West Basin Facility Plan Project 7054

TECHNICAL MEMORANDUM 17

Forest Grove Implementation Plan

FINAL / September 2025

Produced by: carollo

Clean Water Services

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Abbreviations

AB	aeration basin
ADW	average dry weather
AWW	average wet weather
CAMP®	Concentrated Accelerated Motivated Problem-Solving
CIP	capital improvements program
District	Clean Water Services
HHPS	high-head pump station
MDDW	max day dry weather
MDWW	max day wet weather
MHWW	max hour wet weather
MMDW	max month dry weather
MMWW	max month wet weather
N/A	not applicable
NTS	natural treatment system
PC	primary clarifier
PS	pump station
RAS	return activated sludge
SC	secondary clarifier
TM	technical memorandum
VFW	vertical flow wetlands
WAS	waste activated sludge
WRRF	Water Resource Recovery Facility

TM 17 FOREST GROVE IMPLEMENTATION PLAN

17.1 Background

The capacities of existing unit processes at the Forest Grove Water Resource Recovery Facility (WRRF) were established in Technical Memorandum (TM) 10[1]. Evaluations of the existing secondary treatment aeration system and potential hydraulic bottlenecks were documented in TMs 12[2] and 16[3], respectively. This memorandum presents the recommended implementation plan to address capacity and condition related limitations identified during the planning process and to provide the required capacity through the 2045 planning horizon. The plan includes preliminary project scopes, planning-level cost estimates, and a site plan for the recommended improvements.

17.2 Summary

As part of the capacity analysis completed for the Forest Grove WRRF (TM 10), the capacities of the following unit processes were evaluated through the 2045 planning period and buildout:

- Influent Screening.
- Influent Pumping.
- Grit Removal.
- Primary Clarification.
- Secondary Treatment.
- Secondary Effluent Pumping.
- Ultraviolet (UV) Disinfection.
- Outfall.
- Vertical Flow Wetland (VFW) and Natural Treatment System (NTS).
- High Head Pump Station (HHPS).

Table 17.1 provides a summary of the projects identified to provide capacity at the Forest Grove WRRF through the planning and buildout periods. Unit processes not listed were determined to have sufficient capacity through buildout, with the exception of the VFW and NTS, which were identified as capacity limited. However, these limitations are addressed through use of the flow transfer system and no improvement projects were included for them within the 20-year planning horizon.

[1] Carollo Engineers, Inc. (June 2025), TM 10 - Forest Grove WRRF Capacity Evaluation, West Basin Facility Plan Project 7054.
[2] Carollo Engineers, Inc. (July 2025). TM 12 - Forest Grove WRRF Aeration System Evaluation, West Basin Facility Plan Project 7054.
[3] Carollo Engineers, Inc. (August 2025). TM 14 - Forest Grove WRRF Hydraulic Analysis, West Basin Facility Plan Project 7054.

Table 17.1 Summary of Recommended Projects

Project		Driver	Parameter	Year Online	Project Cost (2025)	Description
1	Aeration Improvements	Capacity	MDDW	2029	$10M	Replacement of existing blowers, diffusers, and air headers
2	Screening	Capacity	MDWW	2030	$0.9M	+1 influent screen
3	Secondary Expansion 1	Capacity	MMDW	2035	$30M	+1 AB, 1 SC, RAS/WAS PS and blower capacity
4	HHPS	Capacity	MHWW	2038	$4M	+Larger transfer pumps and wet well improvements.
5	Headworks Improvements	Capacity	MHWW	Buildout	--	Increased capacity of the grit removal process and influent pump station.
6	Primary Clarification	Capacity	AWW	Buildout	--	+1 PC
7	Secondary Expansion 2	Capacity	ADW	Buildout	--	+1-2 ABs
8	Secondary Clarifier Replacement	Condition	N/A	Buildout	--	+1 SC to replace existing SCs 1 and 2

Notes:
AB - aeration basin; ADW - average dry weather; AWW - average wet weather; MDDW - max day dry weather; MDWW - max day wet weather; MHWW - max hour wet weather; MMDW - max month dry weather; N/A – not applicable; PC - primary clarifier; PS - pump station; RAS - return activated sludge; SC - secondary clarifier; WAS - waste activated sludge.

