CHAPTER 11

Analysis of ROMP Engineering Alternatives

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11.1 Introduction

Numerous engineering construction scenarios have been examined in an attempt to reduce the Base Case capital burden. Six of the scenarios were selected as the CIP Engineering Alternatives for further examination to compare their financial impacts to the Base Case. These analyses were required to determine the most advantageous financial pathway for the implementation of the ROMP program.

The following six engineering alternatives differ from the Base Case in several ways. However, the greatest common difference between the Base Case, from an economic perspective, and these six alternatives is the utilization of chlorine technology rather than ultraviolet radiation to achieve the required level of pathogen removal.

All scenarios incorporate assumptions provided in Chapter 10 with the following exception: the Ina Road facility construction contract must be awarded 6 months prior to the start-no-later date of January 2011. In review of the construction cost analysis, it was determined that there may be some construction phasing issues at Ina Road relating to concurrent construction of the wastewater treatment trains and the conversion of existing BNRAS facilities to the new arrangement. This phasing may impact construction scheduling, but it was assumed for this analysis that it could be completed within allotted construction time. Because of this phasing, construction cost may be slightly different than what is developed in this construction cost estimate.

11.2 Engineering Alternatives

The six ROMP Engineering Alternatives are described below.

Alternative 1: All at Once – Chlorine Technology WITHOUT Filtration

Concurrent construction of a new 32 mgd capacity Water Reclamation Campus (WRC) and expansion/upgrade of a 50 mgd capacity Ina Road WRF. Initial construction for the Water Reclamation Campus will consist of sitework and facility construction will be delayed for the first year. Disinfection will occur without a preceding filtration step and will be accomplished via a chlorination technology process similar to the current disinfection method utilized by the two facilities. Demolition and removal of the existing Roger Road WRF occurs after the new Water Reclamation Campus is completed.

Alternative 2: All at Once – Chlorine Technology WITH Filtration

Concurrent construction of a new 32 mgd capacity WRC and expansion/upgrade of a 50 mgd capacity Ina Road WRF. Disinfection will be accomplished via a chlorination technology process similar to the current disinfection method utilized by the two facilities including a preceding filtration step. Demolition and removal of the existing Roger Road WRF occurs after the Water Reclamation Campus is completed.

Alternative 3: 8-mgd WRC Delay – Chlorine Technology WITHOUT Filtration

Concurrent construction of a new WRC at 24 mgd and repair/expansion of Ina Road WRF to 50 mgd and delayed construction of additional 8 mgd at the new WRC upon completion of initial 24 mgd. Disinfection will be accomplished via a chlorine technology process similar to the current disinfection method utilized by the two facilities. Demolition and removal of the existing Roger Road WRC occurs after the new Water Reclamation Campus is completed.

Alternative 4: 8-mgd WRC Delay – Chlorine Technology WITH Filtration

This scenario includes all components from the previous alternative, ***8-mgd WRC Delay – Chlorine Technology WITHOUT Filtration***, and only differs from the addition of a filtration system prior to chlorine disinfection.

Alternative 5: 8-mgd WRC Delay – Utilize Roger Road WRF's Existing Sludge System

Concurrent construction of a new WRC at 24 mgd and repair/expansion of Ina Road WRF to 50 mgd and delayed construction of additional 8 mgd at the WRC upon completion of initial 24 mgd. Disinfection will be accomplished via a chlorine technology process similar to the current disinfection method utilized by the two facilities including a preceding filtration step. Demolition and removal of the existing Roger Road WRF will be delayed to a later date. This scenario retains current biosolids processing facilities at Roger Road WRF and improves current biosolids processing facilities at both Roger Road WRF and Ina Road WRF as needed while deferring new construction of sludge facilities at Ina Road WRF's centralized processing until a later date.

Alternative 6: All at Once – Chlorine Technology WITHOUT Filtration

Concurrent construction of a new 32 mgd capacity WRC and expansion/upgrade of a 50 mgd capacity Ina Road WRF. Facility construction for the new WRC will occur throughout the duration. Disinfection will occur without a preceding filtration step and will be accomplished via a chlorination technology process similar to the current disinfection method utilized by the two facilities. Demolition and removal of the existing Roger Road WRF occurs after the new Water Reclamation Campus is complete.

