

City of Riverside

**WASTEWATER COLLECTION AND TREATMENT  
FACILITIES INTEGRATED MASTER PLAN**

**VOLUME 8: SOLIDS TREATMENT AND HANDLING  
CHAPTER 8: IMPLEMENTATION SCHEDULE AND COST**

**FINAL**  
February 2008



**WASTEWATER COLLECTION AND TREATMENT  
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**VOLUME 8: SOLIDS TREATMENT AND HANDLING  
CHAPTER 8: IMPLEMENTATION SCHEDULE AND COST**

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## IMPLEMENTATION SCHEDULE AND COST

### 8.1 PURPOSE

The purpose of this chapter is to present the costs and schedules of the projects for the solids stream for the City of Riverside (City) Regional Water Quality Control Plant (RWQCP) Integrated Master Plan. This chapter is closely tied to Volume 4, Chapter 14 - Implementation Schedule and Cost, for the liquid stream projects.

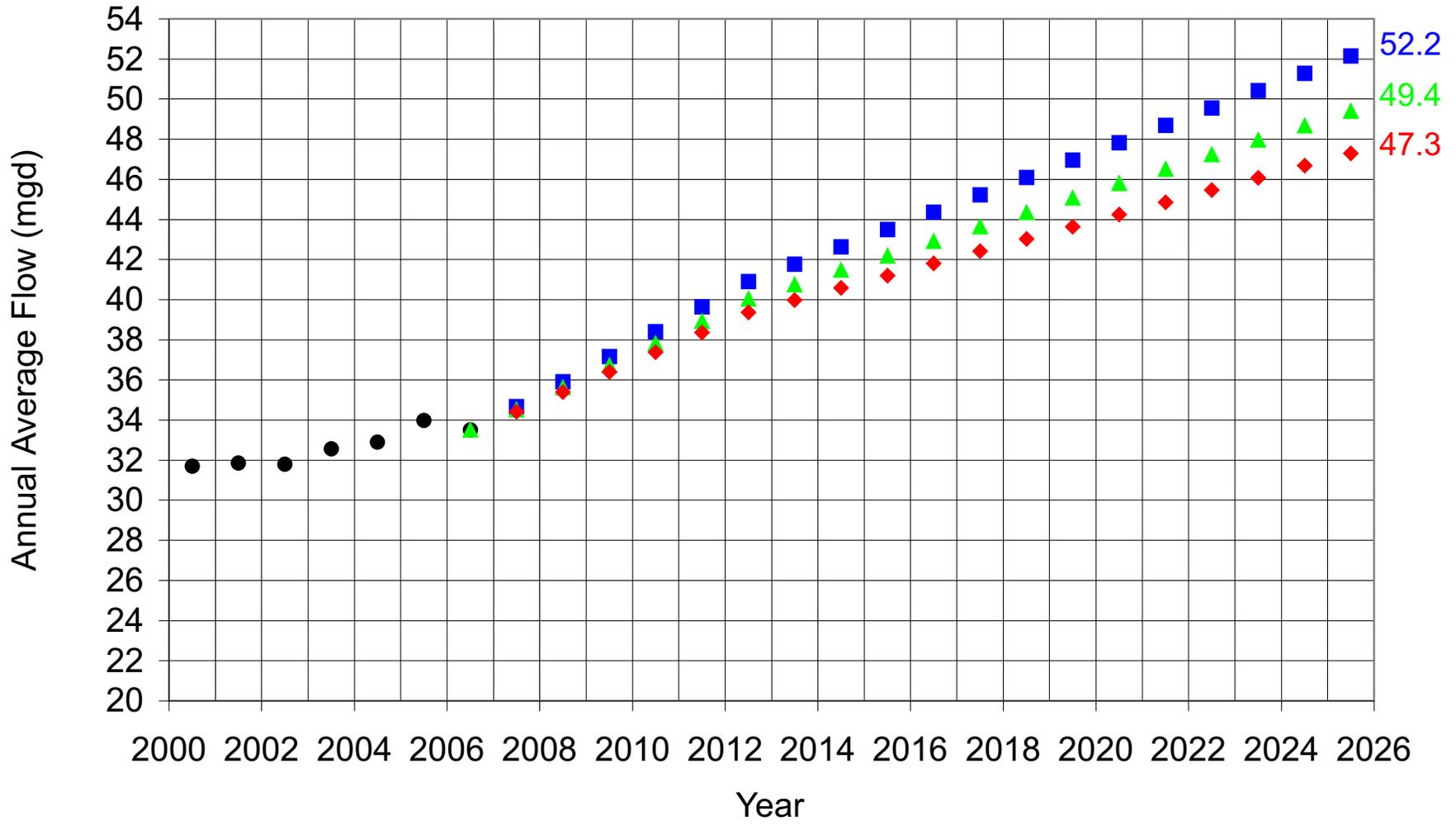
### 8.2 CONCLUSIONS AND RECOMMENDATIONS

- Primary Sludge Thickeners will be included in the Plant 1 Primary Expansion project.
- A Multi-Compartment Acid-Phase Digester will be combined into one project with the Plant 1 Primary Expansion and the Membrane Bioreactor (MBR) projects.
- Waste Activated Sludge (WAS) thickeners will be constructed in the later phase (project to begin in July 2023).

### 8.3 BACKGROUND

In Volume 2, Chapter 3 - Population and Flow Projections, the projected average daily flow for the RWQCP is 49.4 mgd. This is based on increasing the flow at the same rate as the projected population growth, which is 1.09 percent for the City. Because population and flow projections may be different than the actual values, a 90-percent confidence interval was applied to the data. This results in a high-growth scenario at 1.50 percent and low-growth scenario at 0.75 percent. Figure 8.1 shows the projected annual average influent flows for the RWQCP, along with projections using the high- and low-growth scenarios. Based on the existing capacity and future flow requirements, implementation schedules for both high-growth and low-growth scenarios were developed for the solids stream process projects, which are listed below:

- Solids Thickeners - Gravity Belt Thickeners (GBTs):
  - Five GBTs for primary sludge thickening.
  - Nine GBTs for WAS thickening.
- Anaerobic Digestion:
  - A new multi-compartment acid-phase digester.
- Solids Dewatering:
  - The City will have enough dewatering capacity with their existing centrifuges and belt presses. There is no requirement for installation of any additional centrifuges.



