitrogen in USD's WWTP effluent from January 2016 to May 2019 was approximately 45.1 mg/L. To prepare for future nutrient removal requirements, USD is examining potential site impacts resulting from lower nutrient limits.

1.3.2.2 Restrictions on Biosolids Disposal

Senate Bill (SB) 1383 was passed in September 2016. It established methane emissions reduction targets aimed at reducing short-lived climate pollutants including methane. SB 1383 establishes a target of a 50% reduction in the statewide landfill disposal of organic waste by 2020[2] and a 75% reduction by 2025. These reduction percentages are based on the 2014 levels of organic waste disposal in California.

Decomposition of organic matter in landfills, including biosolids, is a significant source of methane emissions in the state. Therefore, landfill disposal of biosolids, including use as alternative daily cover, is a primary target of this bill. While this bill does not explicitly ban landfilling biosolids, it does heavily incentivize beneficial reuse as an alternate means of disposal, so it effectively serves as a landfill ban.

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[1] HDR, Brown and Caldwell. Potential Nutrient Reduction by Treatment Optimization and Treatment Upgrades, November 2014

[2] SB 1383 states January 1, 2020 is the target date for a 50% reduction in organic waste disposal. Enforcement and penalties with the regard to this reduction are scheduled to begin on January 1, 2022.

1.3.3 Wet Weather Effluent Discharge

The Hayward Marsh, owned and operated by the East Bay Regional Park District (EBRPD), receives and further polishes WWTP treated effluent that is not discharged to the EBDA outfall. Currently, during dry weather, approximately 2.6 MGD of WWTP effluent is pumped to Hayward Marsh as a fresh water source for the Marsh. During wet weather, WWTP effluent flows greater than 42.9 MGD are diverted to the Hayward Marsh. EBRPD has decided to convert the Hayward Marsh to a recreational facility and discontinue all treated effluent flows to the Hayward Marsh. Therefore, USD needs a wet weather effluent discharge alternative to the Hayward Marsh. USD is currently collaborating with EBRPD to transition the marsh management plan in a way that maximizes water quality protection at both Hayward Marsh and the Old Alameda Creek outfall where flows in excess to wet weather marsh flows are managed.

1.3.4 Sea Level Rise

According to a preliminary study on the effect of sea level rise on infrastructure at USD, the elevation of the 100-year storm still-water will be at an elevation of 13.00 ft in the year 2050, 14.08 ft in the year 2070, and 16.42 ft in the year 2100[1]. The elevations of the 100-year storm stillwater in 2050 and 2100 may be lower than the estimates from the ESA PWA Study, based on sea level rise estimates from the National Research Council.[2] To protect land, infrastructure, and facilities at the WWTP from erosion, inundation, and flooding in the future, the levees[3] surrounding the plant need to be raised to 13.00 ft plus freeboard. The western levee has a current levee crest elevation of approximately 12 ft NAVD88, and the southern and eastern levees have a levee crest elevation of approximately 7 ft NAVD88. Therefore, the western levee will need to be raised 1 ft and the southern and eastern levees will need to be raised 5 ft. In order to raise the height of the levee, the land would need to be cut horizontally towards the plant for sloping reasons. In **Figure 1-1** the blue cross-hatched area shows the additional area needed in order to raise the levees. The blue area is illustrative of where the future inside toe of the levee would need to be moved to in order to protect the plant against projected sea level rise. Conflicts with existing facilities will need to be worked out when these levees are implemented.

The Alameda County Flood Control & Water Conservation District (ACFWD) owns and operates a series of levees around USD, which falls into ACFWD’s Zone 3A. ACFWD’s levees along Old Alameda Creek vary in height from 10-14 ft NAVD88 to the north, south, and west of USD. If ACFWD raises its levees to protect against future sea level rise, then USD would be protected without needing to raise its own levees. USD should coordinate with ACFWD to plan for future sea level rise.

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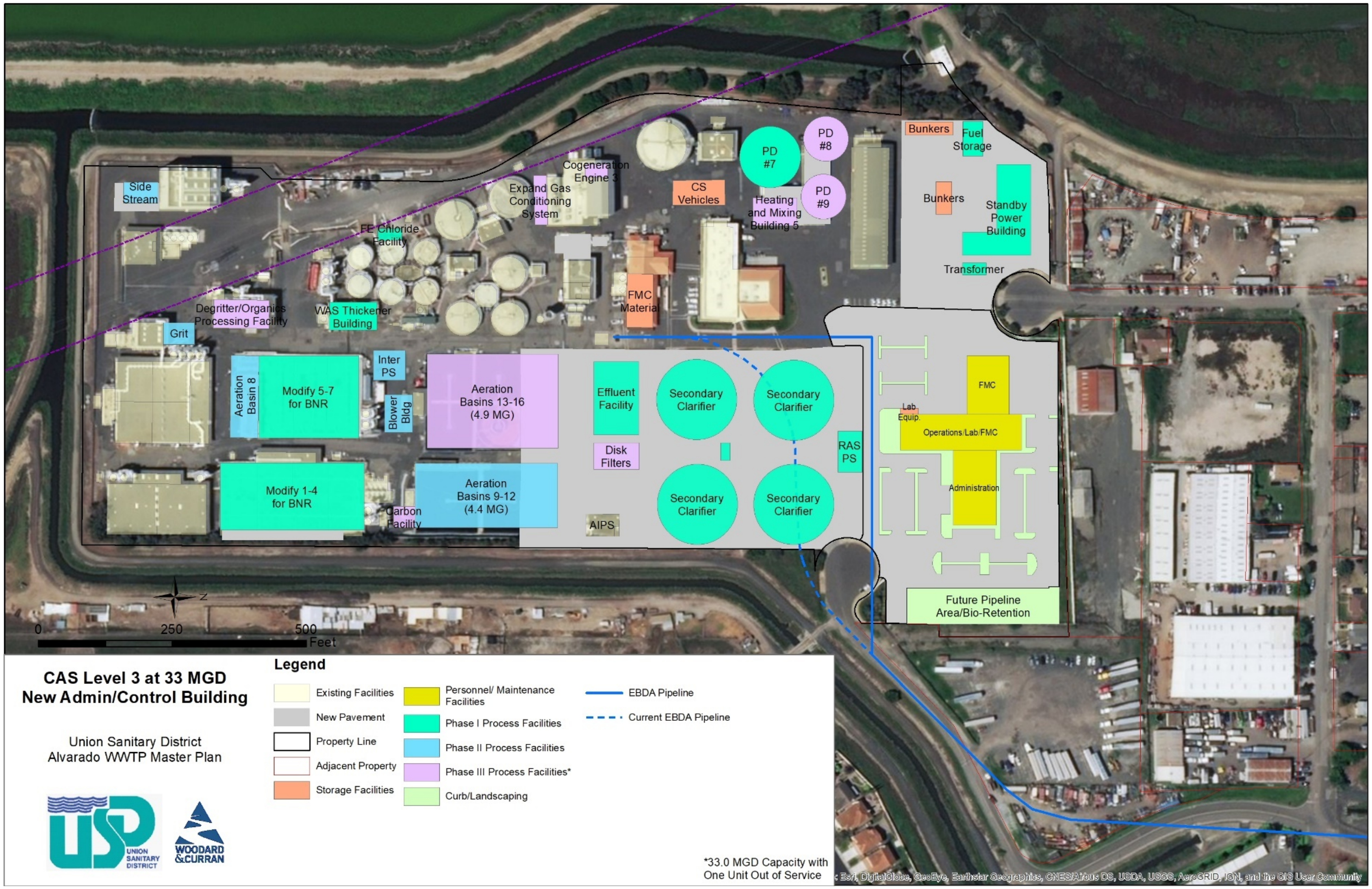
[1] ESA PWA. Union Sanitary District Preliminary Study of the Effect of Sea Level Rise on District Infrastructure, June 2013.

[2] National Research Council. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. Washington, DC: The National Academies Press, 2012.

[3] Levees were evaluated, but other alternatives such as vertical walls, horizontal levees, etc. are available.

Figure 1-1: Alvarado WWTP Site Use Study – Sea Level Rise Impacted Areas



1.3.5 Asset Management

In addition to the capacity, effluent, and nutrient removal drivers, the WWTP is also facing aging infrastructure drivers. While upgrades to the various systems have been completed, major infrastructure repairs are still required. A structural evaluation completed in 2013 noted that the east aeration basin covers need repair. Several of the buildings at the WWTP need significant seismic repairs including the Administration Building and the Control/Lab Building. Phase 1 of the Secondary Treatment Process Improvements, which is recommended for immediate implementation, affords USD the opportunity to address these aging infrastructure drivers while addressing the capacity and effluent disposal needs.

1.4 Additional Studies

The ETSU Program is built on numerous previous studies, combined with additional evaluation of select near-term issues, which require a more in-depth understanding in order to inform key near-term decisions. The additional evaluations performed as part of, or in conjunction with the ETSU Program, include:

- Effluent Management Study (see **Appendix A**)
- Secondary Treatment Process Improvements/Early Action Nutrient Removal – (see **Appendix B**)
- Administration, Control/Operations/Lab, and FMC Building Evaluation (see **Appendix C**)
- Real Estate Acquisition Investigation (See **Appendix D**)

Results of these evaluations are discussed in Section 2 through 5.

1.5 Projects Identified from Previous Studies

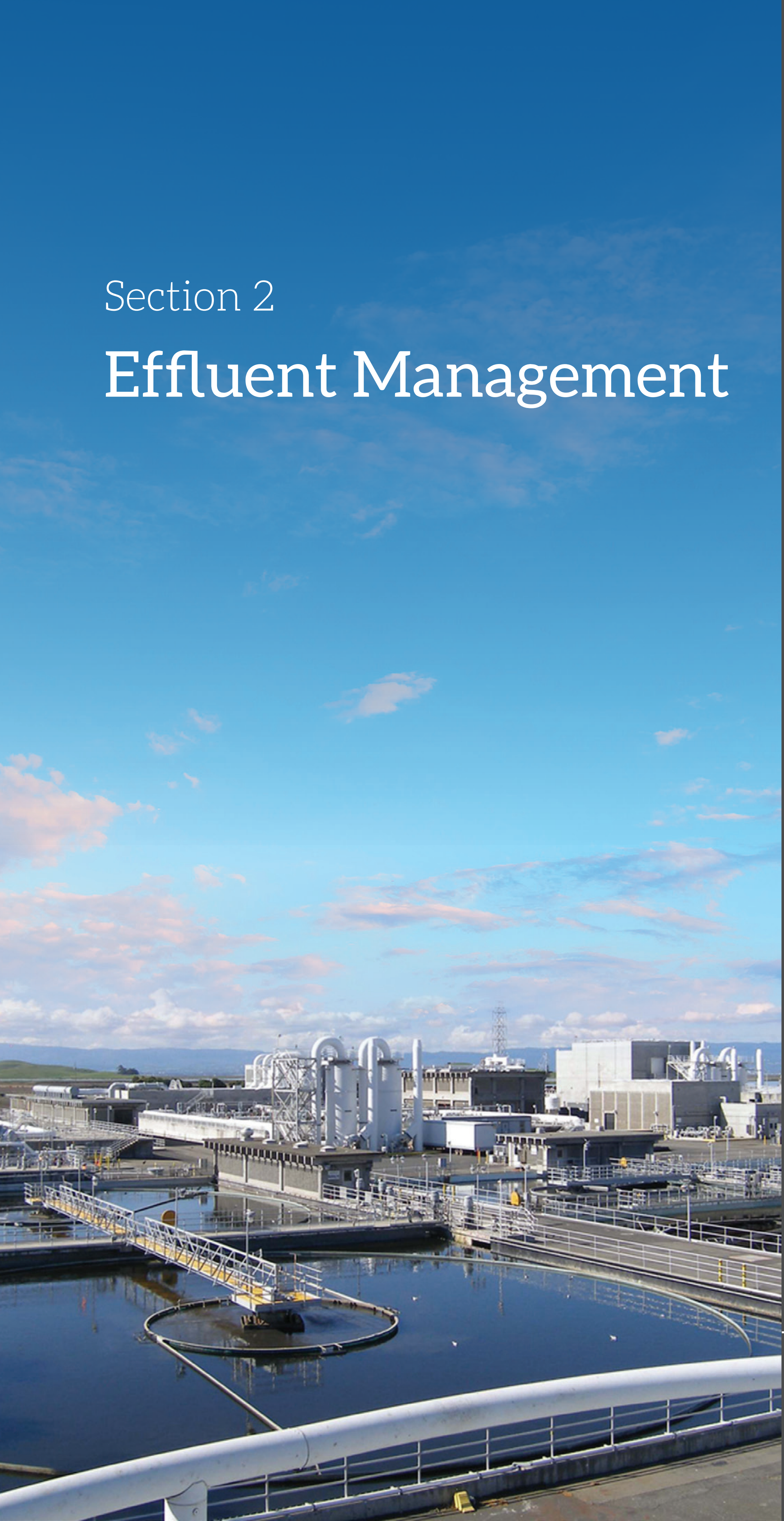
Other than the secondary process upgrades, related building demolitions and rebuilds, and effluent management facility improvements, the ETSU Program was largely developed based on previous projects and studies undertaken by USD. **Appendix E** contains table listing studies which describe these projects in more detail.

1.5.1 Fabrication, Maintenance and Construction Building / Paint Shop

USD's existing maintenance building and paint shop are nearing the end of their useful lives. The new Fabrication, Maintenance, and Construction (FMC) Building will include maintenance shop areas for the mechanics, electricians, and instrument technicians, and also a new paint shop. The proposed area for the building is approximately 15,300 SF. The space requirements will be further evaluated during the predesign phase for the new FMC Building. As part of the ETSU Program, the USD team has updated the FMC plan as part of the Campus Building (see Section 4.2).

Section 2

Effluent Management



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2. EFFLUENT MANAGEMENT

This section summarizes the results of the Effluent Management Study (*Woodard & Curran, August 2019*) and discusses the impact of the conclusions on the ETSU Program. Please refer to **Appendix A** for the comprehensive evaluation.

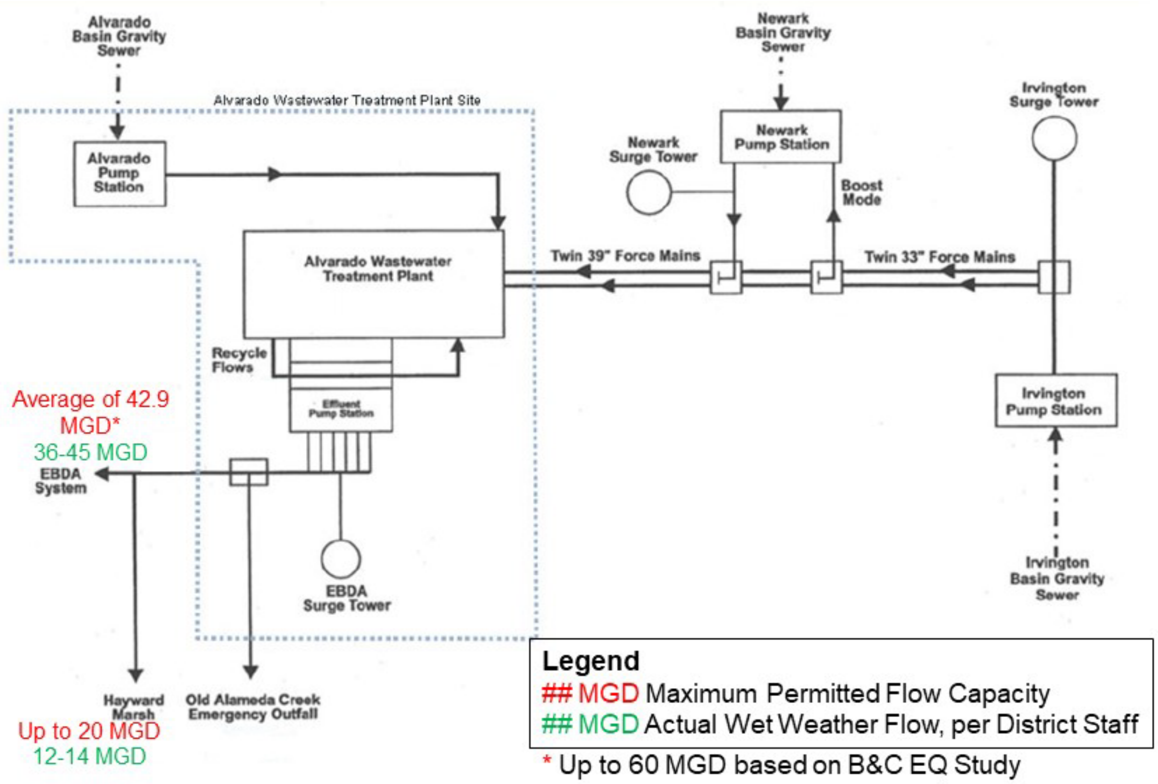
2.1 Existing Effluent Disposal System

The Union Sanitary District is evaluating strategies for disposing of treated wastewater from the WWTP. The WWTP currently provides secondary treatment of wastewater collected from Union City, Newark, and Fremont. Currently, USD is permitted to discharge secondary effluent at three discharge points:

- East Bay Dischargers Authority (EBDA) system
- Hayward Marsh
- Old Alameda Creek, during storm events only

Currently, USD is permitted to discharge up to 33 MGD average dry weather flow (ADWF). The WWTP effluent pump station is used to pump USD's treated effluent into the EBDA system. **Figure 2-1** shows a process flow schematic of the WWTP and the permitted flow capacities associated with its different discharge points.

Figure 2-1: Process Flow Schematic & Currently Permitted Discharge Points



Source: USD's Old Alameda Creek (Wet Weather Outfall) Permit. ORDER No. R2-2015-0045, NPDES No. CA0038733.

On average, approximately 3 MGD of effluent from USD is discharged from the EBDA pipeline to the Hayward Marsh. During peak weather events when total wastewater flow discharged by EBDA member agencies is beyond the capacity of the current system, up to 20 MGD of wastewater from USD's WWTP can be directed to Hayward Marsh. After the secondary-treated effluent flows through the freshwater treatment marsh, the reclaimed wastewater flows to San Francisco Bay.

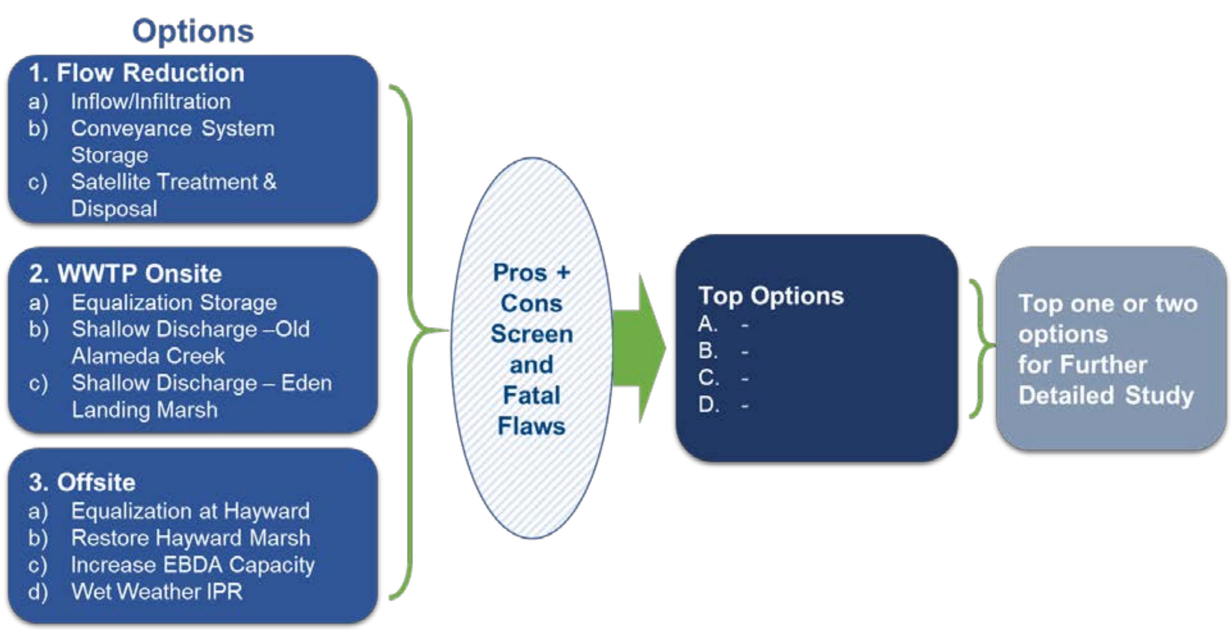
In addition to Hayward Marsh, during wet weather, USD can discharge to Old Alameda Creek. Although the previous maximum discharge flow limitation of 8.4 MG per discharge event is not retained in the current permit for Old Alameda Creek, calculations performed were based on this assumed limitation. USD has not been compelled to use this discharge point since 1998 but it typically has been exercised once per wet weather season since then.