11.2.1 Treatment Capacity

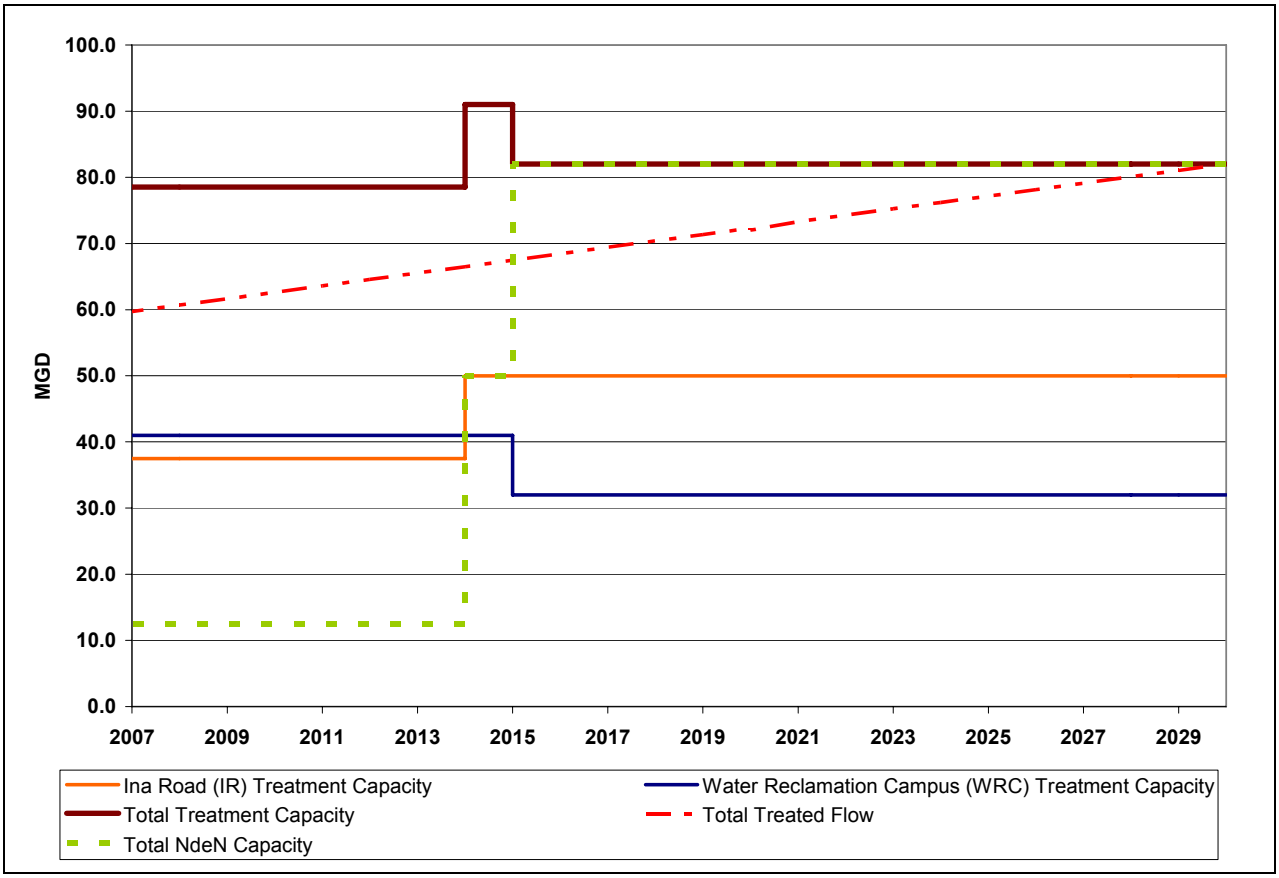
Each scenario must provide adequate NdeN treatment capacity for the projected influent flows. A NdeN treatment capacity analysis has been completed for each of the five engineering alternatives and all alternatives meet the required NdeN capacity for this study. Provided below are The CIP Engineering Alternatives "All at Once" and Alternatives "8-mgd WRC Delay".

All at Once – Chlorine Technology WITH & WITHOUT Filtration

Figure 11-1 shows the treatment capacity flow chart for both Ina Road WRF and the WRC facilities through the year 2030. The green dashed line represents the total NdeN treatment capacity. The NdeN capacity by 2014 is 50 mgd represented by completion of the expansion/upgrade of Ina Road WRF.

Completion of the new 32 mgd WRC by 2015 provides 84 mgd total NdeN treatment capacity, which is a sufficient amount of capacity for treating the total flow (red dashed line).