- Actual Flow Data
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- ▲ Master Plan Flow Projections (1.09% Annual Increase)
- ◆ Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)

**RWQCP FLOW PROJECTIONS**

FIGURE 8.1



- Solids Disposal:
  - The City has an agreement with Enertech to handle their solids disposal for up to 150 wet tons per day.

As mentioned in Volume 2, the City's original decision (August 2006) was to base all alternative analyses on the high-growth scenario. Subsequently (August 2007), after all analyses were completed, the City noticed a slowdown in the population/housing growth, and decided the low-growth scenario would be more appropriate for scheduling projects. Based on the August 2006 decision, the alternative analyses of this Master Plan are based on a 2025 flow of 52.2 mgd. However, as a result of the August 2007 decision, the capital costs, Operations and Maintenance (O&M) costs, Capital Improvement Plan (CIP), and schedule for the projects have been revised to reflect the low-growth scenario (2025 flow of 47.3 mgd).

## **8.4 COST AND SCHEDULE CRITERIA**

The implementation schedule for each project consists of a planning/design period and a construction/start-up period. A 2-year duration for the planning and design period is used for each project to include a conservative schedule at the master plan level. Because the projects for solids stream treatment are relatively small, if completed as separate projects, 1.5 years may be used for the construction and start-up period. The construction and start-up period is based on the contractor being able to perform approximately \$2 million per month worth of construction. When final implementation schedules are established, adjustments to this schedule should be made based on experience, looking at factors such as project sequencing and equipment procurement times. For some of the projects, it may be possible to shorten the planning/design and construction/start-up schedules. However, for the master plan, the schedules will be presented based on the criteria described above.

The costs for these projects are based on the information presented in the previous chapters for Volume 8 - Solids Treatment and Handling. They are based on costs in August 2006 dollars. These costs will be adjusted to their midpoint of construction before placement in the CIP, which is presented in Volume 10 - CIP and Overall Implementation Schedule.