Effluent options are required for USD in order to prepare for the elimination of Hayward Marsh as an option for wet weather discharges.

2.2 Alternatives Development

A range of effluent management and discharge options were identified and evaluated in this first phase of the Effluent Management Study. Management options are classified into three categories: 1) Flow Reductions, which are focused on reducing flows coming into the WWTP, 2) On-site at the WWTP, and 3) Off-site, which are focused on managing effluent downstream of the WWTP effluent pump station.

Figure 2-2: Effluent Management Study Approach



Each alternative was evaluated based on their viability, and the extent to which they can provide a solution to future effluent storage requirements. **Table 2-1** provides a summary of the effluent management options evaluation.

Table 2-1: Summary of Effluent Management Options

Alternative	Agency Coordination/ Complexity	Storage Volume/Flow Discharge Available	Complete solution?	Planning Level Costs	Implementation Timing	Viability
Influent Flow Reduction						
Conveyance System Storage	USD	Additional 1.8 MG @ Irvington, 2 MG @ Newark	Minor	~$10 M – $30 M, each basin [1]	3 – 5 years (based on current CIP)	Moderate
WWTP Onsite/Adjacent						
<u>Equalization Storage</u>						
EQ Basin East of WWTP	USD, ACFCD, ACWD, Army Corps, Water Board	Up to 20 MG	Partial to Full	$90 M [2]	5 years or more for permitting; potential partnership with ACFCD	Low
<u>Early Action Nutrient Removal + Old Alameda Creek Shallow Water Discharge</u>						
Alternative 1: Sidestream Nutrient Removal for Centrate	USD, Water Board	Dependent on negotiations RWQCB; permitting analysis underway	Partial to Full	$20.8 M [3]	4 – 5 years for design, construction, and permitting	Moderate

[1] Costs estimated from ongoing predesign effort for storage basin at Newark Pump Station.
[2] Cost from the Secondary Treatment Process Improvements (CAS Option 3) in Appendix B.
[3] Cost from the Secondary Treatment Process Improvements (CAS Option 2 – Phase II) in Appendix B.

Alternative	Agency Coordination/ Complexity	Storage Volume/Flow Discharge Available	Complete solution?	Planning Level Costs	Implementation Timing	Viability
Alternative 2: Full Flow Nutrient Removal	USD, Water Board	Dependent on negotiations RWQCB; permitting analysis underway	Full	\$23.2 M [1]	7 years for design, construction, and permitting	High (recommended approach)
Offsite						
Baseline Restoration of Hayward Marsh	USD, Water Board, EBRPD	20 MGD	Partial	\$20.1 M (April 2018 dollars)	More than 5 years to complete construction	Low
Wet Weather IPR	USD/ACWD/ Regional Agencies, Water Board	Up to 5 MGD without regional coordination	Partial	\$80 M (2016 dollars; includes treatment and distribution)	Minimum 5 – 6 years for design, construction, and permitting	Low

[1] Only a fraction of the Secondary Treatment Process Improvements (CAS Option 2 – Phase I) in Appendix B is attributable to early action nutrient removal. That fraction is estimated at 10%, or \$23.2 million, and is estimated to result in sufficient nutrient removal to permit increased shallow water discharges to Old Alameda Creek.

2.3 Recommended Alternatives

As shown in the table, the most viable options (with Moderate viability or better) are the following:

- Conveyance System Storage
- Shallow Water Discharge: Early Action Nutrient Removal + Old Alameda Creek

2.3.1 Conveyance System Storage

This option involves expanding the use of available storage within the existing conveyance system for peak flow attenuation. There is an existing wet weather equalization tank at the Irvington Pump Station, with a capacity of 1.8 MG. According to the Flow Equalization Update Report (*Brown and Caldwell, 2013*), this basin could be increased to 3.6 MG. However, there is currently not a reliable method in place for diverting influent flow into the existing storage at Irvington Pump Station without the capacity of the twin force mains being impacted. The Newark Pump Station site could allow for another 2 MG of similar influent storage.

In order to further vet this option, USD would need to identify the efforts and costs needed to avoid impacts to the force mains when diverting influent flow into the Irvington Pump Station basins, and/or to create a new influent storage basin at the Newark Pump Station. The identified influent storage available in the conveyance system is limited compared to the buildout storage needed (20 MG for secondary effluent storage up to 2038, and potentially beyond) so it would only provide a minor solution. Previous evaluation has determined that conveyance system storage is possible and is of moderate viability due to USD ownership of the facilities.

2.3.2 Shallow Water Discharge: Old Alameda Creek

Under this option, additional effluent capacity could be obtained by reducing the constraints on the use of the Old Alameda Creek (OAC) discharge location. Old Alameda Creek currently serves as an emergency outfall during peak wet weather flow conditions, but no maximum discharge rate is specified in the permit. The previous permit order dictated a maximum discharge volume limitation of 8.4 MG per discharge event, which was the expected flow from a storm with a 20-year return frequency (i.e., a 20-year storm). According to the permit, this number was determined from the USD's *1994 District Wide Master Plan* and *1999 Wastewater Equalization Storage Facilities Pre-Design*. The current order replaces the discharge flow limitation with a standard prohibition against the bypass of treatment systems. For more long-term, the increased frequency of use would be required. Some increase in treatment level at the WWTP would likely be required by the Regional Water Quality Control Board (RWQCB) to allow this increase because it is a shallow water discharge and could have more impacts on beneficial uses with increased frequency of use and increased volume of discharge. Consequently, it is anticipated that future nutrient removal improvements would be needed for the portion of flow discharged to Old Alameda Creek. Because the Secondary Treatment Process Improvements are recommended in this ETSU Program for implementation in Phase I to address immediate process improvement needs, it appears that some full flow (not sidestream) ammonia and overall TIN removal would be most cost effective and reduce the potential impacts of increased shallow water discharge volumes and frequencies relative to sidestream treatment.

2.4 Implementation

2.4.1 Shallow Water Discharge

The ETSU Program proposes implementing upgrades to improve secondary process performance as soon as possible. Additional nutrient removal capability as indicated through ongoing evaluation of future nutrient watershed permits would also be implemented concurrently. These upgrades are discussed in more detail in Chapter 3. Incorporating multiple benefits such as improved process performance, Title 22 recycled water production, and other benefits would need to be factored in to increase the viability of the early action nutrient removal options given their capital cost. USD has had favorable discussions with RWQCB staff regarding possibly permitting an increased wintertime discharge to Old Alameda Creek during high flow periods, along with early action nutrient removal; the next steps are underway and include developing technical studies and, if appropriate, a permit application.

USD, in conjunction with Woodard & Curran, is developing more defined technical documentation regarding discharge to Old Alameda Creek. This documentation will include analyses defining:

- Frequency of discharge to Old Alameda Creek after discharge to Hayward Marsh is no longer possible
- Projected water quality of the discharge based on the implementation timeline of process upgrades

If accepted, the RWQCB would be granting USD an exception to the current shallow water discharge prohibition on the basis that USD would be providing an "equivalent level of environmental protection"[1] to San Francisco Bay due to nutrient removal. This technical proposal is expected to be submitted to the RWQCB in September 2019.

In the meantime, USD will continue to work with EBRPD on the transition of Hayward Marsh from facility accepting secondary effluent from USD year-round to a facility used only during wet weather events for equalization and potential discharge in conjunction with Old Alameda Creek.

[1] San Francisco Bay Regional Water Quality Control Board. Order No. R2-2015-0045, NPDES No. CA0038733 Attachment F. November 18, 2015.

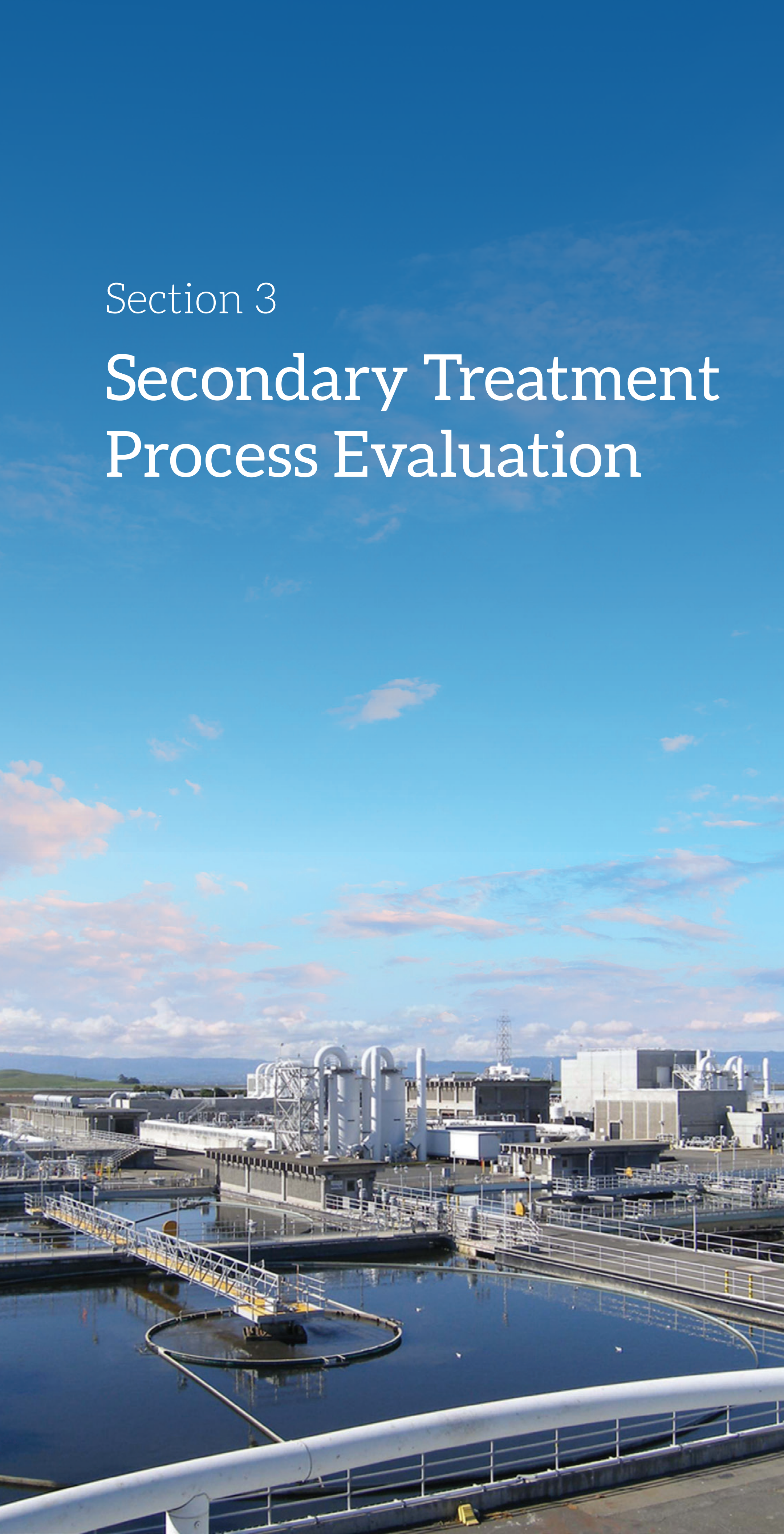
2.4.2 Recycled Water

USD continues to be open to collaborate with ACWD to ensure that secondary effluent may be made available if sufficient demand for recycled water is established. ACWD, in collaboration with SFPUC, is currently evaluating the feasibility and cost of a regional potable reuse project. This study commenced in July 2019; sizing and timing of this facility has yet to be determined.

Section 3

Secondary Treatment Process Evaluation

3



3. SECONDARY TREATMENT PROCESS EVALUATION

The Solids System Capacity Assessment (*Carollo Engineers, August 2018*) provided capacity evaluation of the liquid treatment process and found that the following secondary improvements were required to provide additional capacity:

- Aeration Basins
  - Retrofit Aeration Basins 5-7 to create plug flow operation and anaerobic selectors
  - Add sludge reaeration capabilities and submersible mixers to the retrofitted selectors
  - Add foam and scum decant gates to all basins
  - Retrofit Aeration Basins 1-4 to create anaerobic selectors
- Secondary Clarifiers
  - Shorten Secondary Clarifier 5 baffle to match Secondary Clarifier 6
  - Operate all clarifiers with all 8 rotary valves in use
  - Replace sludge withdrawal mechanisms in Secondary Clarifiers 5 and 6 with suction header type mechanisms
  - Construct Secondary Clarifiers 7 and 8

These recommended improvements, however, were based on the continuation of current conventional activated sludge operation and did not address future nutrient removal requirements. Thus, initial evaluations incorporated these improvements into recommendations that would also address anticipated nutrient removal requirements. The secondary system upgrades initially proposed were all based on capacity evaluation assumptions of full nutrient removal treatment with the largest treatment unit out of service. This conservative basis led to a large footprint requirement at buildout, a which exceeded the space available at the plant.

Real estate acquisition to accommodate expansion of the plant was considered (discussed in further detail in Chapter 5). It became obvious that acquiring real estate near the plant would likely be a time-consuming and expensive process. USD chose to re-evaluate secondary treatment requirements to see if a less space-intensive solution could be formulated. Hazen and Sawyer was retained to conduct this evaluation. The remainder of this section summarizes the results of the Secondary Treatment Process Improvements Final Report (*Hazen and Sawyer, August 2019*) and discusses the impact of the conclusions on the ETSU Program. Please refer to **Appendix B** for the comprehensive evaluation.

3.1 Secondary Treatment Process Challenges and Drivers

The goal of the Secondary Treatment Process Improvements project was to evaluate alternatives to upgrade the secondary treatment system at the WWTP in response to the following challenges and drivers discussed in Section 1:

- Improve Process Reliability and Performance
- Wet Weather Treatment and Effluent Discharge
- Capacity Expansion
- Aging Infrastructure
- Synergy with Future Nutrient Removal
- Constrained Site with Limited Space for New Facilities

3.2 Alternatives Development

3.2.1 Phased Approach

A phased or programmatic approach to the Secondary Treatment Improvements Project is proposed to distribute cash flow and capital improvements over time. The benefit of implementing a phased approach is that later phases can be implemented when needed, preventing overbuilding or stranded assets. This is particularly useful for USD as the timing of near-term drivers are well-defined, but the impact and timing of long-term drivers are not. Therefore, developing a trigger-based approach will optimize capital expenditure and minimize risk.

Phase I of the Secondary Treatment Process Improvements is defined as the improvements needed to address the immediate and near-term needs at the WWTP to address process performance. The time frame for implementing Phase I is 2019 through 2026. Phase I is not tied to specific permit limits, beyond the current BOD and TSS limits in the existing WWTP NPDES permit. As a result, Phase I could include a wide spectrum of secondary treatment options, varying from no nutrient removal, seasonal removal, to year-round removal (however not to BACWA Level 2 standards).

Phase II of the Secondary Treatment Process Improvements covers the need for additional treatment capacity and potential BACWA Level 2 nutrient removal levels which are expected to take effect in 15-20 years. Phase III is the time period in which BACWA Level 3 nutrient removal levels at buildout conditions (33 MGD Annual Average [AA] Flow) may be required. Phase III is proposed to be implemented by approximately 2058.

3.2.2 Design Flows and Loads

The annual average (AA) and maximum month (M) influent flows and loads for the 2028 (Phase I) and 2040 (Phase II) design horizon are presented in **Table 3-1**.

Table 3-1: Design Flows and Loads

Parameter	Year	Current(1)		2028(1)		2040(1)		Buildout (2058)(2)	
	Units	AA	M	AA	M	AA	M	AA	M
Flow	mgd	23.4	26.9	25.8	29.7	29.1	33.5	33	37.9
Peak Hour Flow	mgd	64.7	64.7	67.1	67.1	70.4	70.4	74.4	74.4
Chemical Oxygen Demand (COD)	lbs/day	146,000	167,900	161,300	185,500	181,700	209,000	206,100	237,000
Carbonaceous Biochemical Oxygen Demand (cBOD)	lbs/day	52,600	60,500	58,100	66,800	65,500	75,300	74,300	85,400
Total Suspended Solids (TSS)	lbs/day	70,500	81,100	77,900	89,600	87,800	100,900	99,600	114,500
Total Kjeldahl Nitrogen (TKN)	lbs/day	10,650	12,240	11,800	13,500	13,250	15,240	15,100	17,400
Ammonia as Nitrogen (NH_3-N)	lbs/day	7,200	8,300	8,000	9,200	9,010	10,360	10,300	11,800
Total Phosphorus (TP)	lbs/day	1,350	1,560	1,490	1,720	1,680	1,940	2,000	2,300

(1) Source: Secondary Treatment Process Improvements Project Report, Hazen and Sawyer, August 2019.
(2) Extrapolated based on peaking factors for Current, 2028, and 2040 values.

3.2.3 Process Alternatives

A comprehensive analysis of options for early action nutrient removal was conducted as part of the Effluent Management Study (**Appendix A**) to enable the plant to initiate wet weather discharge to Old Alameda Creek. The results of that study narrowed the alternatives to Membrane Biological Reactor (MBR) and Conventional Activated Sludge (CAS). These two alternatives were further evaluated in the Secondary Treatment Process Improvements (**Appendix B**). Process alternatives evaluated in the Secondary Treatment Process Improvements were sized using a calibrated BioWin™ version 5.3 process model and computational fluid dynamics (CFD) modeling to meet anticipated Phase II permit limits, which are summarized in **Table 3-2**.

Table 3-2: Current and Projected Permit Limits by Phase

Parameter	Units	Basis	Limit/Target		
			Phase I	Phase II	Phase III
San Francisco Bay Discharge (EBDA)					
cBOD	mg/L	Monthly	25		
		Weekly	40		
TSS	mg/L	Monthly	30		
		Weekly	45		
NH_3-N	mg/L	Monthly(1)	Optimize existing infrastructure(2)	2	2
Total Nitrogen (TN)	mg/L	Monthly(1)		15	6
TP	mg/L	Monthly(1)		1	0.3
Old Alameda Creek Discharge(3)					
Flow	mgd	Each discharge event	0-22		
cBOD	mg/L		10		
TSS	mg/L		15		
TN Removal	%		20(4)		
Ammonia	mg/L		2		

Notes:

1) At this time, the basis for nutrient removal limits is not known. For this analysis, the BACWA Level 2 and Level 3 concentrations were assumed to be monthly average targets.
2) No specific permit limits were defined for this phase. USD may optimize existing infrastructure to achieve some level of ammonia removal.
3) No standards for discharge to Old Alameda Creek have yet been defined. These values were used as an initial target for analysis.
4) On an annual mass loading basis, as measured at the EBDA Discharge.