17.3 Recommended Improvements

17.3.1 Preliminary Treatment

Screening - The influent screens are currently out of capacity based on a MDWW redundancy condition. To manage this limitation, excess flows can be bypassed through an unused third channel. Installation of a third screen in this bypass channel will restore redundancy and provide adequate screening capacity through the planning period. Given that Clean Water Services (District) has an acceptable strategy for managing the existing limitation in the meantime, the third screen will not be shown as coming online until 2030.

Headworks Improvements - Both the grit removal system and influent pump station are projected to approach their design capacities by 2045, near the end of the planning period. These have been identified as potential buildout-phase improvements and the District may elect to address them in the future as part of a larger, integrated headworks improvement project.

17.3.2 Primary Treatment

Primary Clarification - Given that the new primary clarifiers at Forest Grove are currently under construction, conservative assumptions were made regarding their future performance in the facility capacity evaluation. Under these assumed conditions, the two new primary clarifiers will have sufficient treatment capacity through the planning period. An additional primary clarifier may be required within the buildout period depending on the actual performance of the new primaries.

17.3.3 Secondary Treatment

Aeration Improvements - Based on the evaluation of the secondary treatment process, the existing aeration system is currently out of capacity. To address this limitation, increased blower capacity, new air headers and new air diffusers are required.

The estimated cost for this project assumes new blowers are installed in the existing blower building which has adequate space to accommodate the additional blower capacity required through the planning horizon. However, given the potential constructability constraints of replacing/adding blowers in the existing building, as well as the distance between the existing blower building and the current and future aeration basins, the addition of a new blower building in a more centralized location should be considered as an optional project within the planning period. Space has been shown for this new building on the site plan (Figure 17.7).

The timing of this project could be affected by the operation and performance of the new primary clarifiers. Given this, the District will wait to begin these improvements until the new primary clarifiers are commissioned (currently anticipated for March of 2026) and their performance tested.

Secondary Expansion 1 - Assuming completion of the aeration improvement project, the existing aeration basins are projected to be capacity limited under MMDW conditions and a new aeration basin and additional blower capacity be required by 2034. As with the aeration improvements project, the timing of this future expansion will depend on the actual performance of the new primary clarifiers and the results of the District's testing following their commissioning.

To support this expansion and improve operational flexibility, this project also includes construction of a new 120 ft secondary clarifier. While not driven directly by a capacity deficiency, existing Secondary Clarifiers 1 and 2 are aging and do not perform as effectively as Secondary Clarifier 3; additionally, their shared infrastructure presents constructability and sequencing challenges that would make replacing them while maintaining treatment for projected flows and loads difficult. Adding a fourth clarifier as part of this project will provide the redundancy needed to enable future replacement of the existing units without major disruption to facility operations.

The estimated project costs for these improvements assume that the configuration of the new basin will be the same as or similar to that of the existing aeration basin and include additional blower capacity. The new secondary clarifier was assumed to be similar to Secondary Clarifier 3 with an attached RAS/WAS pump station.

Secondary Expansion 2 - Within the buildout period, a second expansion would be required to add two aeration basins to treat projected ADW with one basin out of service. If the flow transfer system were leveraged for redundancy instead, only one additional basin would be required to provide sufficient capacity through buildout.

Secondary Clarifier Replacement - The existing Secondary Clarifiers 1 and 2 have aging mechanisms and flow split issues between the two have been reported. With the addition of Secondary Clarifier 4 as part of the Secondary Expansion 1 project, the facility will have sufficient capacity to remove these existing clarifiers and replace them with a single new 120 foot clarifier and an attached RAS/WAS pump station, to restore operational redundancy, outside of the planning period.

17.3.4 Flow Transfer System

High Head Pump Station - The capacity of the HHPS will be limited under MHWW conditions in 2038. The recommended improvements to this system would include the replacement of existing pumps for larger capacity pumps and modifications to the existing pump station and wet well to improve overall operability of the pump station. It is recommended that further evaluation be undertaken to compare the cost/benefits of these improvements to alternative improvements such as increasing the capacity of the outfall.