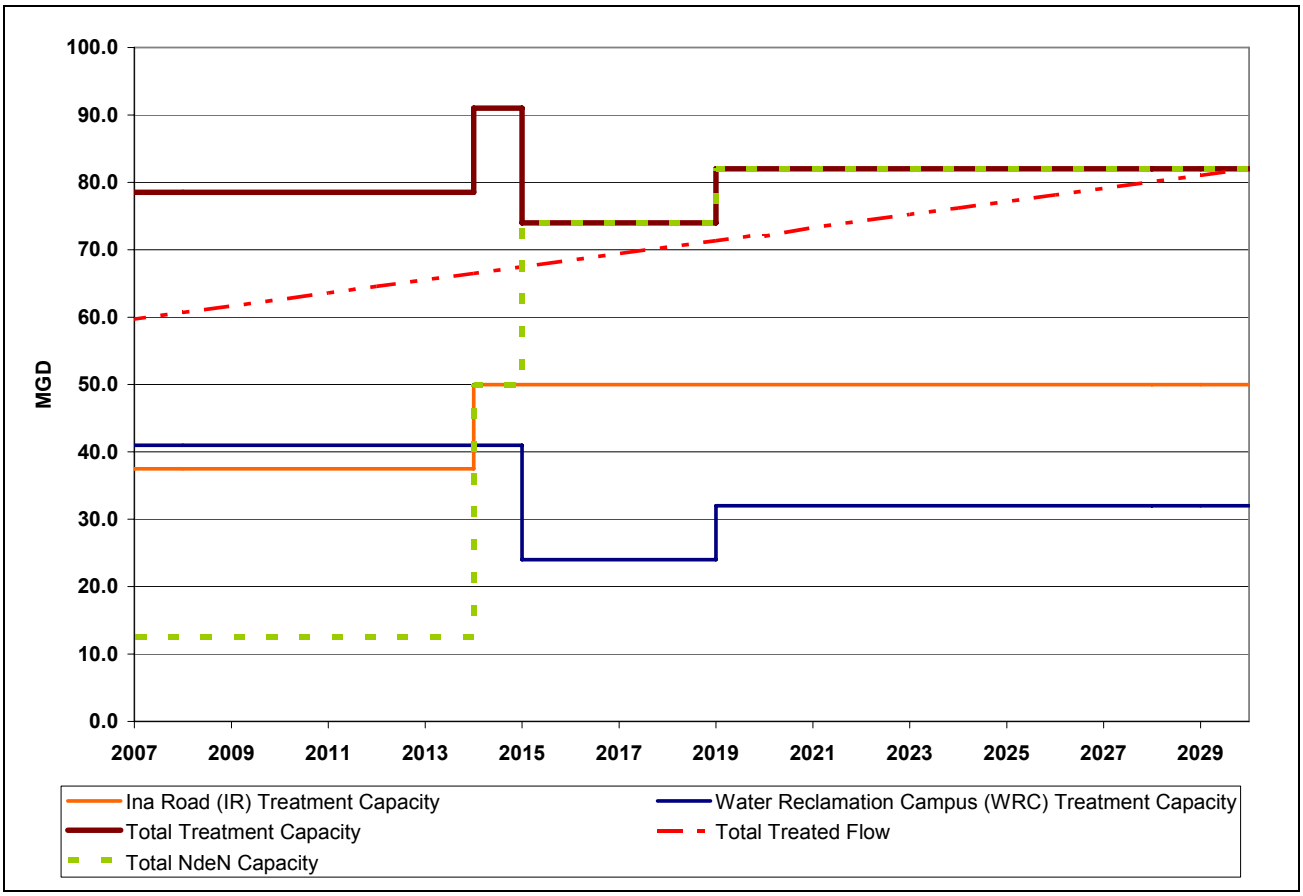
Figure 11-1
ROMP Engineering Alternatives "All at Once" Flow Capacity Analysis



8-mgd WRC Delay – Chlorine Technology WITH & WITHOUT Filtration and Utilize Roger Road WRF's Existing Sludge System

Figure 11-2 shows the treatment capacity flow chart for both Ina Road WRF and the new WRC facilities through the year 2030. The green dashed line represents the total NdeN treatment capacity. The NdeN capacity by 2014 is 50 mgd as represented by completion of the expansion/upgrade of Ina Road WRF. Completion of the new 24 mgd WRC by 2015 provides 74 mgd total NdeN treatment capacity and the additional 8 mgd completed by 2019 provide a sufficient amount of capacity for treating the total flow (red dashed line).