Various combinations of flow and load scenarios were run to evaluate the process alternatives, and these are presented in **Table 3-3**. Redundancy was also incorporated into these scenarios, by taking one aeration basin (AB) or one secondary clarifier (SC) out of service (OOS) during dry weather operation. For more details on how these alternatives were developed, please refer to **Appendix B**.

Table 3-3: 2040 Model Influent Flow, Loads, and Concentrations

Scenario	AA		M		M Load-AA Flows		Redundancy – 1 AB OOS, AA		Redundancy – 1 SC OOS, AA	
Flow, mgd	29		33		29		29		29	
Temp, ºC	16		16		16		16		16	
Units	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	mg/L
cBOD	77,000	270	88,500	270	88,500	310	77,000	270	77,000	270
COD	182,000	749	209,000	749	209,000	861	182,000	749	182,000	749
TSS	85,500	362	98,000	362	98,000	416	85,500	362	85,500	362
TKN	13,300	55	15,300	55	15,300	63	13,300	55	13,300	55
NH_3-N	9,000	37	10,400	37	10,400	43	9,000	37	9,000	37
TP	1,690	6.9	1,940	6.9	1,940	8.0	1,690	6.9	1,690	6.9

In addition to secondary process upgrades, both alternatives require additional facilities for effluent management, sidestream treatment, and chemical phosphorus removal. These facilities are listed in **Section 3.2.3.3**. Development of these additional facilities is also discussed in Chapter 6 of **Appendix B**.

3.2.3.1 MBR Alternative

Figure 3-1 and **Figure 3-2** show the MBR process model flow diagram provided by Hazen and Sawyer. **Table 3-4** summarizes the MBR alternative sized to meet Phase II (BACWA Level 2 Nutrient Removal) permit limits.

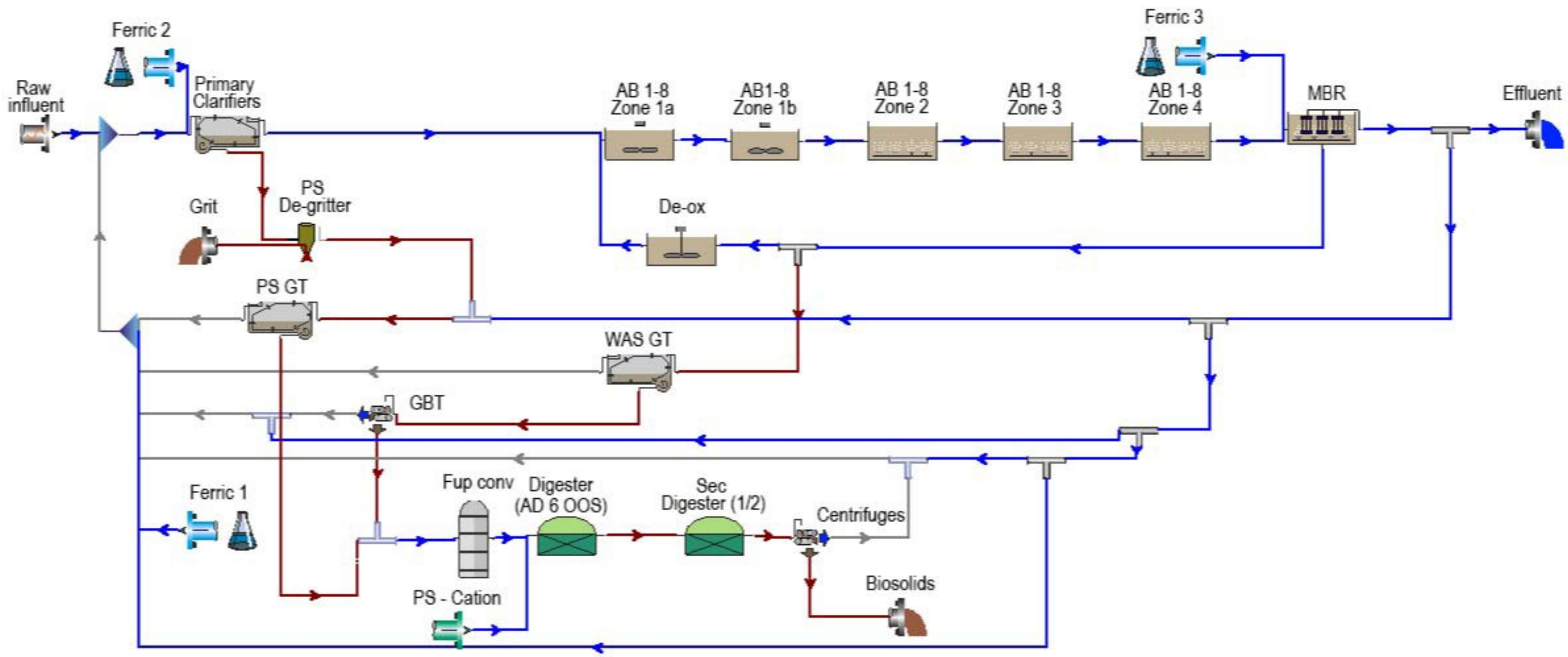
Table 3-4: MBR Alternative Summary and Model Results for Phase II Requirements

Unit Process	Parameter	Units	Scenario	
			All Units in Service(1)	1 Aeration Basin OOS
Aeration	Basins in Service	#	8	7
	Total Volume	MG	8.5	7.4
	MLSS	mg/L	7,300-7,700	8,000
	Solids Retention Time (SRT)	days	13	13
	Aerobic SRT	Days	8	8
MBR Tanks	Trains in Service	#	9	8
	Total Cassettes	#	162	144
	Total Reactor Volume	MG	8.5	---
	RAS Deoxygenation Volume		0.5	---
	Anoxic Volume		2.8	---
	Aerobic Volume		5.2	---
	Surface Area	Msf	3.1	2.7
	Design Flux	g/sf	12.5-14.5	12.5
	Actual Flux	g/sf	9.3-10.7	10.5
	RAS Ratio	%	400	400
WAS	WAS Flow	mgd	0.47-0.48	0.43
	WAS Concentration	mg/L	9,000-9,800	10,100
	WAS Load	lbs/day	36,000-39,300	36,200
Secondary Effluent	cBOD	mg/L	~1	~1
	TSS	mg/L	0	<1
	TN	mg N/L	~11-12	~11-12
	NH_3-N	mg N/L	<0.5	<0.5
	NO_3	mg N/L	~9-10	~9-10
	NO_2	mg N/L	~0	~0
	Total Inorganic Nitrogen (TIN)	mg N/L	~9-10	~9-10
	TP	mg N/L	<1	<1
	PO_4-P	mg P/L	<1	<1

Notes:

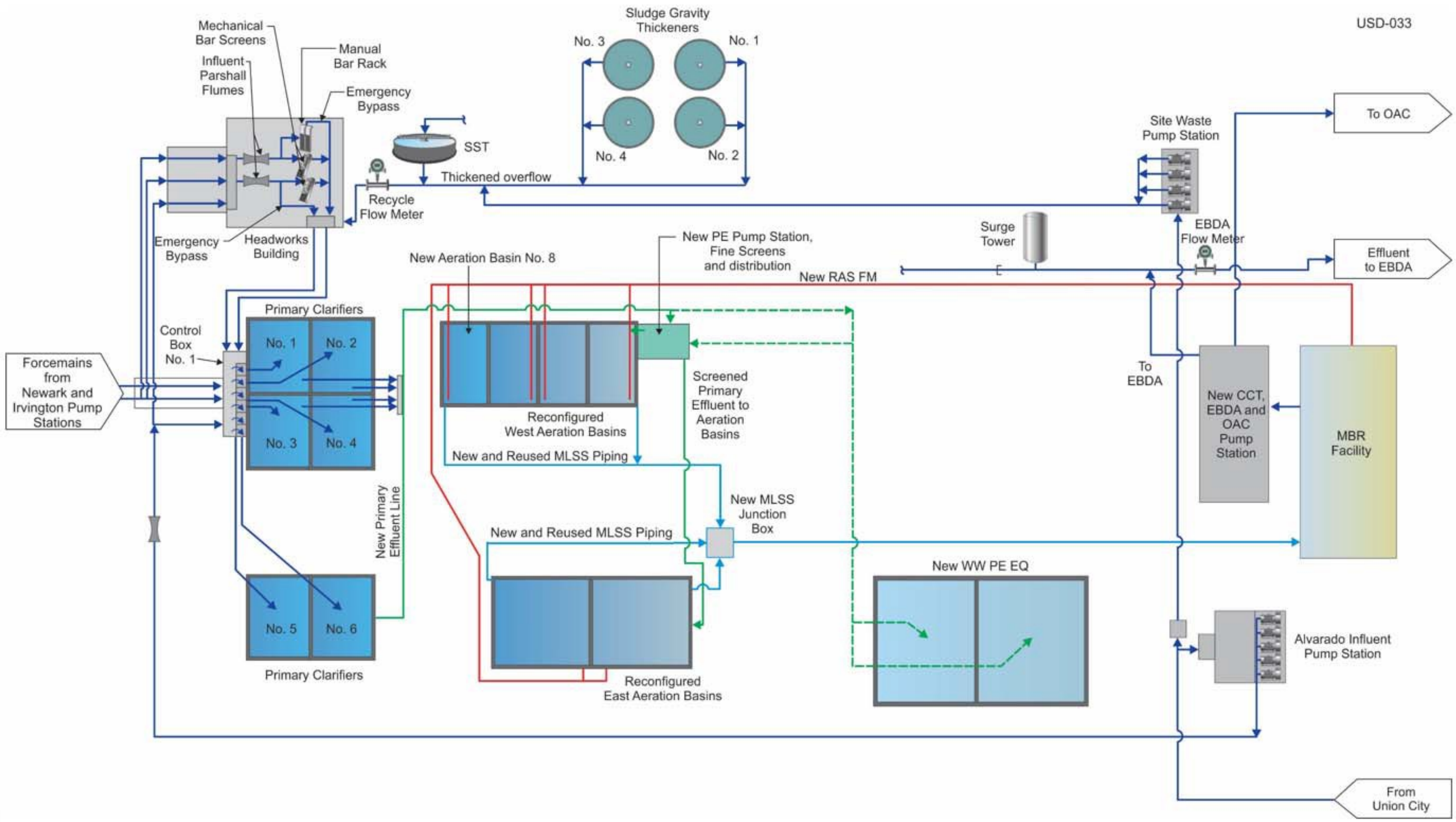
(1) This column reflects the range of scenarios through AA flow and load conditions, M flow and load conditions, and AA flow with M load conditions.

Figure 3-1: MBR Process Model(Biowin) Flow Diagram



Source: Secondary Treatment Process Improvements Final Report, Hazen and Sawyer, August 2019

Figure 3-2: MBR Process Flow Diagram



Source: Secondary Treatment Process Improvements Final Report, Hazen and Sawyer, August 2019

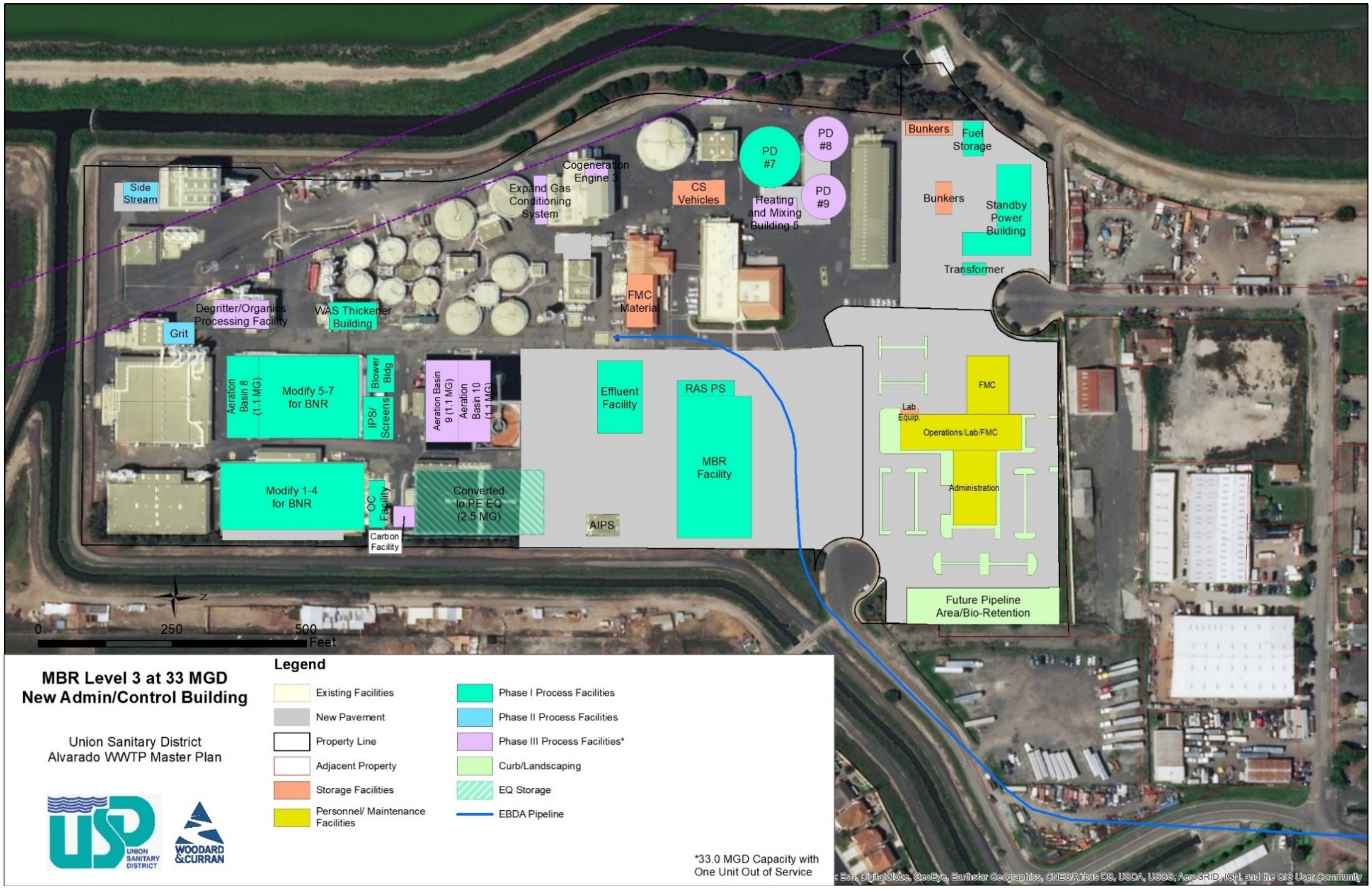
This alternative requires a total of 8.5 MG of reactor volume to meet Phase II permit limits. Existing reactor (aeration basin) volume totals 7.4 MG, therefore 1.1 MG of new reactor volume would be required. The existing reactors would be reconfigured to accommodate anoxic, anaerobic, and RAS deoxygenation zones.

This alternative is comprised of the following key modifications:

- Modified Aeration Basins 1-4 (East)
- Modified Aeration Basins 5-7 (West)
- New Aeration Basin 8 south of existing Aeration Basin 5-7
- New 60-inch PE line to centrally located Intermediate Pump Station routed to the west of existing Aeration Basin 5-7
- New intermediate pump station and fine screen facility
- New blower facility north of existing Aeration Basin 5-7
- PE distribution piping to the east and west aeration basins
- New 2.5 MG equalization basin (converted existing square secondary clarifiers)
- New MLSS junction box and reuse of the existing 60-inch line to the MBR tanks
- New MBR facility that includes:
    - 9 Membrane tanks (cassettes installed in 8 tanks)
    - Clean in place chemical storage and fee system
    - Scour blowers
    - Permeate pumps
- New effluent facility (see **Section 3.2.3.3** for further detail)

To meet Phase III permit limits, an additional 2.2 MG of reactor volume (Aeration Basins 9 and 10) is required, along with carbon addition facilities and additional membrane cassettes to meet increased flows. **Figure 3-3** shows a conceptual layout of these facilities, and phasing.

Figure 3-3: MBR Alternative - Phase III Conceptual Layout



3.2.3.2 CAS Alternative

The CAS alternative evaluated in the Secondary Treatment Process Improvements differs from USD's current configuration. Instead of operating in a simple plug flow configuration with no mixed liquor recycle and aeration diffusers in every segment of the basins, the new configuration incorporates a step-feed operation mode for wet weather treatment, anoxic zones with mixers in lieu of diffusers for denitrification, and mixed liquor recycle pumps to enable nutrient removal. The CAS alternative evaluated by Hazen and Sawyer is summarized in **Table 3-5.** **Figure 3-4** and **Figure 3-5** shows the CAS process model flow diagram provided by Hazen and Sawyer.