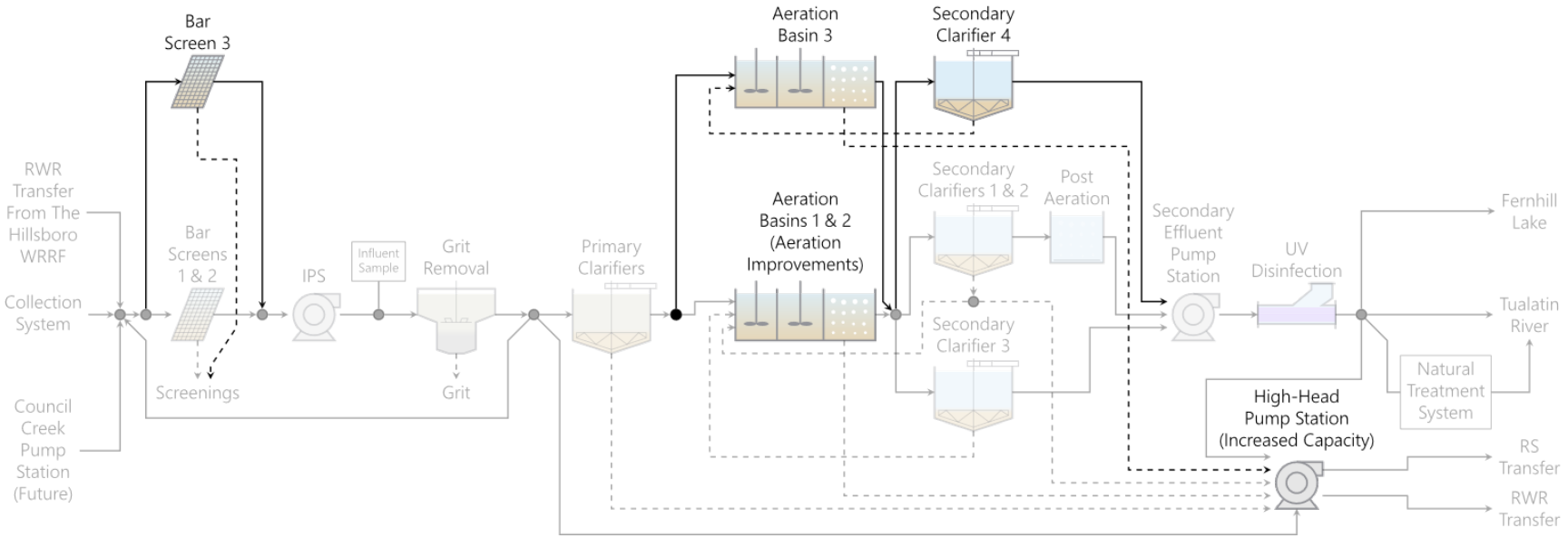

Figure 17.1 Forest Grove WRRF Future Process Flow Diagram

Fig_17.2.pdf

Figure 17.2 Forest Grove WRRF Future Hydraulic Profile

Fig_17.3.pdf

Figure 17.3 Forest Grove WRRF Future Hydraulic Profile

17.4 Planning Level Cost Estimate

The estimated project costs have been developed for the projects identified in Table 17.1. These estimates are based on Association for the Advancement of Cost Engineering Class 5 cost estimates. Class 5 estimates are generally prepared based on very limited information and consequently have wide accuracy ranges. For these estimates, engineering is typically from 0 percent to 2 percent complete. The estimate is intended for strategic planning purposes, market studies, assessment of viability, project location studies, and long-range capital planning only. It was developed using stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. The expected accuracy ranges are from -20 percent to -50 percent on the low side and +30 percent to +100 percent on the high side. Ranges could exceed those shown in unusual circumstances.

Project markup factors applied to each estimated cost are shown in Table 17.2 and the project costs, in 2025 dollars, are shown in Table 17.3.