Figure 11-2
ROMP Engineering Alternative "8-mgd WRC Delay" Flow Capacity Analysis



11.2.2 Construction Flow Charts

Construction flow charts were created to illustrate the preliminary construction schedule for each alternative. Key dates and durations were used to determine whether sufficient time was available for the various alternatives. These dates provide sufficient time for completion of each alternative to meet the NdeN regulatory requirements and are included in **Appendix D**.

The following preliminary construction flow charts have been created to determine the plausibility for the various CIP Engineering Alternatives to provide treatment capacity meeting the ammonia toxicity regulatory requirement dates set in each facility's respective permit. Enough time must be allotted for the Ina Road WRF to be online by January 30, 2014 and for the new WRC by January 30, 2015. **Table 11-1** shows the duration and start date for each component for Ina Road WRF and the new WRC.

Table 11-1
Components Required for the CIP Engineering Alternative Completion

Project Component	Start Date		Duration	
	Ina Road WRF	New WRC	Ina Road	New WRC
Design Procurement	August 2007	January 2008	6 Months	6 Months
Design	January 2008	July 2009	24 Months	18 Months
Construction Procurement*	January 2010	January 2010	6 Months	6 Months
Construction Contract Award	January 2011	January 2011	-	-
Construction	July 2010	January 2011	37 Months	42 Months
Start-Up & Testing	August 2013	August 2014	6 Months	6 Months
Must be Online No Later Than	January 2014	January 2015	-	-

***Selection of an alternative delivery method may reduce the time for selection of contractor after development of plan, longer engineering time, or long construction time.**

11.2.3 Construction Costs

Construction costs for each alternative were developed initially from the yearly construction costs presented in the Base Case. Alternatives "8-mgd WRC Delay" constructs 24 mgd of the WRC's treatment capacity and delays completion of an additional 8 mgd until 2016. Of these three scenarios, the costs for the 24 mgd portion (Phase I) were calculated by taking 75% of the Master Plan's yearly budgeted amount for the duration of that phase of construction. The 8 mgd portion (Phase II) costs were calculated by taking 25% of the Master Plan's yearly budgeted amount for the duration of that phase of construction. An additional 10% of Phase II's yearly cost has been added to each year of Phase II's duration. This additional 10% accounts for costs associated with beginning a new construction phase,

administration, mobilization, demobilization, legal contract development, procurement, etc. Each of the five engineering alternatives costs are shown in **Table 11-2**.

Table 11-2
ROMP Engineering Alternative Cost Comparisons

Alternative	Description	Total Cost* (2006 dollars in Millions)
1	All at Once – Chlorine Technology **WITHOUT** Filtration	**$450**
2	All at Once - Chlorine Technology **WITH** Filtration	**$480**
3	8-mgd WRC Delay – Chlorine Technology **WITHOUT** Filtration	**$455**
4	8-mgd WRC Delay – Chlorine Technology **WITH** Filtration	**$485**
5	8-mgd WRC Delay – Utilize Roger Road WRF's Existing Sludge System	**$485**
6	All at Once – Chlorine Technology **WITHOUT** Filtration	**$450**

***Total Cost includes $22.3M for Santa Cruz Extension Phase IV, costs associated with the 50 mgd upgrade/expansion of Ina Road, and new construction of the 32 mgd WRC.**

11.3 Economic Analysis

The financial implications of the ROMP Base Case and the selected alternatives were evaluated over a 15-year planning period. (FY 2007 – FY 2022). A planning period of this length was selected as it provides sufficient time to address the construction requirements for meeting regulatory compliance schedules, while allowing for sufficient time to incorporate the costs of specific funding assumptions that are identified in the Baseline Financing Plan (see Chapter 10). Capital project costs for each alternative were escalated annually by 5.0% to reflect the anticipated increase in costs over the forecast period. **Table 11-3** provides a projection of the annual ROMP project costs for the Base Case and each of the selected engineering alternatives. **Figure 11-3** summarizes the total ROMP project costs over the planning period.