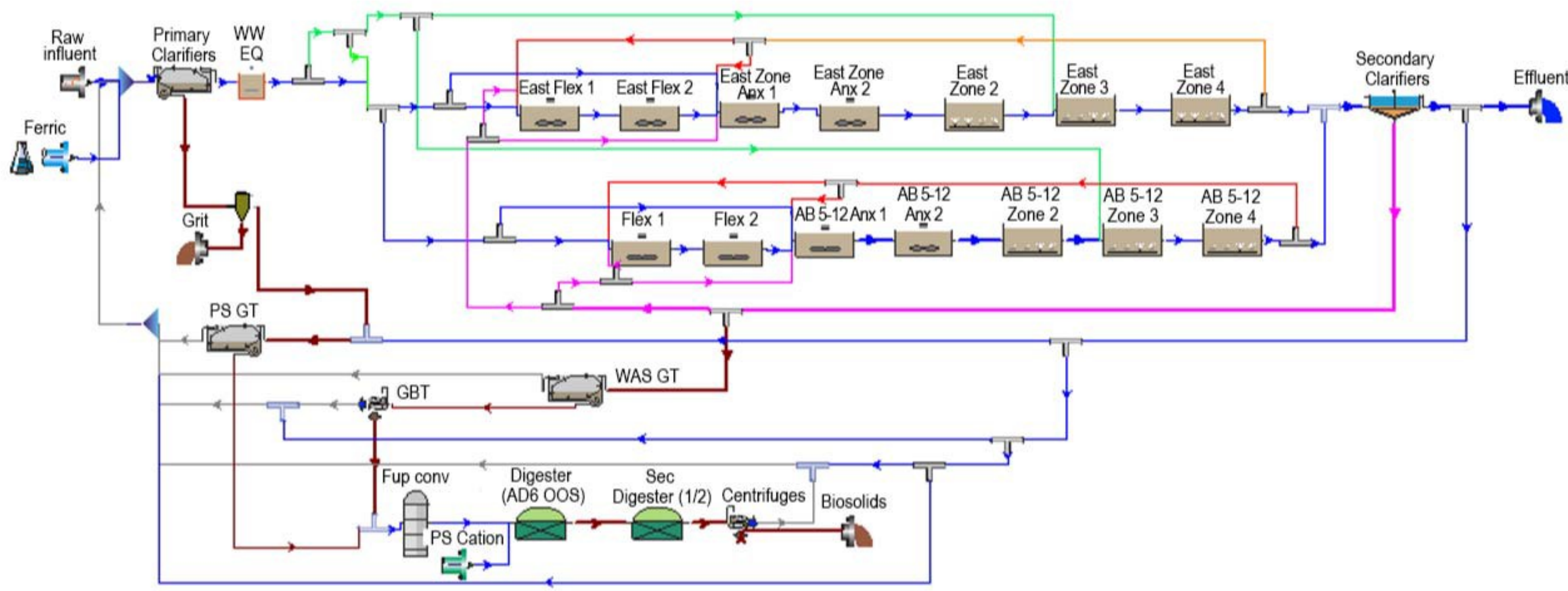
Table 3-5: CAS Alternative Summary and Model Results for Phase II Requirements

Unit Process	Parameter	Units	Scenarios		
			All Units in Service[1]	1 Aeration Basin OOS	1 Secondary Clarifier OOS
Aeration	Basins in Service	#	10	9	10
	Total Volume	MG	12.9	11.6	12.9
	Swing Zone Volume	MG	0.5	---	---
	Anoxic Volume	MG	3.1	---	---
	Aerobic Volume	MG	9.3	---	---
	MLSS zone 2	mg/L	3,100-5,000	3,600	3,100
	MLSS zone 4	mg/L	2,700-3,600	3,600	3,100
	SRT	days	~10-13	~8	~10
	Aerobic SRT	Days	~6.5-8	~5.6	~6.5
Secondary Clarification	Number	#	4	4	3
	Diameter	ft	155	155	155
	Surface Area	sf	75,500	75,500	56,600
	Volume	MG	10	10	7.5
	Surface Overflow Rate (SOR)	gpd/sf	415-810	415	550
	Solids Loading Rate (SLR)	lbs/d/sf	18-23	20	24
	Sludge Volume Index (SVI)	mL/g	110	110	110
	RAS Ratio	%	64	64	64
Waste Activated Sludge	WAS Flow	mgd	0.55	0.55	0.55
	WAS Concentration	mg/L	8,000-9,100	9,100	8,000
	WAS Load	lbs/day	38,000-43,000	35,000	34,000
Secondary Effluent	cBOD	mg/L	<10	<10	<10
	TSS	mg/L	<15	<15	<15
	TN	mg N/L	~12-14	~13	~12
	NH_3-N	mg N/L	~1-2	~2	~1
	NO_3	mg N/L	~7-10	~9	~9
	NO_2	mg N/L	<0.5-1	<1.0	<1.0
	Total Inorganic Nitrogen (TIN)	mg N/L	~7-10	~9	~9
	TP	mg N/L	<1.0	<1.0	<1.0
	PO_4-P	mg P/L	<0.5	<0.5	<0.5

Notes:

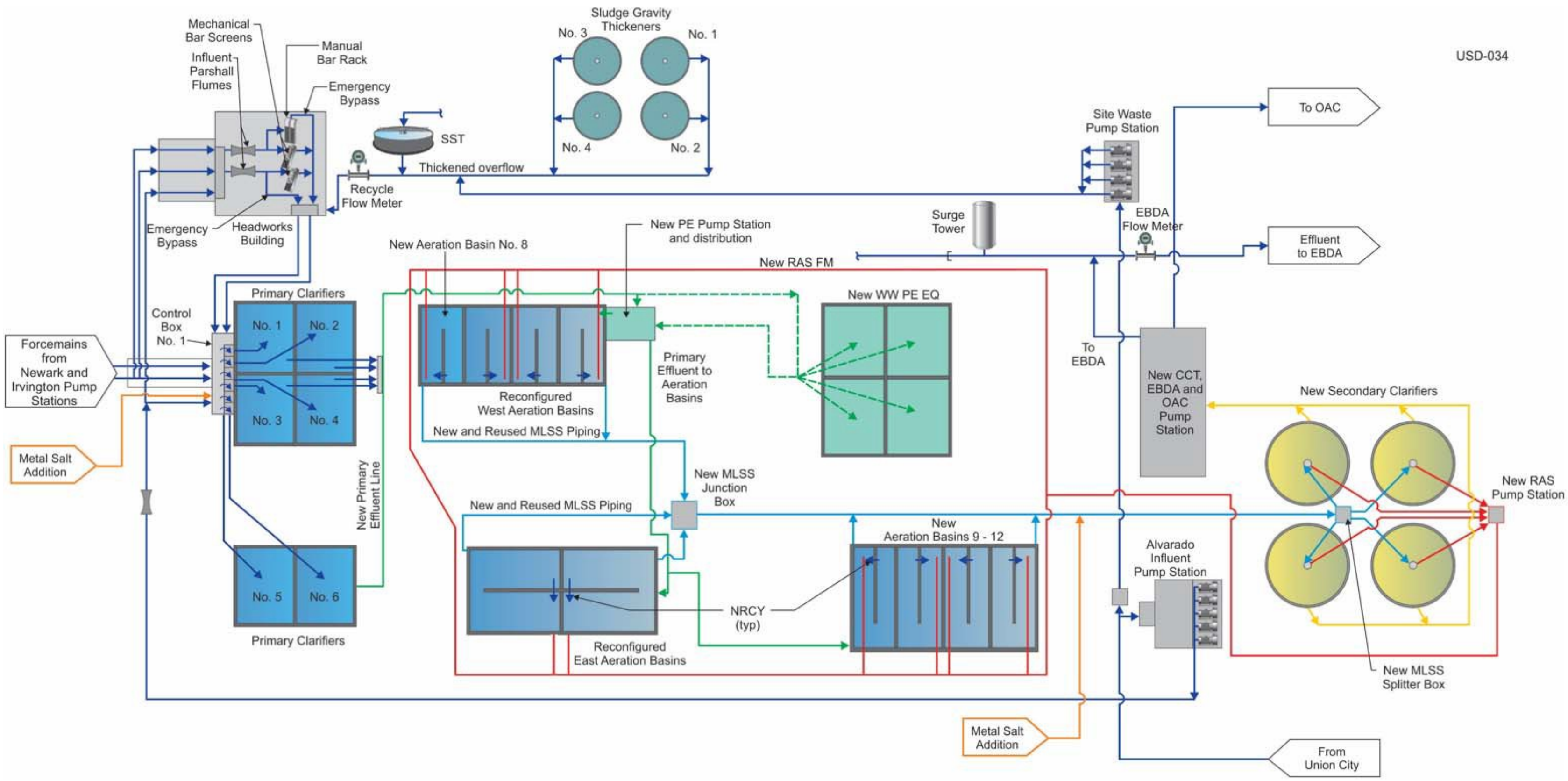
1) This column reflects the range of scenarios through AA flow and load conditions, M flow and load conditions, AA flow with M load conditions, and wet weather flows with M loads. Wet Weather MLSS values reflect step-feed operation.

Figure 3-4: CAS Process Model (Biowin) Flow Diagram



Source: Secondary Treatment Process Improvements Final Report, Hazen and Sawyer, August 2019

Figure 3-5: CAS Process Flow Diagram



Source: Secondary Treatment Process Improvements Final Report, Hazen and Sawyer, August 2019

This alternative requires a total of 12.9 MG of aeration basin volume. The existing aeration basin volume totals 7.4 MG, therefore 5.5 MG of new volume would be required. The existing aeration basins would be reconfigured to accommodate anoxic, anaerobic, and RAS deoxygenation zones. Four new circular secondary clarifiers would also be constructed in place of the existing secondary clarifiers. Key modifications/improvements to the existing plant for this alternative include:

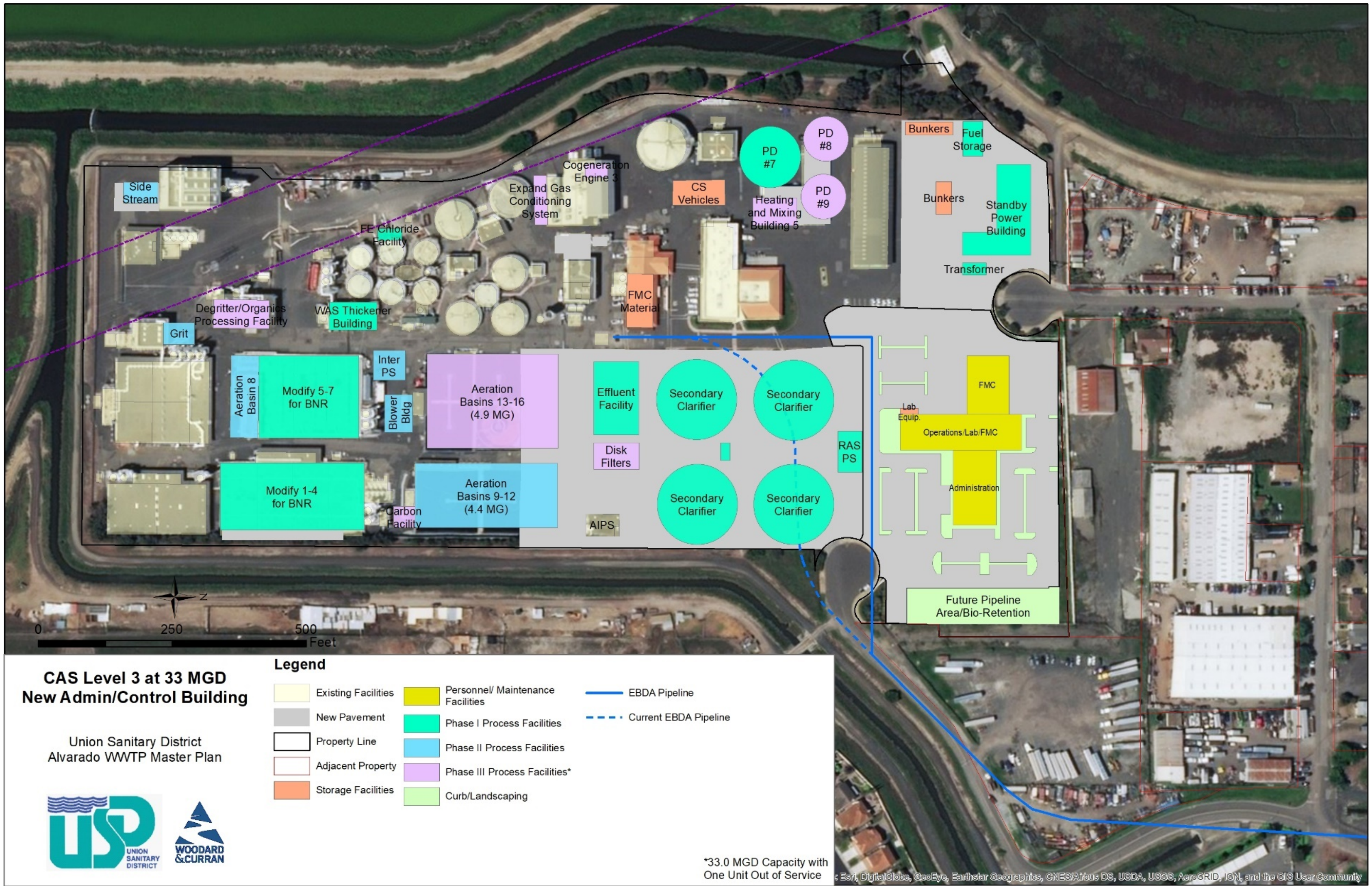
- Modified Aeration Basin 1-4 (East)
- Modified Aeration Basin 5-7 (West)
- New Aeration Basin 8 south of existing Aeration Basin 5-7
- New Aeration Basins 9-12 north of existing East Aeration Basins
- New 60-inch PE line to centrally located intermediate pump station routed to the west of existing Aeration Basin 5-7
- New intermediate pump station
- New blower facility north of existing Aeration Basin 5-7
- PE distribution piping to the existing and new aeration basins
- New 2.5 MG PE equalization basin (converted existing secondary clarifiers)
- New MLSS junction box and reuse of the existing 60-inch line to the new MLSS distribution box
- New MLSS distribution box
- Four new circular secondary clarifiers with sludge suction header
- Centralized RAS pump station
- New RAS force main
- New individual RAS lines (with flow meters and control valves) from force main to each aeration basin
- New 72-inch effluent line to new effluent facility
- New effluent facility (see **Section 3.2.3.3** for further detail)
- Relocation of EBDA force main to facilitate construction of new secondary clarifiers

To Meet Phase III Permit Limits The following additional improvements are required:

- Demolition of PE equalization installed in Phase II
- New Aeration Basin 13-16, 4.9 MG (at location of Phase II PE equalization)
- Carbon addition facilities for further denitrification
- Disk filters to meet low TP requirements

A conceptual layout of the CAS alternative including phasing is depicted in **Figure 3-6**.

Figure 3-6: CAS Option Phase III Conceptual Layout



3.2.3.3 Additional Facilities

The following additional facilities are common to both MBR and CAS alternatives, and are required for secondary treatment:

- Effluent Facilities, including:
    - New flash mixing for chlorination
    - New Chlorine Contact Tack (CCT)
    - New flash mixing for dechlorination
    - New dechlorination contact basin (sized for either thiosulfate or sodium bisulfite)
    - New effluent/reclaim pump station
    - New Old Alameda Creek pump station
    - New elevated discharge box to limit tidal impacts to pumping
    - New sample location for Total Residual Chlorine (TRC) confirmation
- Sidestream Deammonification Facilities for dewatering centrate, including:
    - Centrate equalization
    - 0.37 MG reactor volume
    - Electrical room
    - Chemical room
- Metal Salt Addition Facility for chemical phosphorus removal.

Effluent facilities were included in capital cost estimates for both CAS and MBR due to the following reasons. The existing chlorination and dechlorination facilities are in poor condition, unreliable, and cause hydraulic issues during peak flows. The existing effluent pump station is at the end of its useful life. A new pump station with elevated discharge box will be utilized for the Old Alameda Creek discharge to mitigate tidal influences on the discharge.

Sidestream deammonification is required to meet BACWA Level 2 standards for the for 2040 loads. USD recently piloted an ANITA™mox system. The system was considered in sizing the facility. USD requested that chemical phosphorus removal be assumed, therefore metal salt dosing stations were included.

All of these facilities are discussed in further detail in **Appendix B**.

3.2.4 Alternative Evaluation

To determine the best alternative for USD's secondary treatment process, the MBR and CAS alternatives were evaluated based on the following factors:

- Value
  - Which alternative offers the best benefit relative to lifecycle cost?
- Efficiency
  - Are existing assets leveraged to maximum advantage?
  - Can implementation be phased to "right-size" construction infrastructure and minimize footprint and spread capital investment over time?

The estimated costs, pros and cons of the two alternatives are summarized in **Table 3-6**.

Table 3-6: Alternatives Analysis Summary

Alternative	Cost to Meet Phase II Permit Limits(1)	Pros	Cons
MBR	$508M Capital $8.5M Annual O&M	• Excellent, consistent water quality • Compact footprint • Better effluent for recycled water production in future	• Significantly higher capital costs • Higher energy costs • Limited opportunity for phasing
CAS	$337-376M(2) Capital $4.6M Annual O&M	• Familiar technology • Cost less than other option • Greater opportunity for phasing	• Larger footprint than MBRs • Extended construction period due to phasing

Notes:
(1) Excluded campus building costs.
(2) The range of capital costs reflect 3 different implementation timelines, which are discussed in Section 3.2.5.

The MBR Alternative's capital and operating costs are higher compared to CAS, making it the more expensive alternative. MBR offers excellent effluent quality. While the aeration process in both alternatives is comparable, membranes provide a physical barrier for solids removal, improving solids removal reliability. Therefore, MBR offers a superior starting point for any recycled water and/or advanced treatment process. While the existing aeration basins would be retrofitted for MBR, secondary clarifiers are not required. This means MBR's footprint is more compact. The plant's existing rectangular clarifiers would be repurposed to provide primary effluent equalization.

Implementing MBR would also sacrifice some ability to phase implementation. The newly constructed MBR would have volume sufficient to meet Phase II Permit limits. This means the plant would immediately be implementing nutrient removal, prior to permit limits being implemented by the RWQCB. The Phase I plant optimization process would be omitted.

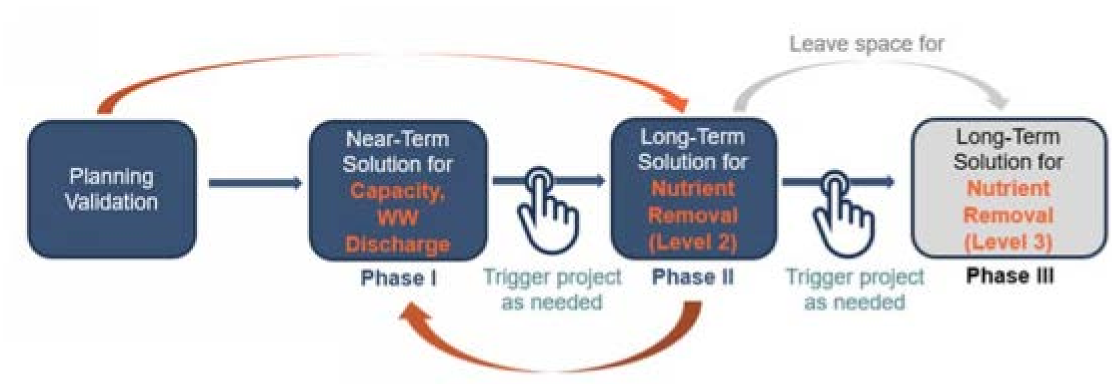
The CAS alternative offers both lower capital and operating costs. Water quality produced through a CAS process is good and would consistently meet permit limits. The use of existing infrastructure will be maximized through reconfiguring the existing aeration basins and utilization of the existing secondary clarifiers for primary effluent flow equalization. However, this flow equalization would eventually be demolished to make room for additional aeration tanks to meet Phase III permit limits. Therefore, some ability to leverage existing assets will be lost.

Another advantage of the CAS alternative is increased modularity, which allows adaptation to future flows, loads, and regulations. While requiring more total reactor volume may be a disadvantage from a footprint standpoint, the larger volume also affords USD the ability to build capacity incrementally as flows and loads dictate. This stands in contrast to MBR, where the conversion of the existing aeration basins results in excess capacity in the initial portion of the planning period. Based on this fact and the lower costs, CAS was chosen as the preferred alternative for the Secondary Treatment Process Improvements.

3.2.5 CAS Implementation Timeline Options

The Secondary Treatment Process Improvements also explored how the CAS alternative might be implemented to minimize footprint and spread capital investment over time while still providing expanded plant capacity and flexible effluent management. Triggers were identified to indicate when subsequent phases should be implemented. This process is illustrated in **Figure 3-7.**

Figure 3-7: Trigger Based Phasing of Near-Term and Long-Term Solutions



Credit: Secondary Treatment Process Improvements Project Draft Report, Hazen and Sawyer, May 2019

As presented in **Section 3.2.1**, it is recommended that the secondary improvements be implemented in three phases tied to BACWA nutrient removal levels. Hazen and Sawyer looked at three different options for CAS Implementation timelines, which they termed CAS Phasing Options. These options vary the timing of intermediate projects to achieve the near-term objectives of increasing plant capacity and improving effluent management during peak flow events. These implementation timeline options are presented along with benefits, considerations, and costs in **Table 3-7**. For a more detailed description and evaluation of the CAS Implementation Options, please refer to **Appendix B**.