Table 17.2 Project Cost Markup Factors

Parameter	Value	Notes/Reference
Contingency	30%	West Basin Alternatives CAMP®
Contractor General Conditions	10%	West Basin Alternatives CAMP®
Contractor Overhead and Profit	12%	West Basin Alternatives CAMP®
Engineering, Legal and Administration	20%	West Basin Alternatives CAMP®

Table 17.3 2045 Capital Improvements Program Cost Summary

Project		Preliminary Scope	Estimated Project Cost (2025)(1)
1	Aeration Improvements	▪ Replacement of existing blowers, existing air headers, and diffusers within the existing blower building.	$10M(2)
2	Screening	▪ Addition of one new influent screen in the existing screen bypass channel.	$0.9M
3	Secondary Expansion 1	▪ New aeration basin similar to the existing. ▪ An additional 120 ft secondary clarifier with attached RAS/WAS pump station.	$30M
4	HHPS	▪ New higher capacity transfer pumps and improvements to the existing pump station and wet well for improved operability.	$4M

Notes:
(1) Additional cost summary information included in Appendix 17A.
(2) Carollo Engineers, Inc. (July 2025). TM 12 - Forest Grove WRRF Aeration System Evaluation, West Basin Facility Plan Project 7054.

17.5 Project Schedule and Triggers

For each of the unit processes evaluated, trigger plots were developed based on unit process design criteria and flow and load projections provided by the District[4]. Table 17.4 summarizes trigger conditions associated with each of the identified improvements and shows the "trigger year" or the year the completed project is required to maintain required capacity.

Table 17.4 Planning Period Project Triggers

Project	Driver	Flow Condition	Redundancy	Trigger Year
Aeration Improvements	Capacity	MDDW	All units in service	2029
Screening	Capacity	MDWW	One unit out of service	2030
Secondary Expansion 1	Capacity	MMDW	All units in service	2035
High Head Pump Station	Capacity	MHWW	All units in service	2038

A summary timeline of triggered projects is shown graphically in Figure 17.4. For some projects, a range of trigger years is shown. This is due to observed flows and loads increasing at a slower rate than originally projected, allowing for flexibility in the timing of the project.

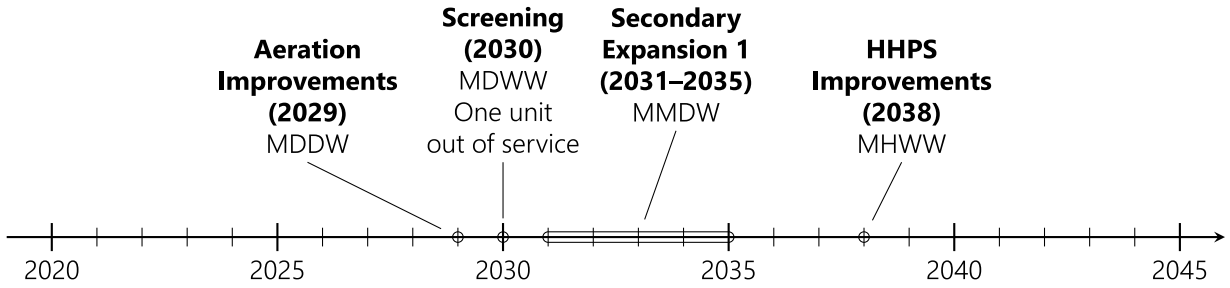

Figure 17.4 Triggered Project Timeline

Project design and construction durations were standardized based on estimated construction costs, as summarized in Table 17.5. These durations were used to develop the Capital Improvements Program (CIP) timeline in Figure 17.5, which illustrates the distribution of CIP projects at the Forest Grove WRRF over the planning period.

Table 17.5 Project Duration Assumptions

Construction Cost	Design Duration (Months)	Construction Duration (Months)	Total Duration (Months)
< $10M	14	20	34
$10M to $30M	18	24	42
$30M to $50M	20	30	50
> $50M	24	36	60

[4] Jacobs (2022-02-08). Flow and Load Projections. Memorandum. West Basin Master Planning Preliminary Work