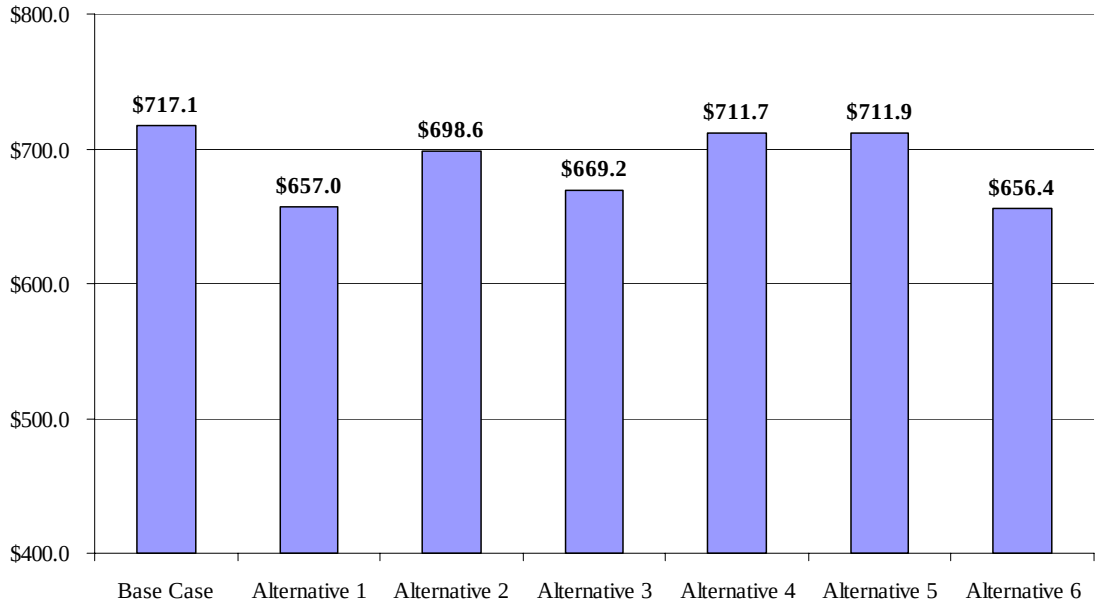
Table 11-3
ROMP Engineering Alternatives ($ Millions by Year)

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
ROMP Project Costs (1)								
Base Case	$ 0.35	$ 8.10	$ 51.92	$ 66.42	$ 102.31	$ 140.97	$ 156.84	$ 107.45
Alternative 1	$ 0.35	$ 8.10	$ 21.21	$ 28.97	$ 71.21	$ 153.42	$ 165.03	$ 111.84
Alternative 2	$ 0.35	$ 8.10	$ 21.21	$ 28.97	$ 77.24	$ 167.08	$ 179.10	$ 119.47
Alternative 3	$ 0.35	$ 8.10	$ 21.21	$ 28.97	$ 70.60	$ 147.10	$ 146.04	$ 89.99
Alternative 4	$ 0.35	$ 8.10	$ 21.21	$ 28.97	$ 76.63	$ 160.20	$ 158.52	$ 95.91
Alternative 5	$ 0.35	$ 8.10	$ 21.21	$ 28.97	$ 74.82	$ 157.01	$ 154.59	$ 93.76
Alternative 6	$ 0.35	$ 8.10	$ 22.52	$ 29.73	$ 102.24	$ 144.06	$ 175.93	$ 81.50

	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
ROMP Project Costs (1)								
Base Case	$ 36.22	$ 24.14	$ 7.39	$ 7.18	$ 7.82	$ -	$ -	$ -
Alternative 1	$ 23.74	$ 37.06	$ 8.72	$ -	$ 14.59	$ 12.77	$ -	$ -
Alternative 2	$ 23.91	$ 37.06	$ 8.72	$ -	$ 14.59	$ 12.77	$ -	$ -
Alternative 3	$ 46.97	$ 72.31	$ 10.18	$ -	$ 14.59	$ 12.77	$ -	$ -
Alternative 4	$ 49.38	$ 74.84	$ 10.18	$ -	$ 14.59	$ 12.77	$ -	$ -
Alternative 5	$ 48.92	$ 74.35	$ 10.18	$ -	$ 21.29	$ 18.39	$ -	$ -
Alternative 6	$ 22.89	$ 2.77	$ -	$ -	$ 43.45	$ 22.87	$ -	$ -