Table 3-7: Summary of CAS Implementation Options, Benefits, and Considerations

Option	CAS Option 1 Clarifier Modifications and Limited Seasonal Biological Nitrogen Removal (BNR)	CAS Option 2 New Clarifiers Early and Year-round BNR	CAS Option 3 No Old Alameda Creek Discharge
Near-term Objectives	• Increase capacity • Earliest opportunity for creek discharge with limited BNR	• Increase capacity • Increased potential for discharge to Old Alameda Creek through year-round nutrient removal	• Increase capacity • Avoid creek discharge
Unit Processes Required in Addition to CAS Improvements	• Near-term Clarifier Modifications • Disk Filters	• None	• Secondary Effluent Equalization Basin
Benefits	• Achieves seasonal BNR (3 months) quickly to get to Old Alameda Creek with a gap of only 2 years • Achieves improved clarification performance (over current)	• Year round BNR • No sidestream treatment required in Phase I • Greatest TN removal • No stranded disk filters • No clarifier modifications • Better clarifier performance • New RAS control in Phase I • 2.5 MG available for PE EQ	• Simplified operation during wet weather • Storage provides flexibility for off-spec water during dry weather • Can shave daily peak flow in dry weather to reduce effluent pumping costs • EQ provides flexibility for future construction
Considerations	• Only achieves seasonal BNR • Stranded assets in disk filters and clarifier modifications • Less reliable clarifier performance until Phase II • Need sidestream treatment • O&M complexities due to two effluent qualities	• Need to move buildings delays getting to Old Alameda Creek by two additional years over CAS Option 1	• Permitting and environmental process poses additional risk • Land acquisition and restoration requirement pose additional risk • Option does not provide synergy with future nutrient removal
Total Project Costs(1)(2)(3)	**$356M**	**$337M**	**$376M**

Notes:
1. Costs are in 2019 dollars; includes 30% non-construction costs but excludes inflation.
2. Includes costs in Phase I for replacement of existing aeration blowers, odor control, electrical gear, and associated appurtenances.
3. Excluded Campus Building costs.

CAS Option 1 resulted in stranded assets including disk filters and improvements to the existing secondary clarifiers, so it was eliminated. CAS Option 3 was eliminated due to having the highest total project cost and a probable lengthy permitting and environmental review process. CAS Option 2 maximizes use of existing assets and equipment, in additional to affording better effluent quality and more reliable technology at a lower cost.

Project Costs for the preferred option, CAS Option 2, are provided in **Table 3-8**. Sequencing of implementation is further discussed in Chapter 7 – Implementation.

Table 3-8: CAS Option 2 - New Clarifiers Early and Year-round BNR Estimated Costs

Scope Item	Cost (1)
Phase I (2)	**$ 232 M**
Aeration Basin Modifications	
Effluent Facilities & EBDA Relocation	
New Secondary Clarifiers	
Plant Equalization Storage	
Phase II (3)	**$ 254 M**
New Intermediate Pump Station and Flow Splitting	
New Aeration Basin Volume (5.5 MG)	
New Blowers and Blower Building	
Sidestream Treatment	
Chemical P Removal	
Total Project Costs (4)	**$ 486 M**

Notes:

(1) Costs include inflation to midpoint of anticipated construction.
(2) Includes costs for replacement of existing aeration blowers, odor control, electrical gear, and associated appurtenances.
(3) Assumes preliminary design for Phase II improvements to begin in July 2035.
(4) Excluded Campus Building costs.

3.2.6 2040 versus Buildout

Secondary Treatment Process Improvements concentrated on the year 2040 for implementation, which equates to influent flows of 29.1 MGD AA and 33.5 M. However, buildout flows for the WWTP equates to 33 MGD AA and 37.9 MGD M, which is predicted to occur in approximately 2058.These buildout flows require additional work to accommodate these flows and loads:

- Demolition of primary effluent equalization
- Construction of Aeration Basins 13-16
- Construction of disk filters
- Carbon addition for nutrient removal

Figure 3-8: shows the plant layout at 2040, while **Figure 3-9**: show the plant layout at buildout.

Figure 3-8: CAS Layout at 2040

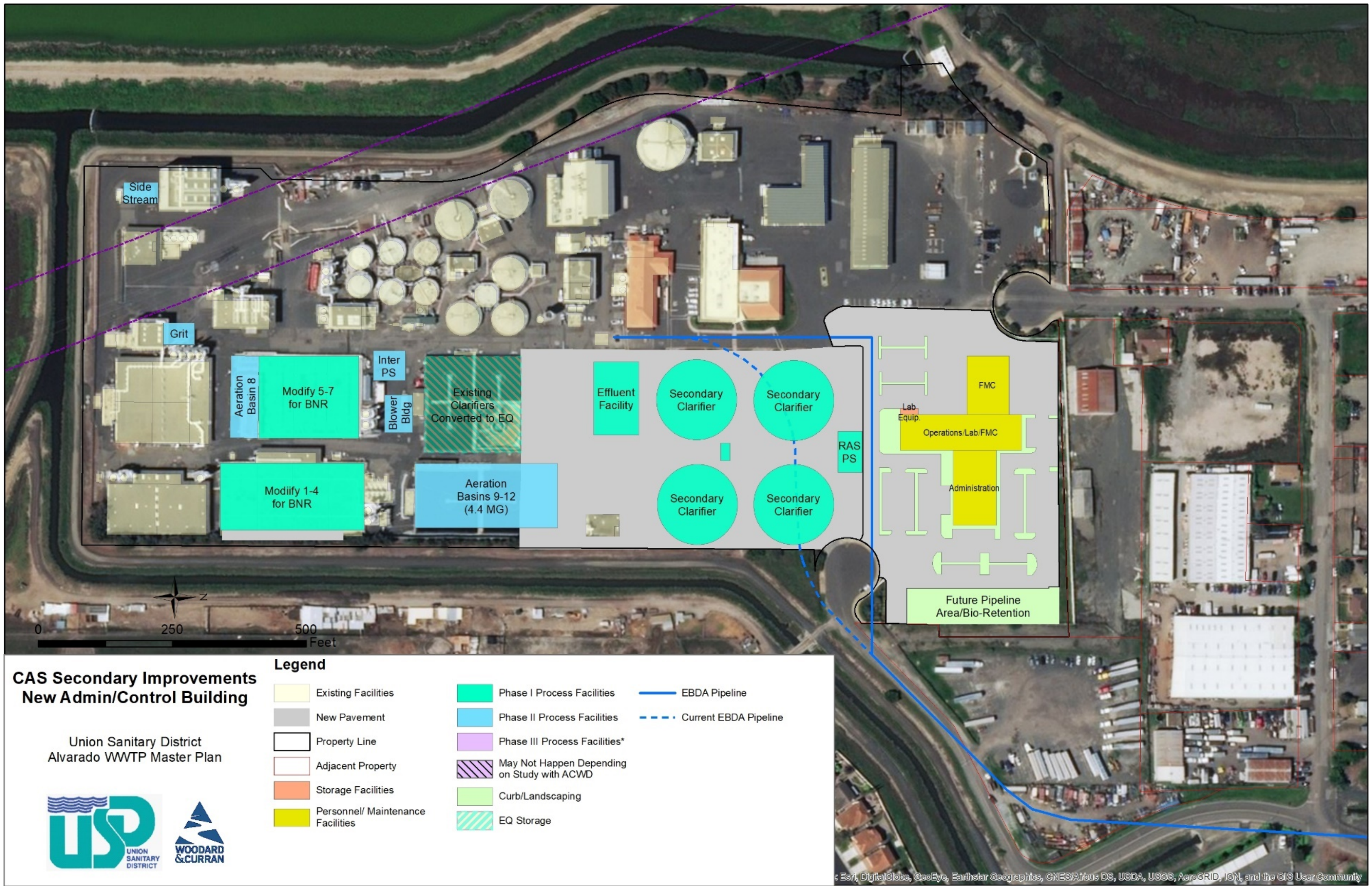
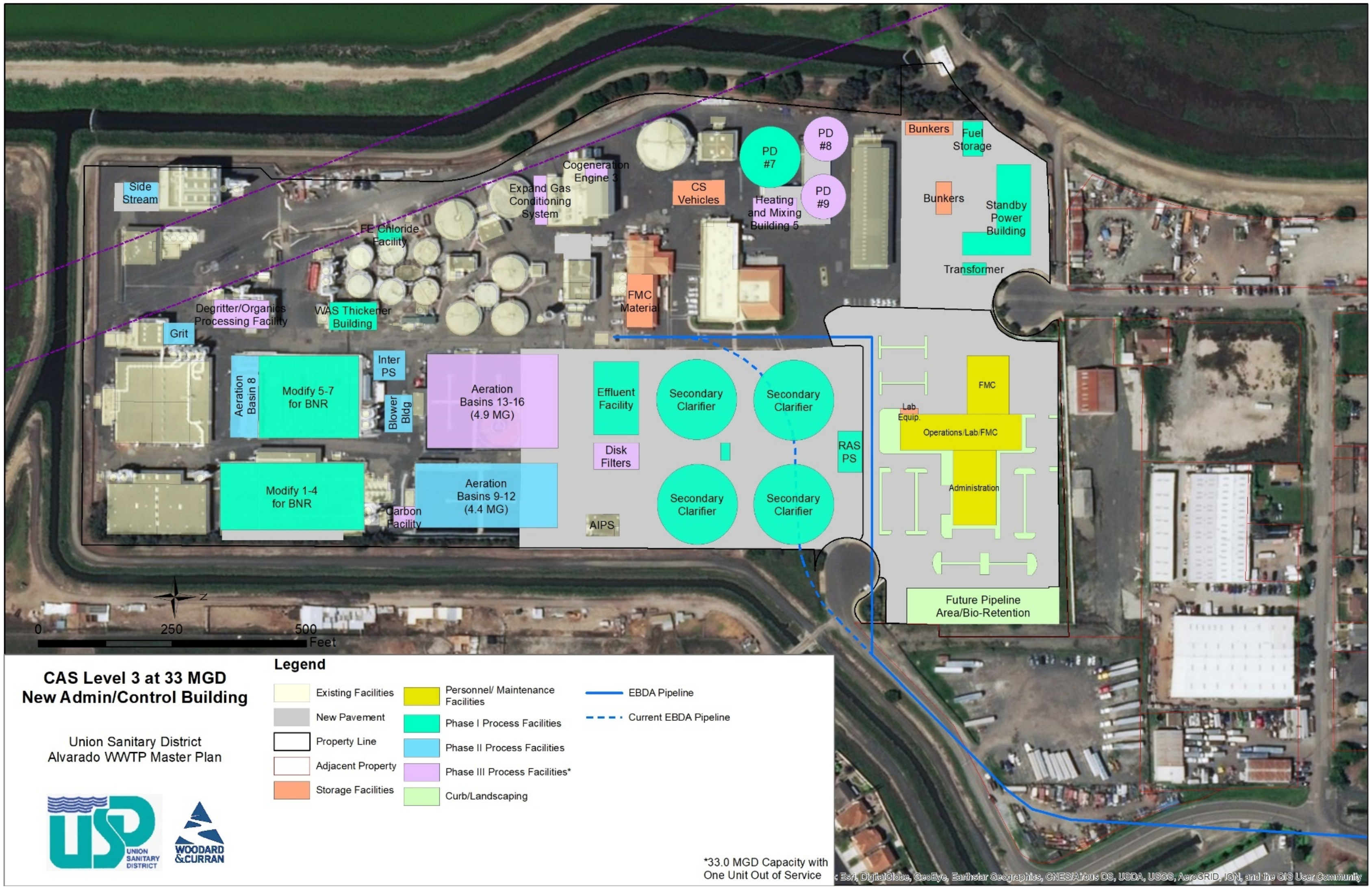


Figure 3-9: CAS layout at Buildout (2058)



Section 4

Administration and Control Buildings

4

Union Sanitary District's
Enhanced Treatment and Site Upgrade Program

4. ADMINISTRATION AND CONTROL BUILDINGS

The existing Administration Building is an obstacle to expanding the secondary treatment process. This combined with maintenance issues with the building led USD to explore options for relocation. This chapter discusses the development of the following options for upgrading or replacing the Administration and Control Buildings to determine the most viable option to pursue:

- Renovation of Existing Facilities
- Construction of New Administration and Control Building with Standalone Fabrication, Maintenance, and Construction (FMC) Building
- Construction of a New Combined Campus Building

4.1 Existing Administration and Control Buildings Renovation

Previous studies identified multiple building vulnerabilities that would require repairs at the existing Administration and Control Buildings and upgrades to the buildings necessary to address anticipated future needs of USD. These recommended repairs to the existing Administration and Control Buildings identified in these studies include seismic upgrades, mechanical, electrical, and plumbing (MEP) upgrades and building envelope repairs for water intrusion preventions. In addition to these repairs, several other improvements such to the Administration and Control Buildings are recommended to improve and optimize building space usage.

An evaluation was performed to weigh the advantages and disadvantages of retrofitting the existing Administration and Control Buildings compared to demolishing the existing Administration and Control buildings and constructing a new consolidated building. The decision to renovate the existing buildings or construct a new building will impact which treatment plant upgrade alternative will be recommended.

4.1.1 Seismic Assessment

Degenkolb Engineers performed seismic assessments of various buildings and structures for USD[1]. The findings recommended retrofitting the existing Administration Building and Control Building to mitigate seismic deficiencies. For the Administration Building, Degenkolb recommends strengthening or replacing existing braces with new buckling restrained braces, bracing existing precast concrete panels, and localized retrofits. At the Control Building, Degenkolb recommends strengthening the existing shear walls, the diaphragms and the connections at the discontinuous walls and diaphragms.

[1] Degenkolb Engineers Detailed Seismic Assessments & Conceptual Strengthening Schemes, (April 22, 2016)

4.1.2 Administration Building Envelope Repair

The Administration Building has experienced ongoing water intrusion during rain events. It was assumed that the building envelope would be repaired by removing and replacing the cladding components as part of Administration Building retrofit evaluation. The storefront windows at sill locations should also be replaced to direct water away from the structure.

Figure 4-1: Water Intrusion at Existing Administration Building

4.1.3 Mechanical and Electrical Upgrades

An evaluation of the mechanical, electrical, plumbing and fire protection (MEP/FP) systems at the Administration Building and Control Building was performed by PAE[1]. In the Administration Building, most existing MEP/FP equipment were installed in 1999 when the Administration Building was constructed. Based on visual inspection, the equipment appears to be in fair condition, but needing immediate upgrade. Certain equipment does not meet current building standards and HVAC thermal comfort issues were reported in the building due to poor balancing of air flow. The following upgrades for the MEP/FP systems are recommended in the Administration Building:

- New HVAC system including new AC units, control system, boilers and ductwork
- New LED lighting and controls
- New plumbing fixtures, some new plumbing distribution
- New electrical distribution equipment
- New fire alarm lateral pipe, sprinkler and front-end devices

Figure 4-2: Existing HVAC Unit at Administration Building

[1] USD Admin Building MEP/FP Due Diligence Report, PAE February 16, 2017 and USD Control/Operations Building MEP/FP Due Diligence Report, PAE March 16, 2017

The evaluation of the Control Building showed that laboratory plumbing equipment requires replacement and that the HVAC equipment is not code-compliant to the latest laboratory exhaust design and energy efficiency standards. The following upgrades for the MEP/FP systems are recommended in the Control Building:

- New HVAC system including new AC units, control system, boilers and ductwork
- New LED lighting and controls
- New plumbing fixtures, plumbing distribution and water heater
- New electrical distribution equipment to affected spaces and new mechanical
- New fire alarm lateral pipe, sprinkler and front-end devices to affected areas

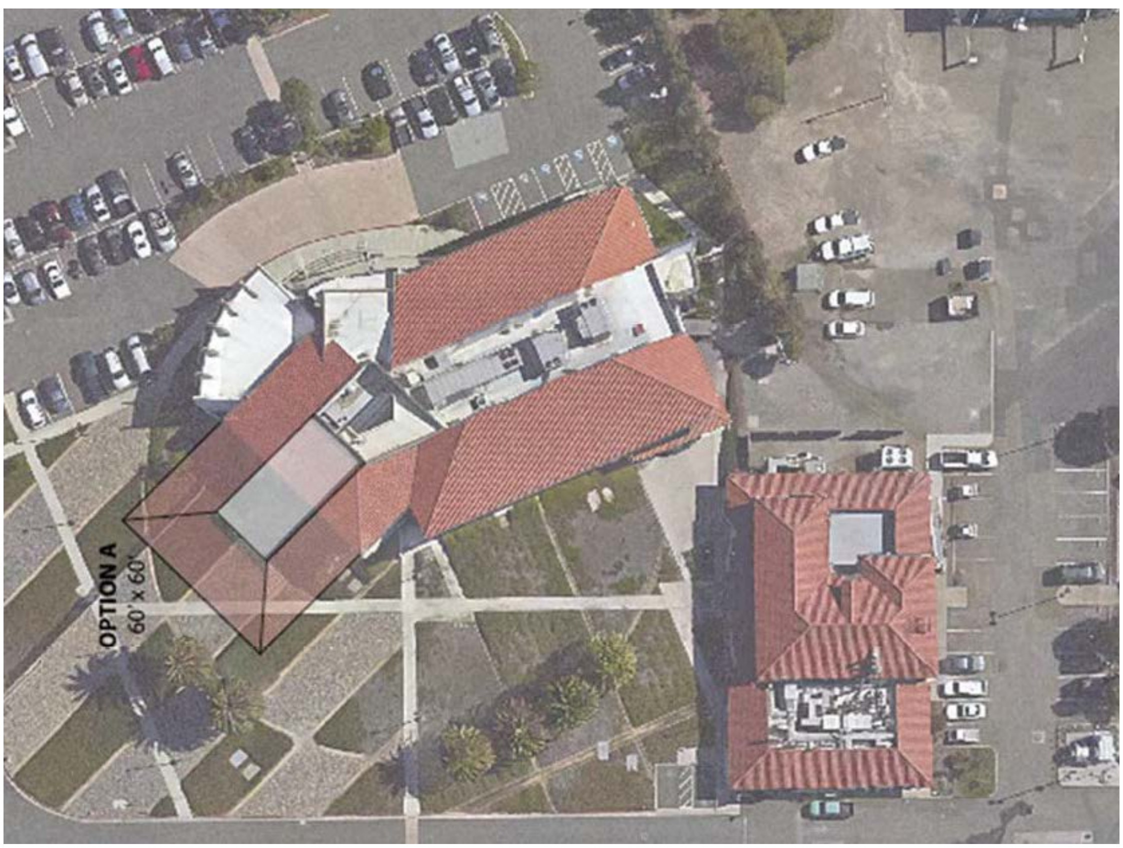
Figure 4-3: Existing HVAC equipment at Control Building

4.1.4 Administration Building Space Needs

The existing Administration Building does not have adequate space for staff or new functions. Siegel & Strain Architects[1] performed a spatial program study for the existing Administration Building and provided three options for a building addition to address the future space needs. If the Administration Building is retrofitted, a two-story addition at the north side of the building is recommended to provide USD with adequate space for anticipated future needs. The conceptual addition would total 7,000 SF (3,500 SF per floor) and would provide additional conference rooms, future staff space and additional staff support space.

Additional work including bathroom expansion/relocation, internal partition relocation and rehabilitation of Boardroom and front counter are also recommended to improve space usage in the Administration Building.

Figure 4-4: Recommended addition to Administration Building



[1] Three Building Program, Siegel & Strain, April 5, 2016.

4.1.5 Control/OPS Building Space Needs

The existing Control/Operations Building currently contains laboratory space, office space, locker rooms and showers on the first floor; and Control room, Operations hub, office space, break room that doubles as a conference room and open-air terrace on the second floor. The existing laboratory space is insufficient. The following renovations are recommended to optimize space use in the Control Building[1]:

- Reconfigure lab office to lab space
- Create new lab office space at first floor
- Enclose existing deck space to become usable interior area
- Reconfigure crew break room to accommodate smaller break room and additional office space.
- Relocate office and meeting space to expanded second floor
- Add elevator and elevator machine room

4.1.6 Interior Finishes

Updates to the interior finishes are also recommended to be performed with the above recommended upgrades to the Administration and the Control/Operations Buildings. In both buildings, new paint, flooring, and ceiling grids are recommended. At the Control Building, new laboratory casework at lab expansion spaces, new partitions, doors, windows, and finishes at second floor expansion. The second-floor restrooms would also require updates to meet accessibility requirements including all new fixtures and finishes.