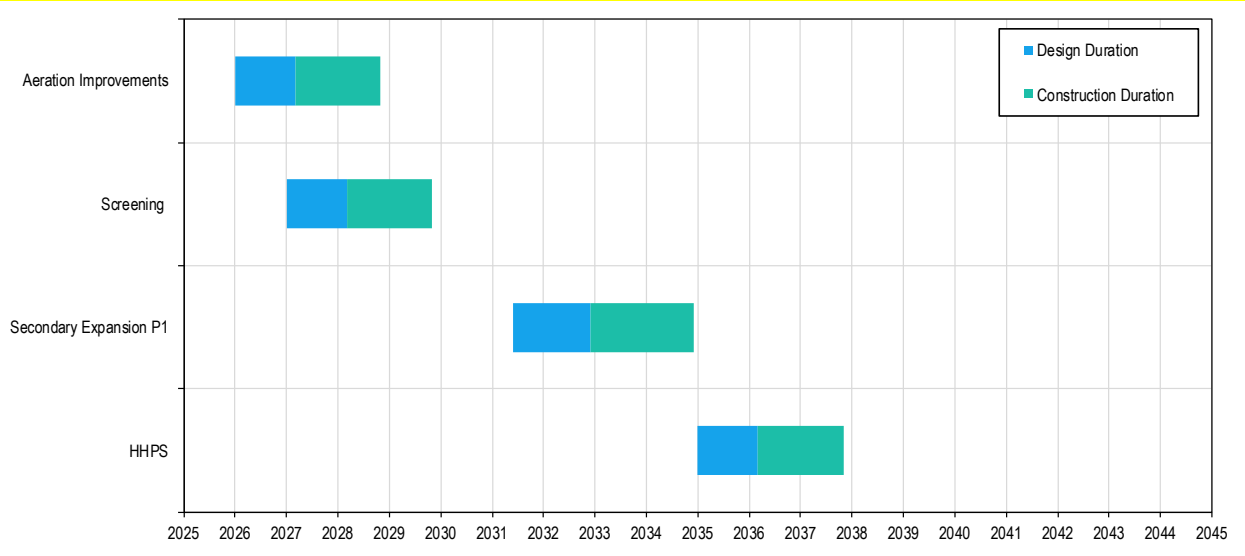

Figure 17.5 Forest Grove WRRF CIP Timeline

17.6 2045 Capital Improvements Plan

The estimated cash flow for the recommended improvements over the 20-year planning horizon is presented graphically in Figure 17.6 and summarized in Table 17.6. CIP costs shown in Figure 17.6 and Table 17.6 are escalated to the anticipated midpoint of construction based on the CIP timeline shown in Figure 17.5.