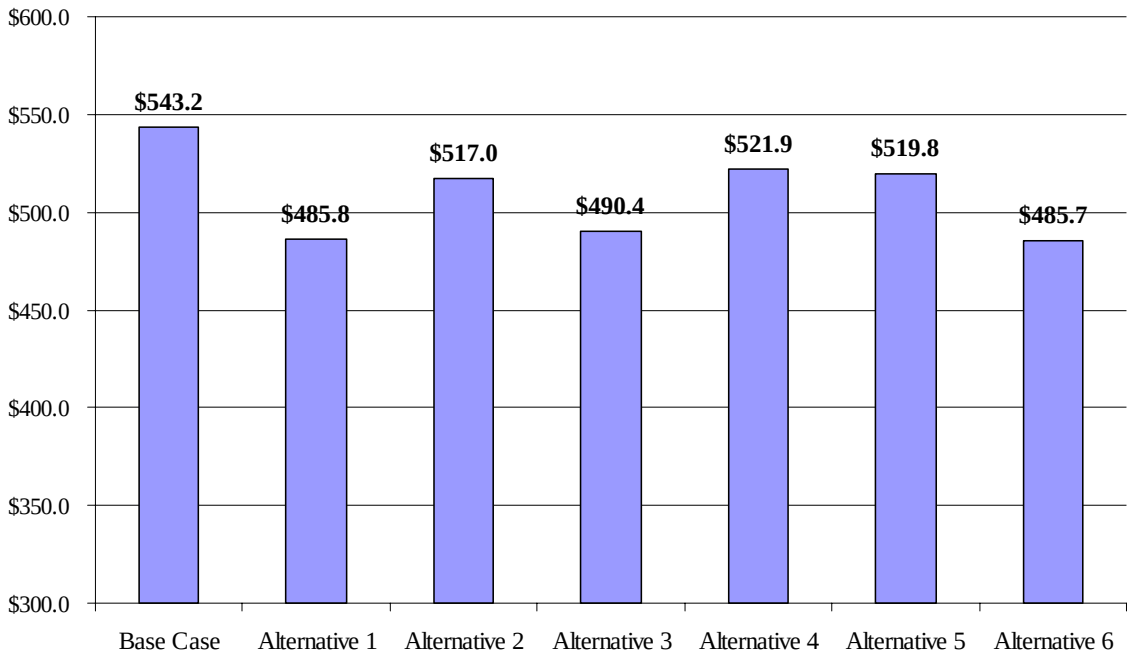
(1) ROMP project costs are escalated annually at a rate of 5.0%.

Figure 11-3
ROMP Engineering Alternatives - Total Cost ($ Millions)



It was determined that the most appropriate metric to serve as basis for comparing the economic impacts of the Base Case and the selected alternatives was a net present value (NPV) calculation. The NPV calculation is an effective tool that is designed to capture the difference in the timing of future investments, which provides a meaningful basis for comparing alternatives. For each alternative, the projected capital costs identified above were discounted back to a present value term based on a discount rate of 4.5%. The discount rate of 4.5% was chosen as it represented a reasonable proxy for the average cost of capital associated with PCRWRD's most recent revenue bond issuance. **Figure 11-4** presents the NPV Calculation for the Base Case and the selected alternatives.

Figure 11-4
ROMP Engineering Alternatives - NPV of Total Costs ($ Millions)



11.4 Summary and Recommended Alternative

The NPV calculation identified Alternative 6 as the most cost-effective ROMP engineering alternative. As described previously, Alternative 6 represents the concurrent construction of a new 32 MGD WRC and expansion/upgrade of a 50 MGD Ina Road WRF, with both facilities utilizing chlorination disinfection without a preceding filtration step.

While it is apparent that Alternative 6 would be the most cost effective approach to delivering the ROMP projects, both in terms of total cost and NPV, the feasibility of Alternative 6 has not been fully evaluated.

As is the case with the "All at Once" scenarios, Alternative 6 achieves a significant portion of its cost savings from the concurrent construction of the full 32 MGD Water Reclamation Campus at Roger Road WRF and the upgrades and expansion to 50 MGD at Ina Road WRF. Concurrent construction phasing may introduce some issues at Ina Road WRF that could potentially result in delays in the construction schedule at that facility. The feasibility and constructability of concurrent construction needs to be evaluated, as well as any potential cost increases due to this method. Therefore, it needs to be determined that concurrent phasing assumptions are feasible and will not result in significant cost increases..

Additionally, it should also be noted that the Base Case scenario, which has been presented to ADEQ, utilizes UV disinfection while many of the alternatives utilize chlorine for disinfection. While it is likely that the use of a chlorination process is indeed feasible, its feasibility has not been positively determined.

Therefore, until the feasibility of Alternative 6 is positively confirmed, the Base Case scenario is considered to be the most probable course of action with respect to the implementation of the ROMP projects and the economic analysis presented in Chapter 10 is based on the Base Case scenario.
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