4.1.7 Surge Space

While the existing buildings undergo renovations, surge space will be required to temporarily house employees and equipment. An allowance is added to the total renovations costs to account for required surge space and moving costs.

[1] Existing Building Evaluation and Master Plan, Burks Toma, March 16, 2017.

4.2 New Building Construction

Due to the extensive repairs and upgrades that will be required to bring the existing buildings up to code and meet USD's long-term space needs, the feasibility of demolishing the existing Administration and Control Buildings and constructing new buildings in a new location north of the existing buildings was evaluated. Constructing new Administration and Control Buildings would allow USD more flexibility for future treatment process expansion by creating space for a continuous process layout. Two new building alternatives were evaluated, the first with a combined Administration and Control Building with a Standalone FMC building and the second alternative with a new building campus.

4.2.1 New Combined Administration and Control Building with Standalone FMC Building

The first new buildings alternative assumed a new combined Administration/Control building and a separate FMC building. The footprint of the new three-story Administration and Control Building was estimated to be 41,900 SF which is the combined square footage of the existing Administration (23,600 SF) and Control (11,300 SF) Buildings and the 7,000 SF addition for the Administration Building extension. Each story of the Admin/Control Building is approximately 15,000 SF. The new FMC building is estimated at 15,300 SF which is based on the Siegel Strain FMC programming work. New landscaping and site improvements would be required to accommodate this alternative.

4.2.2 New Campus Building

The new Campus Building alternative evaluated the option to locate the Administration, Control, and FMC building functions in a group of adjacent buildings. This option would allow employees in each of the buildings to share facilities such as parking, elevators, stairs, restrooms, locker rooms, and staff entries. This alternative would also allow internal access to different functional spaces.

As part of the evaluation of the campus alternative, an illustrative refined space programming was developed. The overall footprint of the building is 50,463 SF of office space and 8,940 SF of high-bay FMC shop space. The breakdown in space is summarized in **Table 4-1**.

Table 4-1: Campus Alternative Footprint Summary

<table>
<tr><th></th><th>Space</th><th colspan="2">Gross Area
(SF)</th></tr>
<tr><td rowspan="3">First Floor</td><td>High-Bay Shop Space</td><td colspan="2">8,940</td></tr>
<tr><td>Administration</td><td>10,169</td><td rowspan="2">25,574</td></tr>
<tr><td>FMC/OPS/Shared</td><td>15,405</td></tr>
<tr><td rowspan="2">Second Floor</td><td>Administration</td><td>11,882</td><td rowspan="2">24,993</td></tr>
<tr><td>FMC/OPS/Shared</td><td>13,111</td></tr>
</table>

The preliminary campus layout is comprised of a high-bay shop space for FMC, a combined Operations/Lab/FMC office Building and an Administration Building and is shown in **Figure 4-5** through **Figure 4-7**. The site layout is configured to provide separate public and employee entrances and parking areas and also to provide adequate turn radius for FMC vehicles.

Figure 4-5: Recommended Campus Site Layout

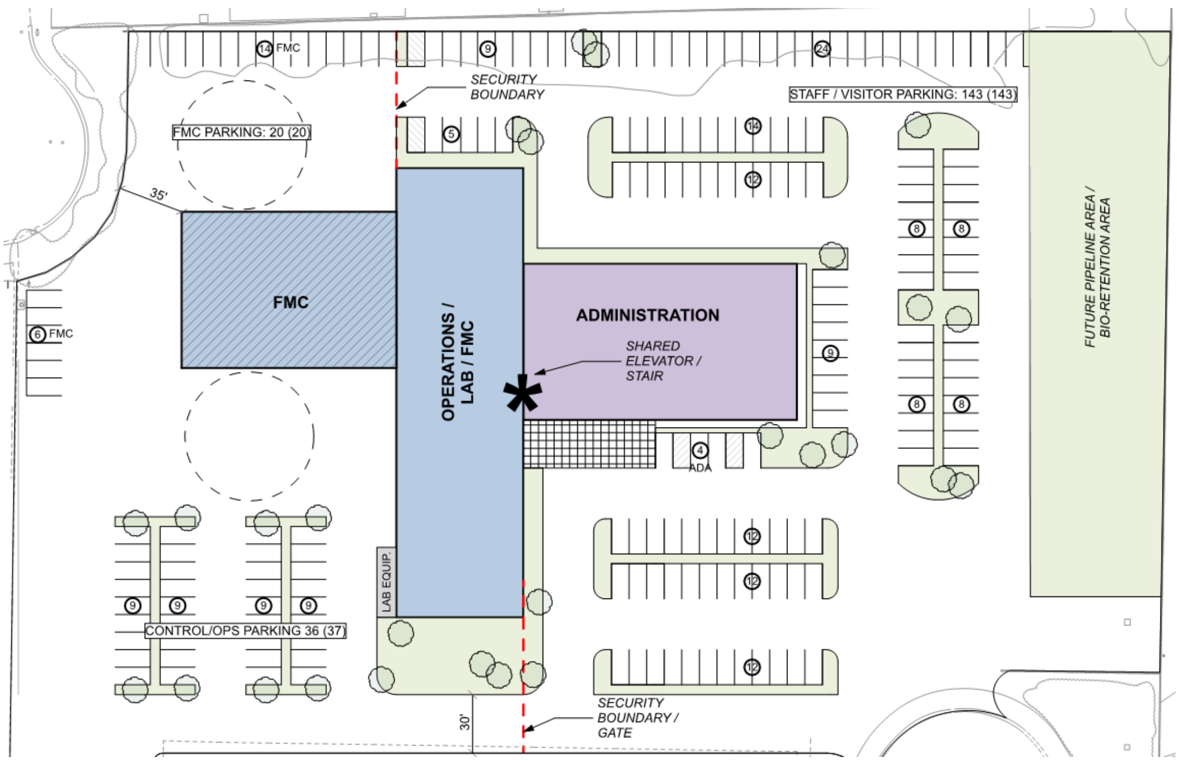


Figure 4-6: Campus Site Program First Floor

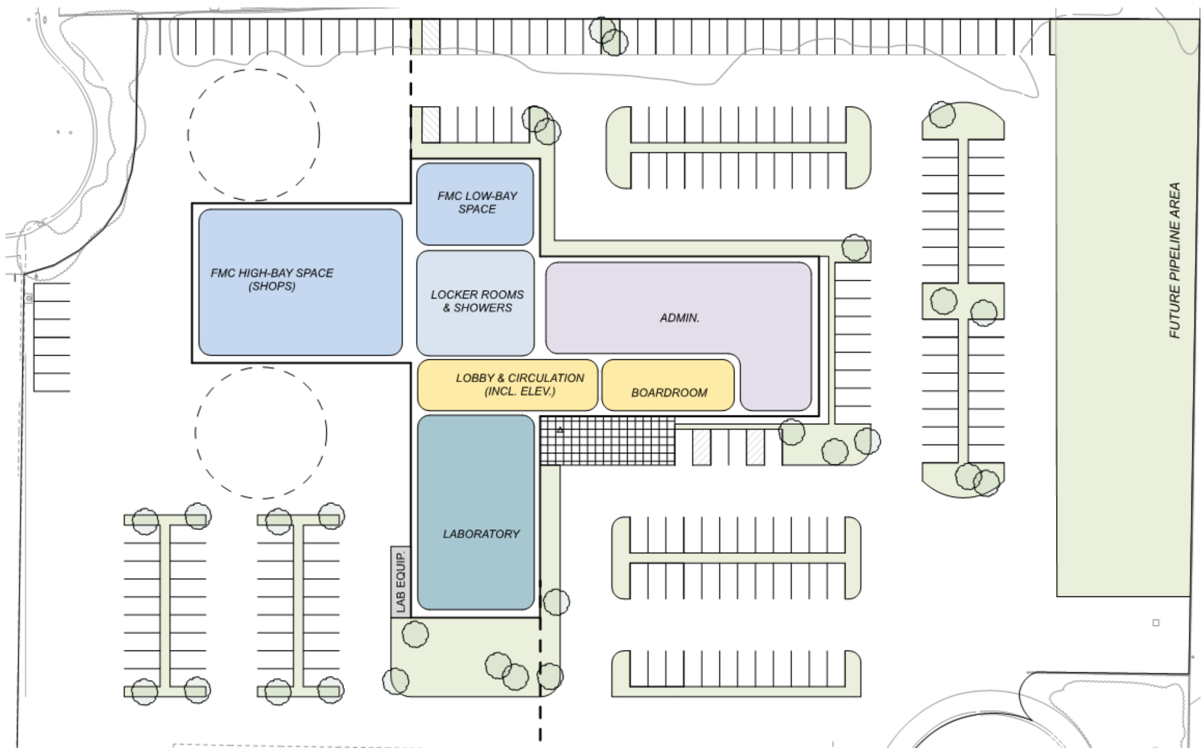
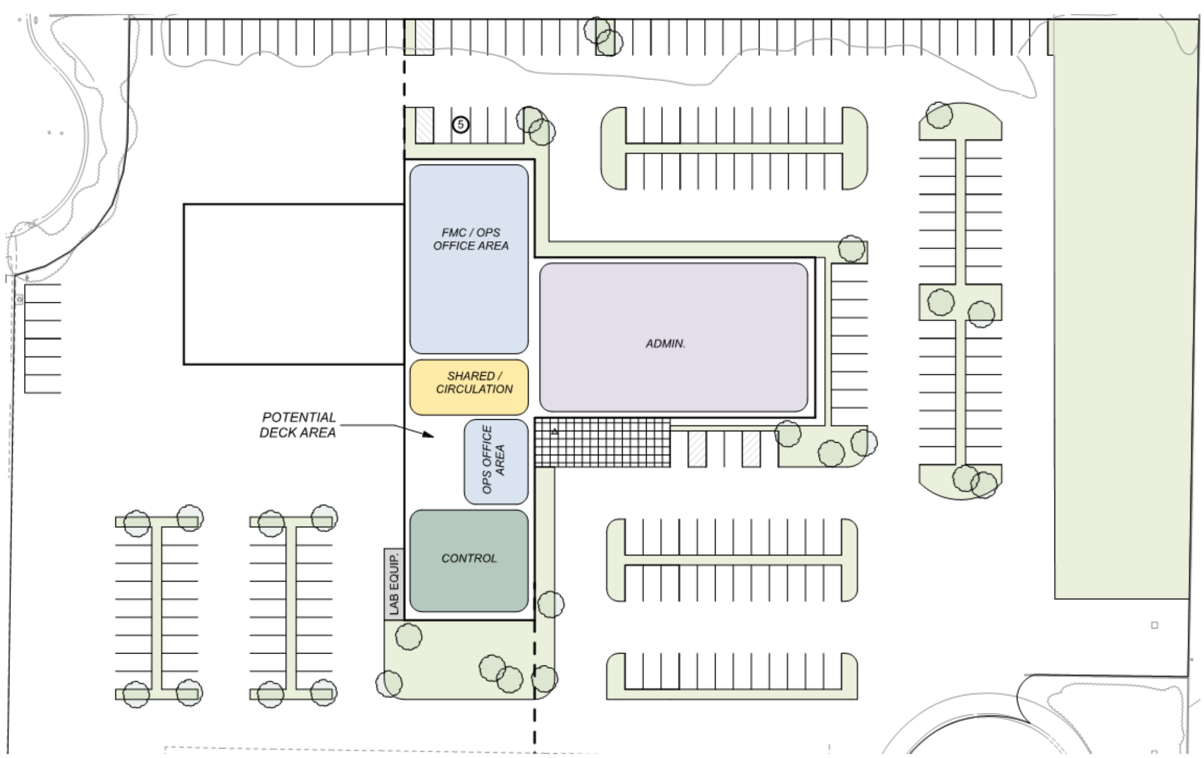


Figure 4-7: Campus Site Program Second Floor



4.3 Summary of Alternatives

The scope of existing building renovation and new building construction is summarized in **Table 4-2**.

Table 4-2: Summary of Scope for Building Renovation and New Construction

Alternative	Scope	Recommended
Retrofit Existing Administration and Control Building	Administration Building Renovation	• Seismic retrofit • MEP upgrades • Building envelope repair • 7,000 SF addition • Update interior finishes
	Control Building Renovation	• Seismic retrofit • MEP upgrades • Additional lab space • Enclose patio • Break area renovation • ADA accessibility • Update interior finishes
	New FMC	15,300 SF (High-Bay Space 8,300 SF, Low Bay Space 7,000 SF)
New Combined Admin and Control Building and Standalone FMC	New Administration and Control Building	Total footprint 41,900 SF
	New FMC	15,300 SF (High-Bay Space 8,300 SF, Low Bay Space 7,000 SF)
New Campus Building	New Administration, Control and FMC Combine Campus	Admin/Control/FMC 50,463 SF High-Bay Shop Space 8,940 SF

4.4 Estimated Cost Comparison of Building Alternatives

Construction costs were estimated for renovating the existing Administration and Control Buildings and for constructing a new combined Campus Building by TBD Consultants[1]. All costs were escalated to March 2019 dollars. The salvage value after 20 years of each option was incorporated to determine the present value of the buildings.

The estimated costs for three alternatives: 1) renovating existing buildings; 2) construction of a combined Administration and Control Building; and 3) Campus Building alternative, are summarized in **Table 4-3** and **Table 4-4**, respectively.

Table 4-3: Estimated Construction and Life Cycle Cost Summary of Existing Building Renovation

Existing Administration and Control Building Remodel & Retrofit	Costs (1)
Admin Building Renovation	$10.2M
Admin Exterior Skin Upgrade	$1.2M
Admin Building Extension (7,000 SF)	$5.8M
Control Building Renovation	$10.0M
New FMC Building w/ Site Improvements	$12.2M
Surge Costs	$3.2M
Total Construction Cost (2)	**$42.6M**
Salvage Value after 20 yrs. (FMC only)	-$2.8M
20 yrs. O&M PV @ 3%	$4.3M
REHABILITATION TOTAL PRESENT VALUE	**$44.1M**

Notes:
1. March 2019 costs; except new FMC Building estimated by escalating 17.5% from May 2017.
2. Includes seismic, MEP, interior refinishing, and all other building improvements.

[1] New Administration, Ops/Lab and FMC Facility, Burks Toma/TBD Consultants, March 2019

Table 4-4: Estimated Capital and Life Cycle Cost Summary of Separate Administration, Control and FMC Buildings and Campus Building Alternative

New Buildings vs. Campus Building Alternative	Separate Admin, Control and FMC Buildings (1,3)	Campus Building Alternative (3)
New Building Construction Cost	41.6M	$44.1M
Site Improvements (2)	$5.0M	$5.0M
Total Construction Cost	**$46.6M**	**$49.1M**
Salvage Value after 20 yrs. (PV @ 3%)	-$11.5M	-$12.2M
NEW BUILDINGS TOTAL PRESENT VALUE	**$35.1M**	**$36.9M**

Notes:
1. Does not include 10% bidding contingency.
2. Includes demo of existing Admin, Control buildings, site improvements, utilities work.
3. March 2019 costs; except new FMC Building estimated by escalating 17.5% from May 2017.

4.5 Recommended Building Alternative and Construction Cost

Rehabilitating existing facilities would require significantly more capital cost than building new facilities, due to extensive renovations required for seismic retrofit, repair of existing buildings, and expansion. Of the two new building alternatives, the Campus Building alternative provides the smallest building footprint at small additional expense compared to the separate building concept. Therefore, the campus alternative is recommended for construction. Total project costs for this alternative are estimated at $72.4M as listed in **Table 4-5**.

Table 4-5: Estimated Project Cost of Campus Alternative

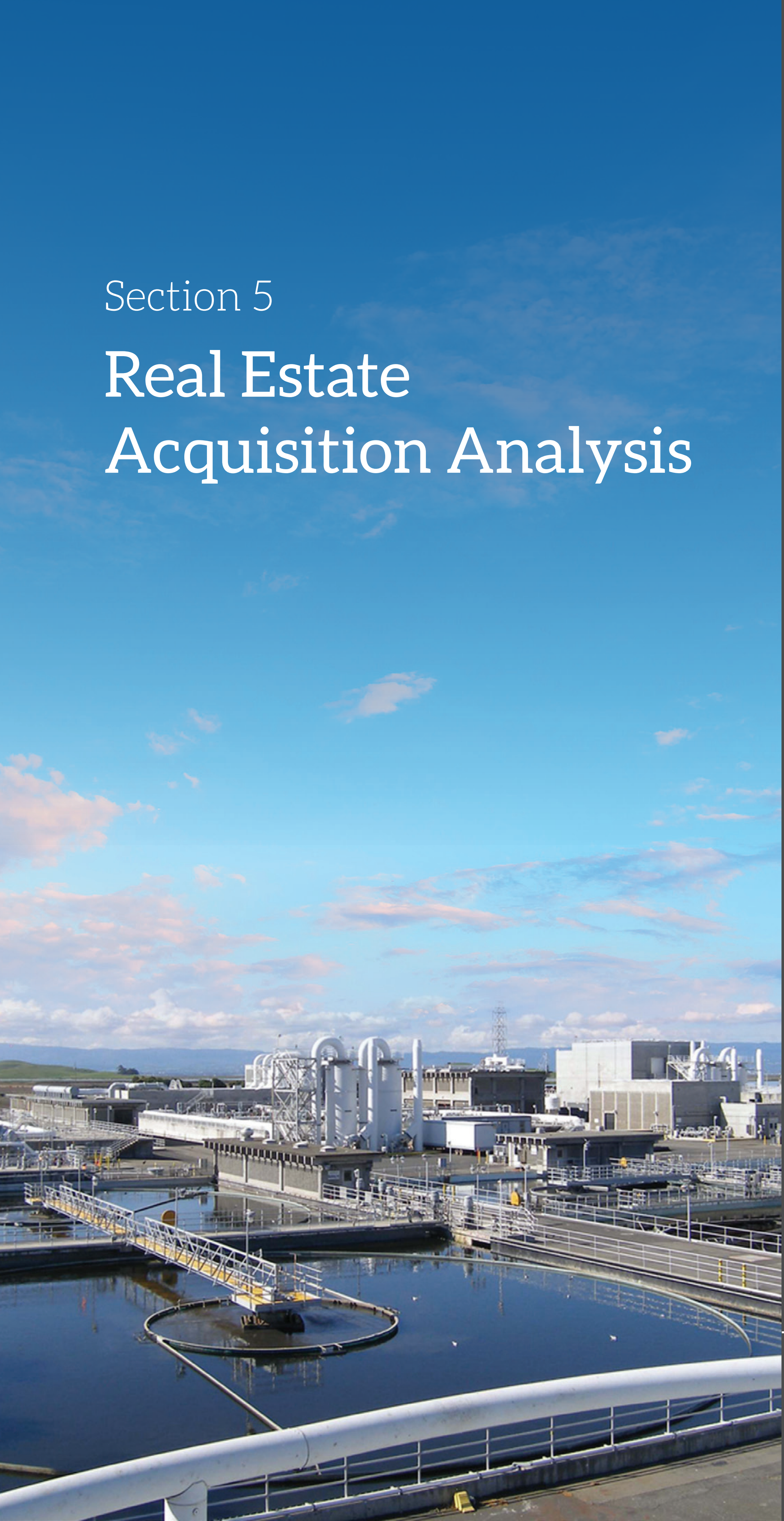
New Buildings/Campus Alternative	Costs
Total Construction Cost (1)	$49.1 M
Solar Panels (optional)	$2.0 M
Implementation Cost (Design, Permitting, ESDC, CM) (30%)	$15.3 M
Inflation (midpoint of construction)	$6.0 M
TOTAL PROJECT COST	**$72.4 M**

Notes:
1. March 2019 costs; except new FMC Building estimated by escalating 17.5% from May 2017.