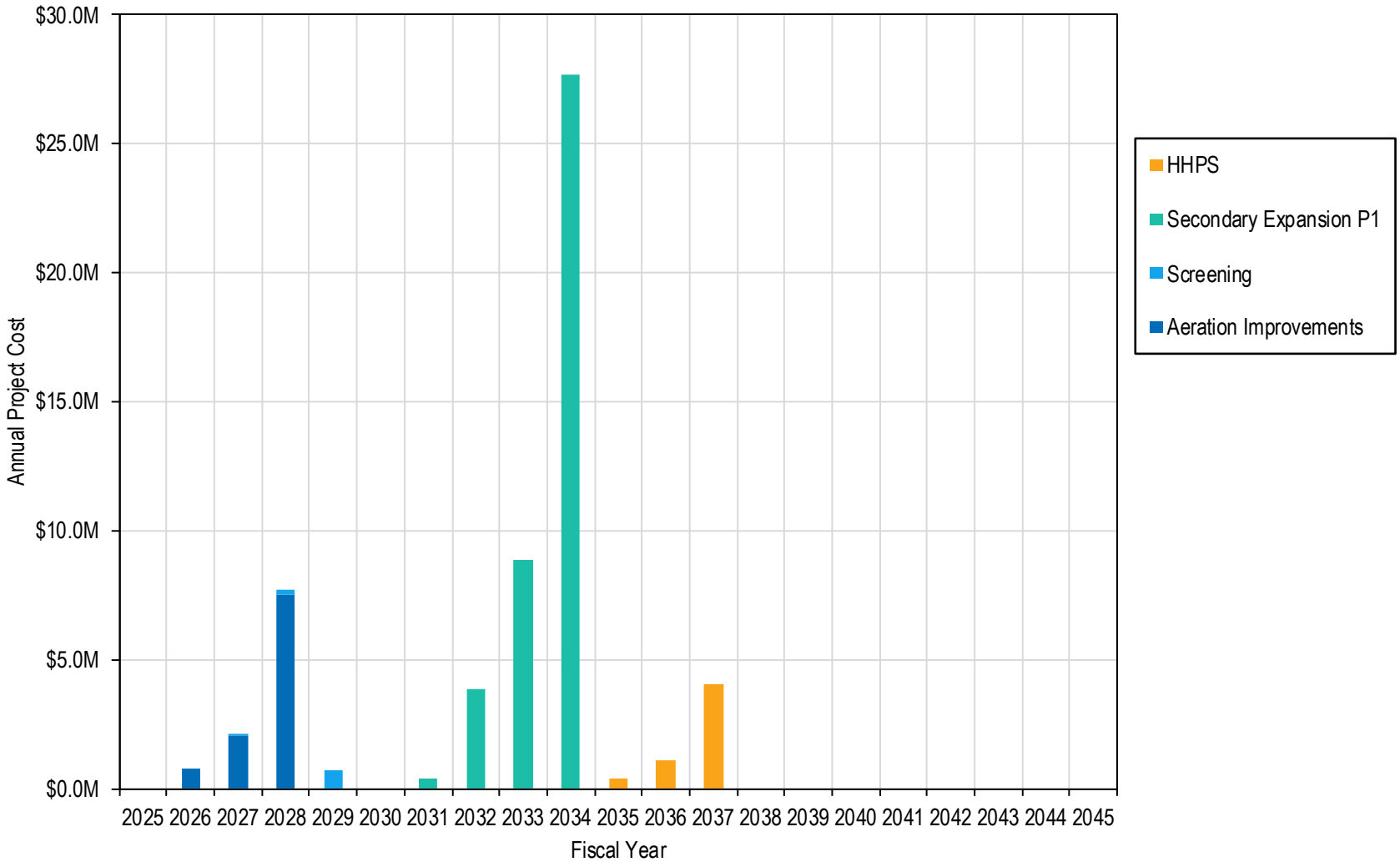

Figure 17.6 Forest Grove WRRF CIP Cashflow

Table 17.6 Forest Grove WRRF CIP Tabulated Cashflow(1)(2)

Fiscal Year	Aeration Improvements	Screening	Secondary Expansion P1	HHPS	Total
2025					**$0**
2026	$800,000				**$800,000**
2027	$2,100,000	$100,000			**$2,200,000**
2028	$7,500,000	$200,000			**$7,700,000**
2029		$700,000			**$700,000**
2030					**$0**
2031			$400,000		**$400,000**
2032			$3,900,000		**$3,900,000**
2033			$8,900,000		**$8,900,000**
2034			$27,700,000		**$27,700,000**
2035				$400,000	**$400,000**
2036				$1,100,000	**$1,100,000**
2037				$4,100,000	**$4,100,000**
2038					**$0**
2039					**$0**
2040					**$0**
2041					**$0**
2042					**$0**
2043					**$0**
2044					**$0**
2045					**$0**
Total	**$10,400,000**	**$1,000,000**	**$40,800,000**	**$5,600,000**	**$57,800,000**

Notes:
(1) Costs have been escalated to the mid-point of construction.
(2) Summation differences for totals are due to rounding.

17.7 Site Plan

A site plan layout is presented in Figure 17.7 showing the location of recommended improvements. This site plan shows the footprint of the additional processes planned to provide capacity through the planning period (2045) and through buildout. Additionally, the site plan shows footprint for three optional processes: tertiary filtration, solids handling and a more centralized blower building based on the following rationale:

- **Tertiary Filtration**: Tertiary filtration is not currently required for the Forest Grove facility to meet discharge limitations. However, as flows increase beyond buildout, meeting the District's bubbled summer effluent TSS mass load limit will become more challenging and will likely require a change of process at either Rock Creek, Durham or Forest Grove. One option to meet this bubbled mass load

limit would be to add tertiary filters to Forest Grove. This option would allow the District to pursue additional reclaimed water opportunities in the area of Forest Grove.