Section 5

Real Estate Acquisition Analysis

5



Union Sanitary District's
Enhanced Treatment and Site Upgrade Program

5. REAL ESTATE ACQUISITION ANALYSIS

To address the District's real estate needs to accommodate future facility needs, analysis of nearby parcels was performed and a plan to appraise, acquire and relocate the properties was considered. The details of this work are presented in **Appendix D**, but the highlights are presented in this report.

As part of the Site Use Study, a preliminary Land Evaluation was performed by PPC Land Consultants (PPC)[1] to examine zoning, redevelopment plans, environmental and title reports, and fence line evaluations of immediate parcels surrounding the WWTP.

A Real Estate Acquisition analysis of parcels surrounding the WWTP was subsequently performed by Overland, Pacific and Cutler, Inc. (OPC) to expand upon the work completed by PPC. Analysis by OPC included market data research, property owner outreach, acquisition cost estimates, identifying all applicable regulatory compliance issues, staffing functions, approval procedures, document controls, and schedule and cost controls. A preliminary Real Estate Acquisition Management Plan (RAMP)[2] was prepared by OPC that documents the real estate needs, practices and procedures for the Program.

Subsequent to the initial analysis of the 17 parcels immediately north and northeast of the WWTP, USD identified nine additional parcels of interest tracts further north of the WWTP. OPC performed a title report search of these nine parcels.

5.1 Owner Outreach on Parcels of Interest

OPC conducted owner outreach to discuss owners' interest in selling 17 tracts of interest directly north of the WWTP. The 17 tracts are currently owned by 13 different parties. OPC attempted to contact each of the property owners through letters, phone calls, and in-person site visits throughout April to October 2017. As of October 8, 2017, contact was made with 10 owners and 3 owners were not responsive. The responses from owners have been sorted into 5 categories- Responsive, Non-Responsive, Unwilling to Sell, Willing to Sell and Willing to Consider Property Exchanges. Responsive owners have responded to attempts to contact them and have indicated a willingness for future meetings but have not provided an answer on whether they are willing to sell. Non-Responsive owners have not responded after multiple attempts to contact them. A summary of owner and property information and results from owner outreach activities is presented in **Table 5-1**. A map of the tracts is shown on **Figure 5-1**. The five Technical Memos documenting the results of the owner outreach activities are provided in **Appendix E**.

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[1] Union Sanitary District Alvarado Wastewater Treatment Plant Expansion Land Analysis, PPC Land Consultants, October 15, 2014.

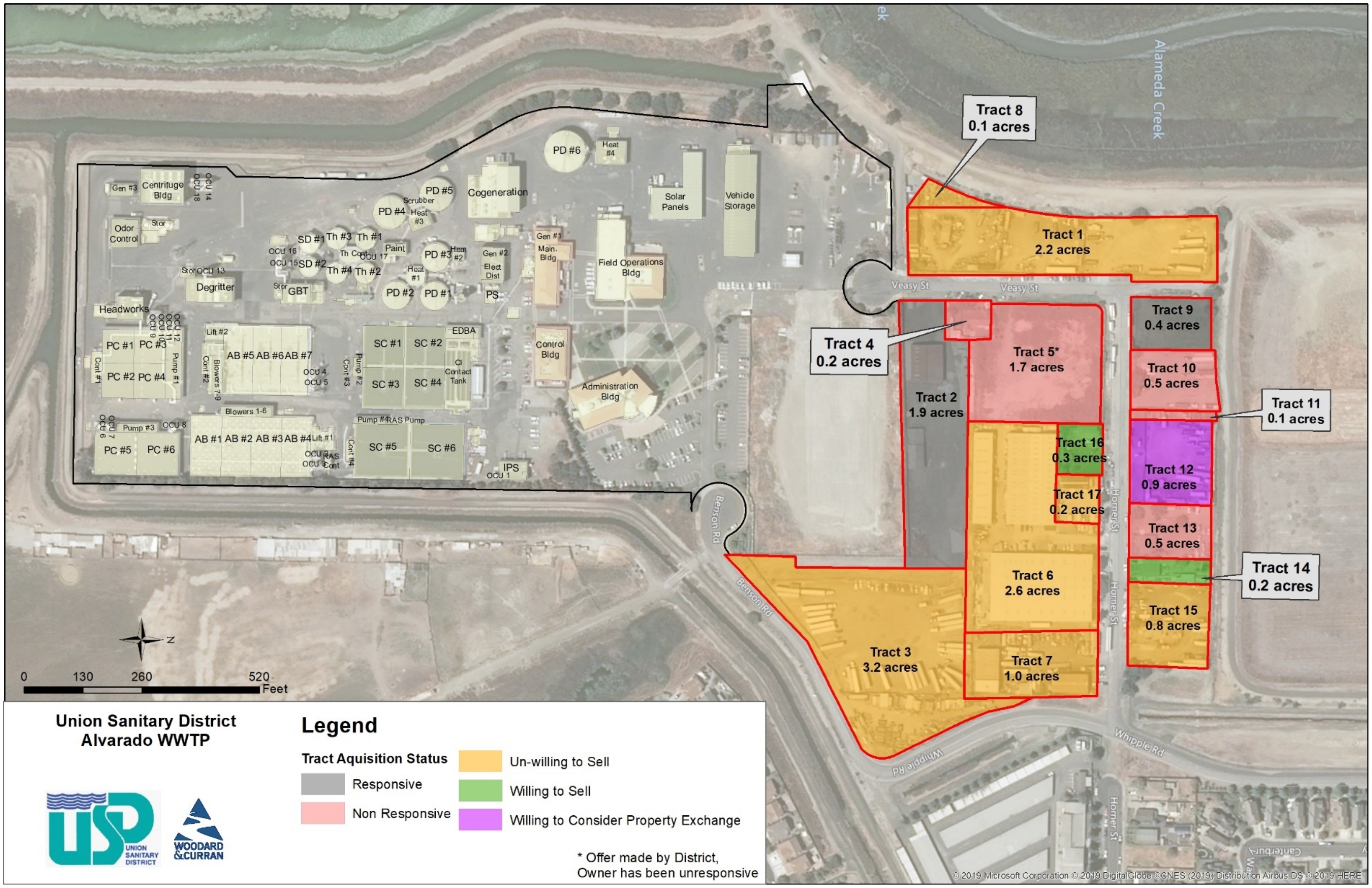
[2] Real Estate Acquisition Management Plan, Overland, Pacific and Cutler, Inc., October 2017.

As described indicated on in the WWTP Site Use Study, Tracts 2 and 3 are the primary parcels of interest for site expansion. The owner of Tract 3 made himself available for a phone conversation and indicated that they are not interested the selling the property and declined further meetings and discussions.

Table 5-1: Tract Owner Outreach Summary

Tract	APN	Ownership	Outreach Result
1	482-22-1-2/482-22-7/ 482-22-9-1	Ken Bertelson	Unwilling to Sell
2	482-27-4-3	Shri Guru Ravidas Sabha Bay Area	Responsive
3	482-27-7-19	Tony Goncalves	Unwilling to Sell
4	482-27-6-1	Miguel Ramirez	Non-Responsive
5	482-27-13	Promax Investment 385 LLC	Non-Responsive
6	482-27-3-3	UMO Steel	Unwilling to Sell
7	482-27-1-10/ 482-20-18	Maninder Pattar	Unwilling to Sell
8		Ken Bertelson	Unwilling to Sell
9	482-20-9	Union City Redevelopment Agency	Responsive
10	482-20-8-2	Donald and Barbara Kirby	Non-Responsive
11	482-20-2-3	Donald and Barbara Kirby	Non-Responsive
12	482-20-7	Allan Williams	Willing to consider exchange
13	482-20-6	Patrick Barrera	Non-Responsive
14	482-20-5	Roland Marcelo	Willing to Sell
15	482-20-18	Maninder Pattar	Unwilling to Sell
16	487-27-2	Frank Perez	Willing to Sell
17	482-27-14	UMO Steel	Unwilling to Sell

Figure 5-1: Property Map



5.2 Title Search on Parcels of Interest to North of WWTP

Subsequent to the initial analysis of the 17 parcels immediately north and northeast of the WWTP, USD identified nine additional parcels of interest tracts further north of the WWTP. OPC performed a title report search of these nine parcels from November to December of 2018 to determine the feasibility of acquiring these parcels. These parcels are shown on **Figure 5-2**. The results of the title search are summarized in **Table 5-2**.

From the title search, Tracts 2, 3, 4 and 5 are zoned and permitted for agricultural use and are protected under wetlands designation. Tracts 3, 4 and 6 are also owned by the Alameda County Flood Control District (ACFCD). Lands controlled by ACFCD would likely require federal and state regulatory permits from multiple agencies prior to construction. These agencies potentially include the U.S. Army Corps of Engineers (USACE, San Francisco District), the Federal Emergency Management Agency (FEMA), the Natural Resources Conservation Service, the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration (NOAA), and the U. S. Geological Survey (USGS). Due to restrictions on land development for designated wetlands and additional permits required further research and evaluation of these parcels was not conducted.

5.3 Real Estate Recommendations

A real estate acquisition management plan was not developed further.

Table 5-2: Title Search Result Summary for Parcels North of WWTP

Tract	APN	Owner Name(s)	Zoning and Permitted Use
1	482-0096-007 482-0096-008	RREFF America REIT II, Columbia, MD	Light Industrial
2	482-0096-018 482-0096-019	RREFF America REIT II, Columbia, MD	Agriculture, Wetland Designation
3	482-0005-011-03 482-0020-019-05	Alameda County Flood Control District	Agriculture, Wetland Designation
4	482-0020-019-05	Alameda County Flood Control District	Agriculture, Wetland Designation
5	482-0080-003 482-0090-003 492-0095-003	State of California	Agriculture, Wetland Designation
6	482-0022-006-05	Alameda County Flood Control District	Light Industrial
7	482-0022-009-01 482-0022-001-02 482-0022-009-007	Bertelson Pre Cast Steps, Inc.	Light Industrial

In conclusion, the programming team determined that the unavailability of adjacent parcels in the immediate term has incentivized the development of facilities that can fit within USD's current footprint for the WWTP within the 2040 timeframe, and potentially to buildout, using the approach to treatment process technology presented in this ETSU Program.

Figure 5-2: Property Map of Parcels North of WWTP

Section 6

Near-Term Facility Needs

6

Union Sanitary District's
Enhanced Treatment and Site Upgrade Program

6. NEAR-TERM FACILITY NEEDS

USD is pursuing a phased approach to secondary treatment improvements as identified in the Secondary Treatment Process Improvements Report (*Hazen and Sawyer, August 2019,* ***Appendix B***). Phase I of the recommended improvements would address capacity limitations and imminent effluent management restrictions (specifically the closing of Hayward Marsh) and are intended to be completed by the end of fiscal year 2026. Therefore, improvements to be implemented in the near-term, within the next 5-10 years, include these Phase I improvements as well as additional projects that have been identified in other studies to be completed within this time period.

6.1 Secondary Treatment Process Improvements

Phase I of the secondary treatment improvements achieves the near-term facility needs of increasing plant capacity and potential discharge to Old Alameda Creek through year-round nutrient removal. The scope of these improvements is listed in **Table 6-1**. The total project cost of these improvements is estimated at $155M.

Table 6-1: Phase I Secondary Treatment Process Improvements

Project	Description	Costs [1,2,3]
Aeration Basin Modifications	Retrofit existing Aeration Basins 1 through 7 to operate as a biological nutrient removal (BNR) process. Project includes constructing deoxygenation and anoxic zones, internal recycle pumps, and modifications to facilitate step feed operation and surface wasting.	$44M
Effluent Facilities	Construction of chlorination/dechlorination basins, effluent pump station, Old Alameda Creek pump station, relocate EBDA force main	$32M
Secondary Clarifiers	Construction of four new 155-foot diameter secondary clarifiers, mixed liquor control box, centralized RAS pump station	$67M
Plant Equalization Storage	Retrofit existing Secondary Clarifiers 1 through 4 to operate as a 2.5 MG primary effluent equalization basin	$12M
TOTAL PROJECT COST		**$155M**

Notes:
1. Costs are in 2019 dollars.
2. Includes costs for replacement of existing aeration blowers, odor control, electrical gear, and associated appurtenances.
3. USD CIP costs are higher and include inflation to midpoint of anticipated construction.

6.2 New Campus Building

This project consists of construction of a new Campus Building the combines the Administration, Operations/Lab, and FMC buildings, as well as the demolition of existing structures in this area. Total project cost is estimated at $66.4M. This project will have to be completed before the construction of new secondary clarifiers to make the space of existing administration buildings available.

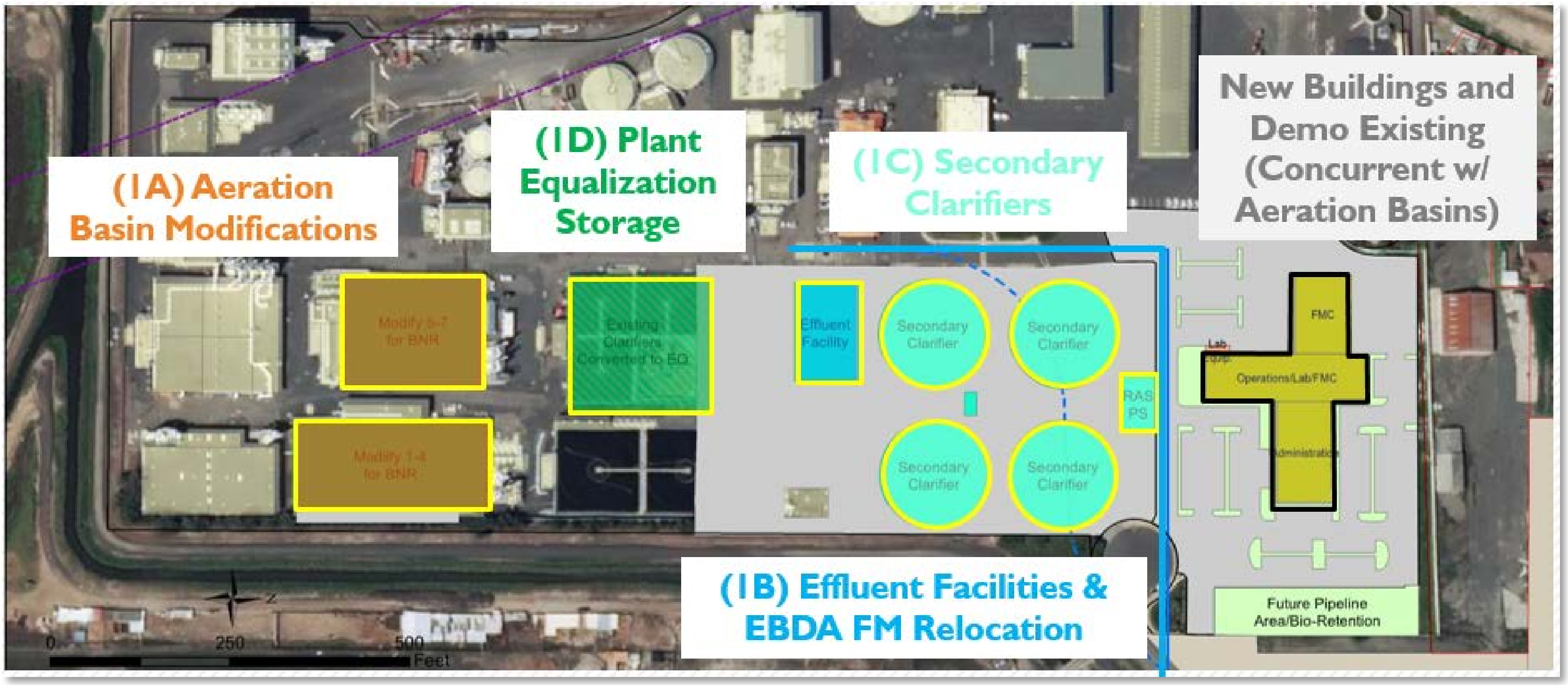
Table 6-2: New Campus Building – Estimated Costs

Project	Description	Costs [1,2]
New Campus Building	Consolidated Administration, Operations/Lab, and FMC Building. Demolition of Existing Structures.	$49.0M
Solar Panels (optional)	Construction and Implementation	$2.0M
Implementation Cost	Design, Permitting, ESDC, and CM at 30%	$15.3M
TOTAL PROJECT COST		**$66.4M**

Notes:
1) Costs are in 2019 dollars.
2) USD CIP cost includes inflation to midpoint of construction, and is presented as $72.4 M.

Figure 6-1 shows the scope of the Near-Term Secondary Treatment Process and Campus Building Improvements.

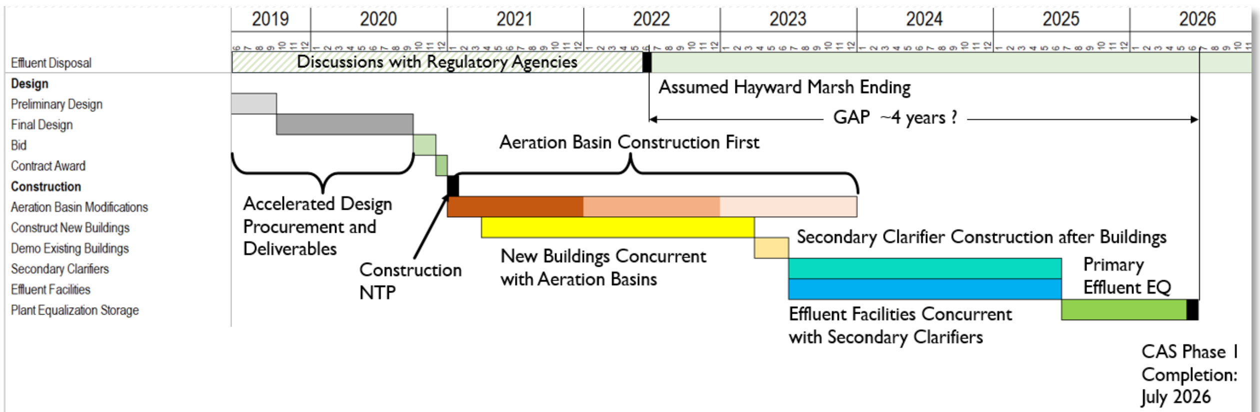
Figure 6-1: Layout of Phase I Facilities and Buildings



6.3 Sequence of Construction

Sequence of construction for near term projects associated with Secondary Treatment Process Improvements and Campus Building are shown in **Figure 6-2**.

Figure 6-2: Phase 1 Secondary Treatment Process Improvements and New Campus Building Schedule



These projects are to address immediate needs to address secondary process performance and wet weather effluent management. Therefore, it is recommended to initiate the design process in the 3rd quarter of 2019, with the first components to be addressed being concurrent construction of aeration basin improvements (the 3 colors denote the phases of retrofit of the east basins, the west basins, and the common facilities because each bank of basins needs remain in operation while the other is retrofitted) and construction of the new campus of buildings to house administration, laboratory, and FMC facilities. The campus requires construction to relocate these facilities prior to demolition of existing buildings for secondary clarifiers. Effluent facilities can be built concurrently with secondary clarifiers, with the last component (primary effluent equalization) completed in July 2026.