- **Solids Handling**: Providing solids handling for Forest Grove was evaluated during the West Basin CAMP®. This analysis found that it would be more cost-effective for the District to continue its current practice of centralized solids treatment at Rock Creek. However, given the uncertainty in biosolids regulations, the CAMP® documentation (TM 1) recommended setting a site aside at Forest Grove to address changes in biosolids regulations.
- **Blower Building**: The costs developed for the Aeration Improvements project assume new blowers installed in the existing blower building. However, given the potential constructability constraints of this installation, as well as the distance between the existing blower building and the current and future aeration basins, an optional new blower building in a more centralized location has been shown as an optional project in Figure 17.7.

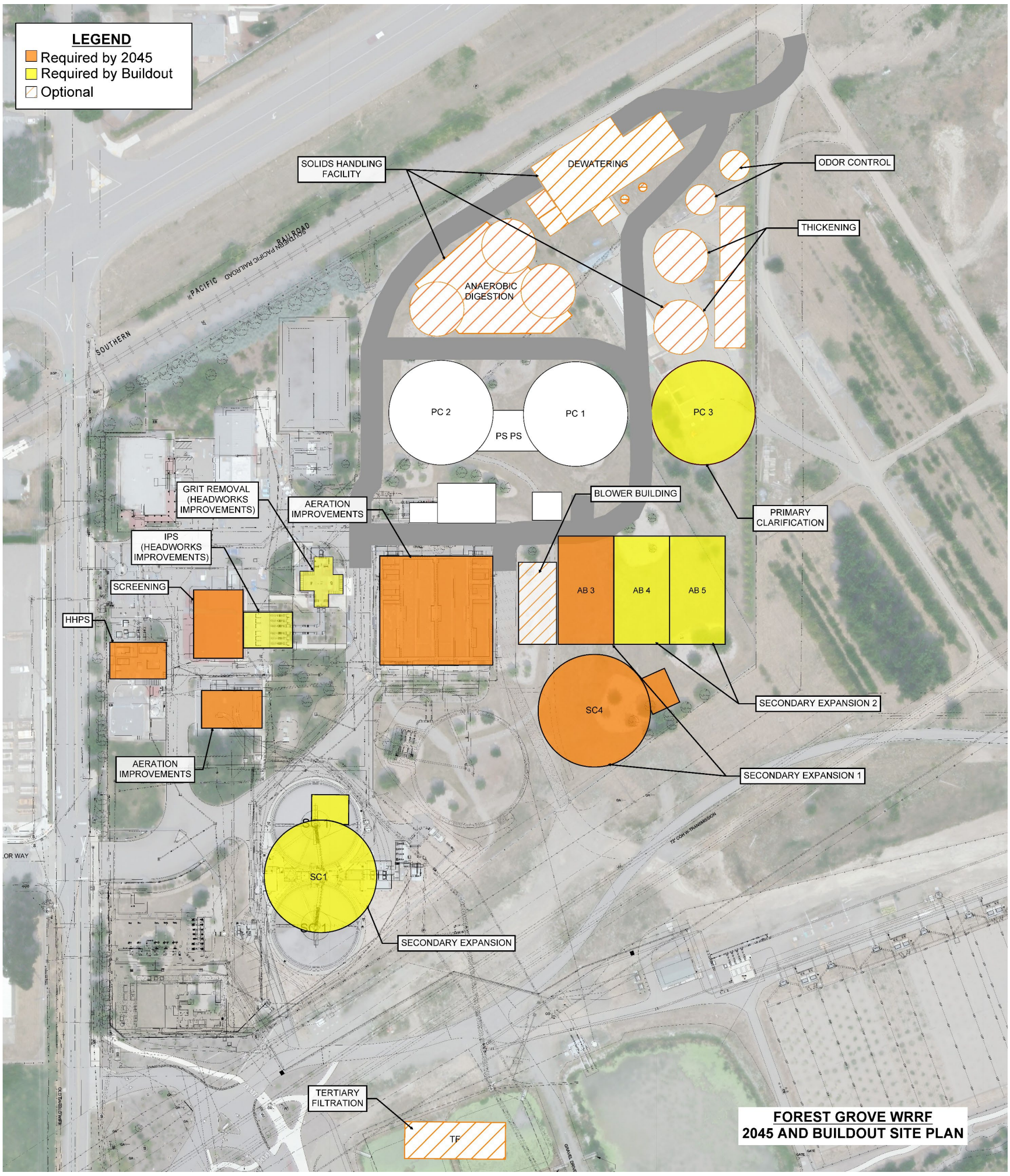

Figure 17.7 Forest Grove WWRF Recommended 2045 and Buildout Site Plan

APPENDIX 17A

COST DATA SUMMARY SHEETS

FG Headworks Screening

Project:	**7054 WBMP**	**Estimate Class:**	**5**
Client:	**Clean Water Services**	**PIC:**	**BRM**
Location:	**Hillsboro, OR**	**PM:**	**BRM**
Zip Code:	**97123**	**Date:**	**4/1/2025**
Carollo Job #	**200908**	**By:**	**AC**
		Reviewed:	**NG**

NO.	DESCRIPTION		TOTAL
1	New Screen		$ 230,000
2	Equipment Installation		$ 50,000
3	EI&C	10%	$ 30,000
4	P&A	40%	$ 130,000
	TOTAL DIRECT COST		**$440,000**
	Contingency	30.0%	$140,000
	ESCALATED DIRECT COST WITH CONTINGENCY		**$580,000**
	General Conditions	10.0%	$60,000
	Subtotal		**$640,000**
	General Contractor Overhead and Profit	12.0%	$80,000
	Subtotal		**$720,000**
	TOTAL ESTIMATED CONSTRUCTION COST		**$720,000**
	Engineering, Legal & Administration Fees	20.0%	$150,000
	TOTAL ESTIMATED PROJECT COST		**$870,000**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Secondary Expansion Phase 1

Project:	**7054 WBMP**	**Estimate Class:**	**5**
Client:	**Clean Water Services**	**PIC:**	**BRM**
Location:	**Hillsboro, OR**	**PM:**	**BRM**
Zip Code:	**97123**	**Date:**	**5/16/2025**
Carollo Job #	**200908**	**By:**	**AC**
		Reviewed:	**ERA/NG**

NO.	DESCRIPTION		TOTAL
1	AB 3		$ 4,470,398
2	SC 4		$ 4,941,800
3	EI&C	30.0%	$ 2,830,000
4	Piles		$ 886,505
5	Yard Piping	10.0%	$ 1,313,000
6	Sitework	10.0%	$ 1,444,000
	TOTAL DIRECT COST		**$15,890,000**
	Contingency	30.0%	$4,770,000
	ESCALATED DIRECT COST WITH CONTINGENCY		**$20,660,000**
	General Conditions	10.0%	$2,070,000
	Subtotal		**$22,730,000**
	General Contractor Overhead and Profit	12.0%	$2,730,000
	Subtotal		**$25,460,000**
	TOTAL ESTIMATED CONSTRUCTION COST		**$25,460,000**
	Engineering, Legal & Administration Fees	20.0%	$5,090,000
	TOTAL ESTIMATED PROJECT COST		**$30,600,000**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

HHPS - Nominal Improvements

Project:	**7054 WBMP**	**Estimate Class:**	**5**
Client:	**Clean Water Services**	**PIC:**	**BRM**
Location:	**Hillsboro, OR**	**PM:**	**BRM**
Zip Code:	**97123**	**Date:**	**5/16/2025**
Carollo Job #	**200908**	**By:**	**AC**
		Reviewed:	**NG**

NO.	DESCRIPTION		TOTAL
1	New pump + operational improvements to station and wetwell		$ 2,000,000
	TOTAL DIRECT COST		**$2,000,000**
	Contingency	30.0%	$600,000
	ESCALATED DIRECT COST WITH CONTINGENCY		**$2,600,000**
	General Conditions	10.0%	$260,000
	Subtotal		**$2,860,000**
	General Contractor Overhead and Profit	12.0%	$340,000
	Subtotal		**$3,200,000**
	TOTAL ESTIMATED CONSTRUCTION COST		**$3,200,000**
	Engineering, Legal & Administration Fees	20.0%	$640,000
	TOTAL ESTIMATED PROJECT COST		**$3,800,000**

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