This leaves a gap of approximately 4 years from the assumed closure of the Hayward Marsh effluent disposal option to the ability for USD to discharge to Old Alameda Creek during wet weather. Three options have been discussed as stop-gap measures, although at this time the preferred stop-gap measure has not been identified. These measures include:

1. Continuing a to use portion of the Hayward Marsh pond system for temporary secondary effluent storage until hydraulic capacity in the EBDA line becomes available.
2. Installing treatment facilities on the Old Alameda Creek Discharge to chemically remove ammonia.
3. Entering into an agreement with the RWQCB that would grant a temporary exception to water quality standards on the Old Alameda Creek discharge that would solidify the timing of the secondary treatment improvements.

Section 7

Implementation

7

Union Sanitary District's
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7. IMPLEMENTATION

The Secondary Treatment Process Improvements were proposed to provide a phased approach in order to meet both near-term and future challenges posed by capacity limitations, future nutrient removal, and effluent discharge. This phased approach maximizes the value of existing assets by rehabilitating those that can readily accommodate reuse and allows for initiation of improvements based on trigger points as discussed in this section.

7.1 Implementation Plan

Figure 7-1 provides the roadmap for implementation of USD's ETSU Program. The key trigger points that will drive when projects need to occur or need to be accelerated are:

- Phase out of Hayward Marsh as shallow water discharge during wet weather; this trigger is imminent
- SB1383 restriction on organics/biosolids disposal that will drive organics processing
- ACWD and potential regional (SFPUC and others) needs for advanced water treatment of Recycled Water
- BACWA Level 2 and Level 3 Benchmarks, and potential future Nutrient Limits
- Additional power needs driven by plant expansion
- Sea-level rise; this is currently not captured as a trigger, but expansions are planned leaving room for expanded levees.

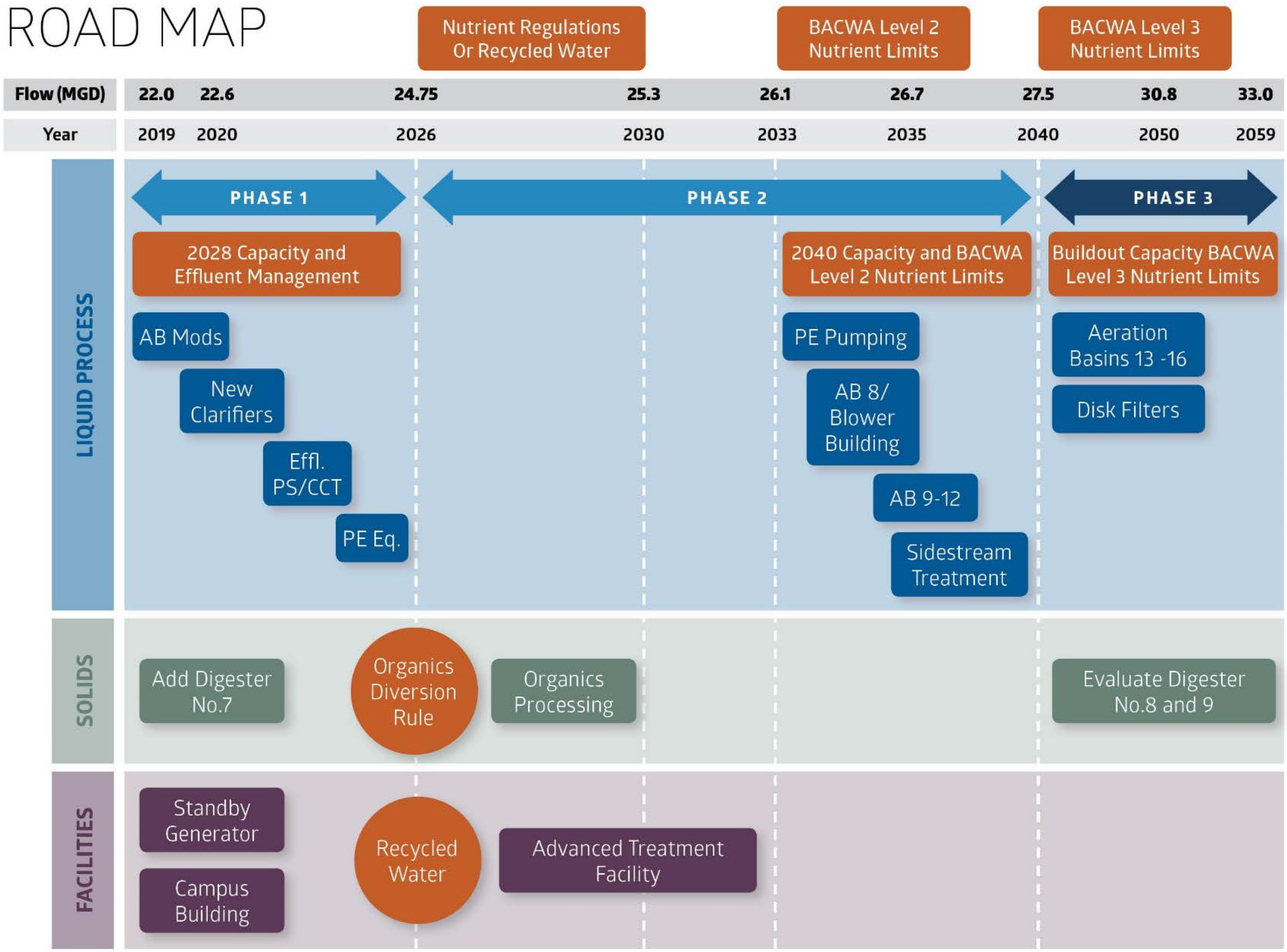
This ETSU Program is not intended to approve any individual phase or project, but to identify the proposed projects USD intends to pursue, subject to further review during a formal decision-making process. As the program is implemented and projects are designed and considered, environmental review required by CEQA will be conducted and USD will pursue any required regulatory permits. The program and the projects described propose no change in treatment capacity and are consistent with the uses approved by the City of Union City in Use Permit AP-4-95.

7.2 Key Factors

7.2.1 Effluent Management

Effluent Management is key concern for USD as wastewater discharge to Hayward Marsh phased out. Peak Flow attenuation in the form of conveyance system storage will serve as a partial solution for effluent management. Expanded and more frequent shallow water discharge to Old Alameda Creek, in conjunction with early action nutrient removal is anticipated to provide the remaining effluent management capacity. Modifications required for shallow water discharge are detailed in Section 7.2.2.1 below.

Figure 7-1: Road Map for USD's Enhanced Treatment and Site Upgrade Program Implementation



7.2.2 Secondary Treatment Capacity

CAS Option 2 is the preferred option for Secondary Treatment Process Improvements and BNR. For a more detailed description of these components, please see **Appendix B.** This phased approach maximizes use of existing infrastructure and does not result in stranded or redundant assets.

Operation of nutrient removal CAS system will be significantly different from that of USD's existing CAS system. BNR is typically a two-step process. In the first step, ammonia is oxidized to nitrate, which is referred to as nitrification. In an activated sludge system, this occurs in the aerobic zone of the aeration tanks. The SRT in the aerobic zone of the activated sludge system needs to be longer for nitrifying systems than for BOD-only removal and the required SRT can vary based on seasonal temperature differences in the wastewater. The Alvarado WWTP currently operates at a very short SRT of approximately one day, which is prone to filamentous bulking and too short to support nitrification. To achieve consistent year-round nitrification and target effluent ammonia concentrations of less than 1 mg/L, the SRT will need to be increased to a range of 8-13 days as shown in **Table 3-5**, depending on various operational factors.

The second step in biological nitrogen removal is denitrification, in which nitrate is reduced to nitrogen gas and released to the atmosphere. In an activated sludge system, this reaction occurs in an anoxic environment where dissolved oxygen is not present. The heterotrophic organisms in the mixed liquor of the anoxic zone will utilize the oxygen in the nitrate for the biodegradation of organic matter, resulting in the release of nitrogen gas. Swing zones, which can fluctuate between aerobic or anoxic, may be used to change the size of the aerobic zone to accommodate seasonal solids retention time (SRT) changes and maximize volume for denitrification.

Step feed, which is suggested for wet-weather BNR operation, is when all or a portion of the primary effluent to be fed to an intermediate location of the aeration basin to lower the solids loading to the secondary clarifiers and preserve the nitrifier population in the upfront zones.

7.2.2.1 Secondary Treatment Process Improvements

Phase I modifications have the dual intent of providing increasing treatment capacity of the WWTP as well as providing effluent management facilities. Specifically, plant modifications would include:

- Increasing Plant Capacity
    - Modify existing aeration basins: forming 2 aeration basins from existing Aeration Basins 1-4, creation of RAS deoxygenation zone, and creation of anoxic zones
    - Replace existing secondary clarifiers with circular clarifiers: four new circular clarifiers will be constructed where the administration building is currently located
- Improving Effluent Management (Old Alameda Creek Discharge)
    - Modify existing secondary clarifiers to provide 2.5 MG primary effluent equalization
    - Construct chlorination and dechlorination facilities
    - Construct new EBDA Pump Station
    - Re-route EBDA forcemain

Phase I accomplishes improved effluent quality through year-round BNR. The aeration basin modifications described in Section 6.2.1.1 coupled with the new modern clarifiers will provide USD with the capability to operate in BNR mode year-round because:

- The RAS system associated with the new modern clarifiers allows for step feed operation during wet weather.
- The PE equalization shaves peaks during wet weather.
- The new clarifiers can handle wet weather at the higher solids loading required for BNR
- Year-round BNR operation can achieve approximately 50% effluent TN load reduction for the year. It also achieves significant ammonia removal in wet weather.

To meet the stringent TSS standards (TSS<15 mg/L) for creek discharge during wet weather while maintaining solids inventory for BNR, USD would use several features in CAS Option 2 Phase I:

- PE equalization to shave off peak flow during storm events
- Step feed operation to off load solids loading to the secondary clarifiers
- Modern clarifiers with more total surface area and improved RAS control.

7.2.2.2 Nutrient Removal

Phase II nutrient removal permit limits will require the following additional modifications:

- Construct intermediate pump station: To accommodate the 5.5 mg of new aeration basin volume additional primary effluent distribution lines and a new lift station will be needed.
- Construct 5.5 MG of new aeration basin volume: This new volume will accommodate aerobic and anoxic zone to achieve TN removal.
- Construct new blower building: New blowers will be centrally located in a new facility north of the existing Aeration Basins 5-7 to accommodate this phase and future aeration tanks through buildout.
- Implement chemical P removal
- Construct sidestream treatment

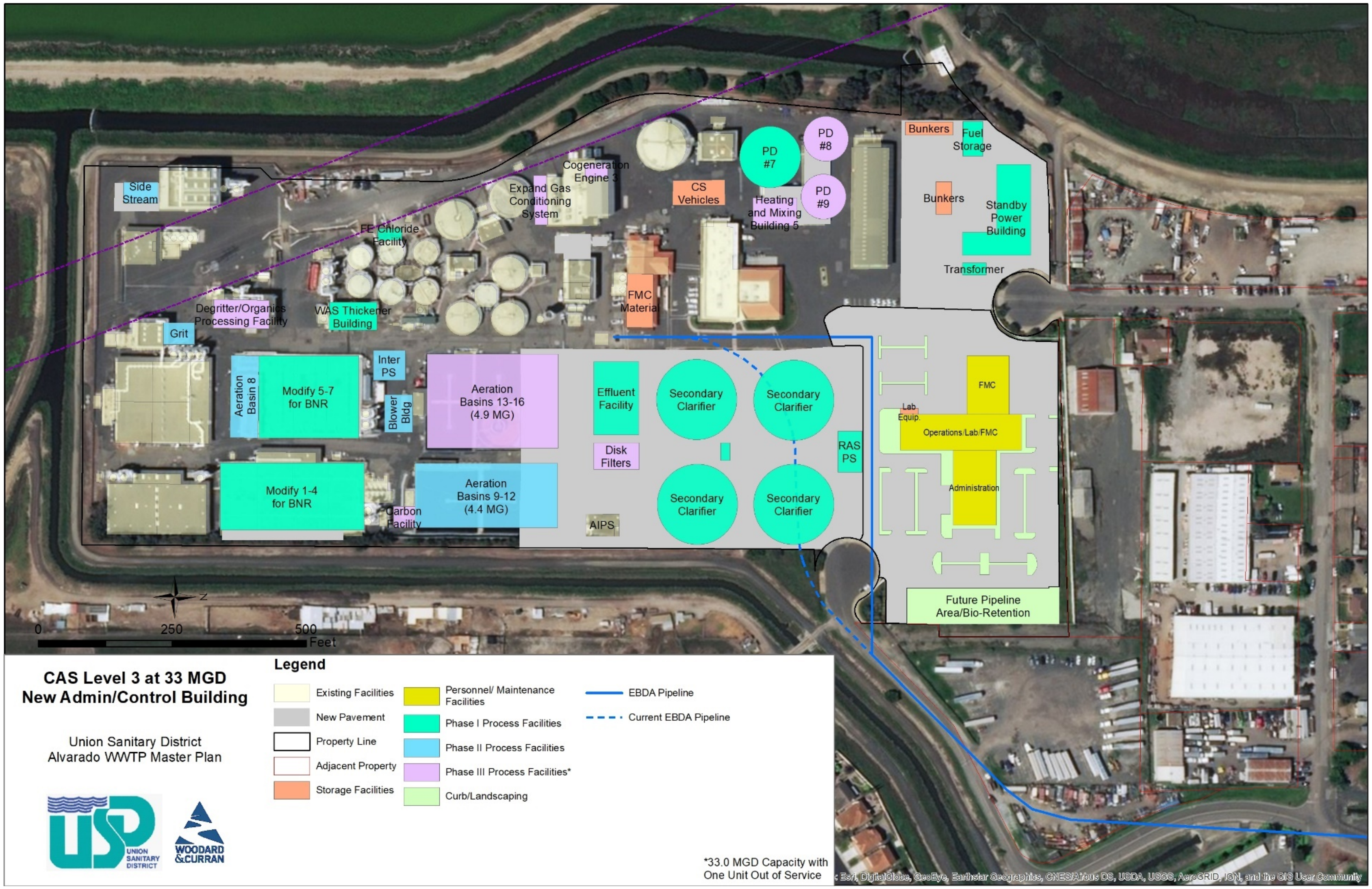
7.2.3 Restrictions on Biosolids Disposal

SB 1383 establishes the following targets for reducing landfill disposal of organic materials, including biosolids, based on the 2014 levels of organic waste disposal in California:

- 50% reduction by 2020
- 75% reduction by 2025

Depending upon the needs of the Union City, Newark, and Fremont Tri-Cities area for broad scale organics diversion, including food waste processing, and potential regional markets for organics diversion, an organics processing facility may be implemented by USD at its discretion. The viability of processing additional organics will need to be evaluated with regard to nutrient impacts of associated solids processing sidestreams as USD moves forward to implement the secondary treatment process improvements project, which will consider nutrient removal now and into the future. Space for such a facility is not currently accounted for within the site layouts included herein.

Figure 7-2: Phase III Plant Layout



7.3 Resources Needed

The costs of the key projects recommended in the ETSU Program are summarized in **Table 7-1**, including Secondary Treatment Process Improvements.

Table 7-1: Estimated Costs for Secondary Treatment Process Improvements (Phase I and Phase II) and Campus Building

Project	Costs
Campus Building	$ 72.4 M
Secondary Treatment Process Improvements Phase I	$ 231.8 M
Secondary Treatment Process Improvements Phase II	$ 253.5 M
GRAND TOTAL	**$557.7 M**

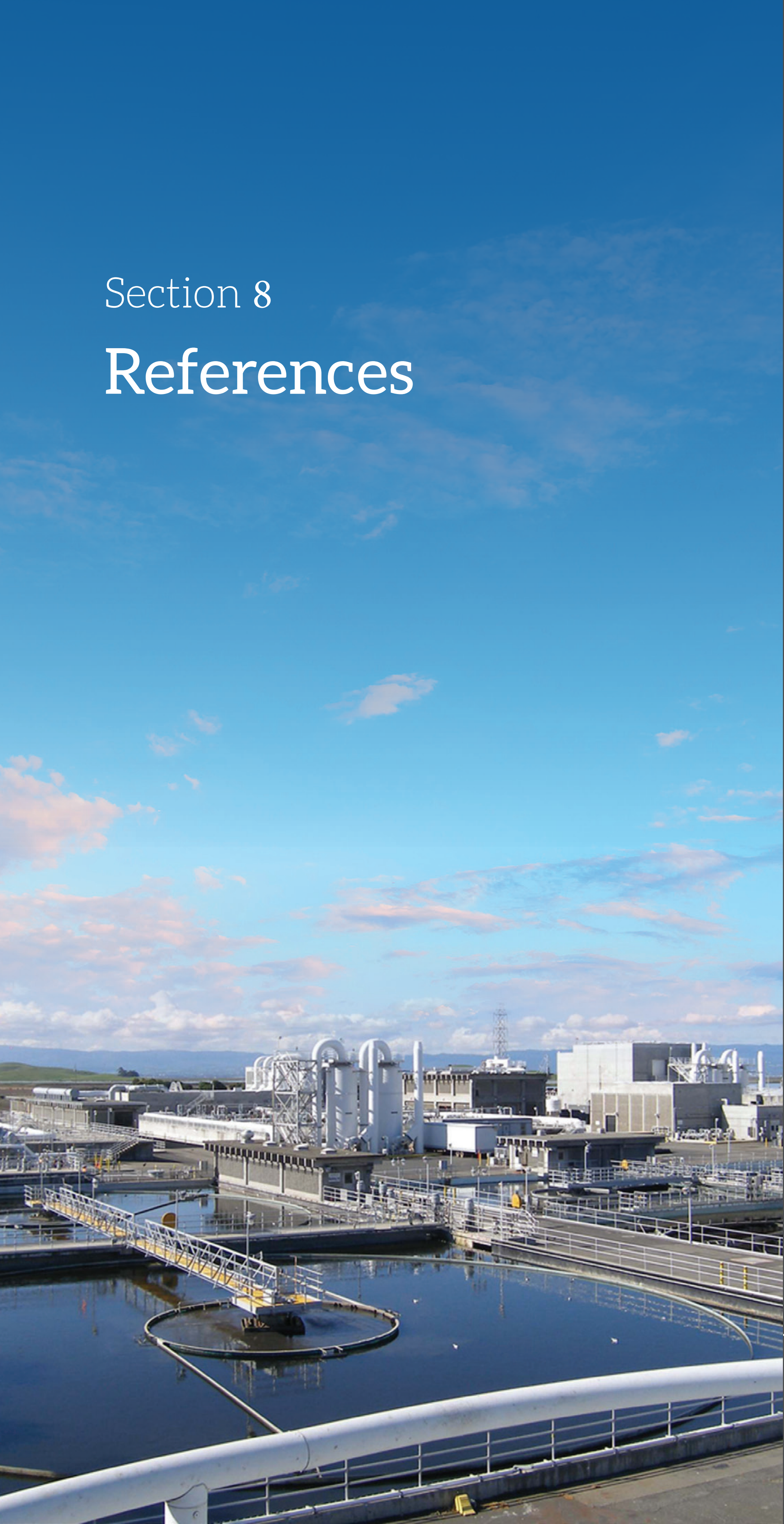
Notes:

1. Costs include inflation to midpoint of anticipated construction.
2. Assumes preliminary design for Phase II improvements to begin in July 2035.

The proposed Campus Building combines a new administration building, new control building and laboratory, and a new Facilities Maintenance (FMC) building, with shared parking, elevators, lockers etc. to maximize efficiency and collaboration of staff. The Secondary Treatment Process Improvements, Phase I, include the upgrades to improve plant process performance immediately, improve effluent quality for increased shallow water discharge to Old Alameda Creek, and early action nutrient removal. Phase II includes improvements to meet Level 2 nutrient requirements and project flows and loads through 2040.

Section 8

References



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