## **8.5 SOLIDS STREAM TREATMENT FACILITIES SCHEDULE**

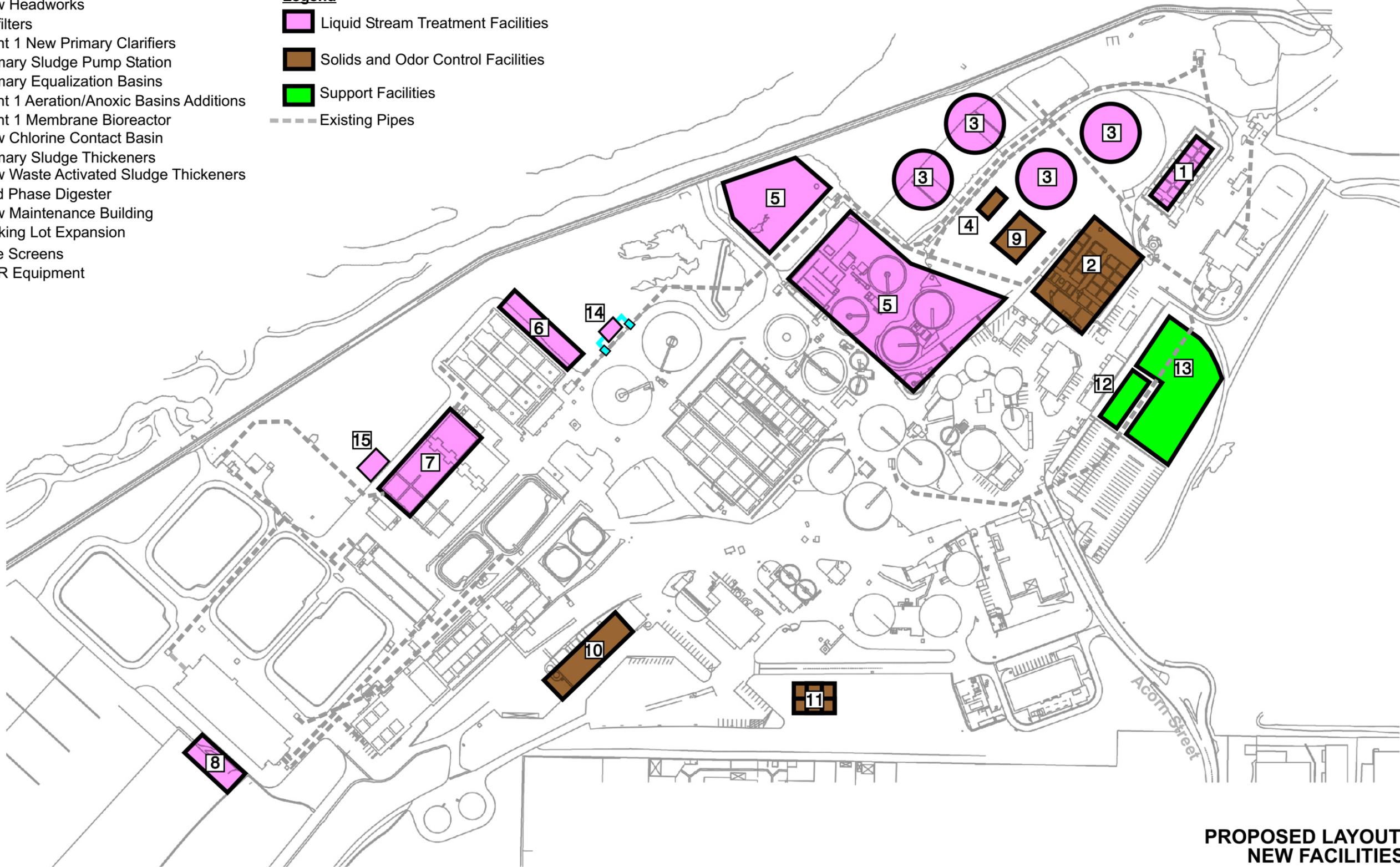
Figure 8.2 shows the proposed layout of the new solids stream treatment facilities. It also includes the liquid treatment facilities proposed in Volume 4 - Wastewater Treatment System. The schedules for the solids stream treatment facilities are discussed as follows.

**Key**

- 1 New Headworks
- 2 Biofilters
- 3 Plant 1 New Primary Clarifiers
- 4 Primary Sludge Pump Station
- 5 Primary Equalization Basins
- 6 Plant 1 Aeration/Anoxic Basins Additions
- 7 Plant 1 Membrane Bioreactor
- 8 New Chlorine Contact Basin
- 9 Primary Sludge Thickeners
- 10 New Waste Activated Sludge Thickeners
- 11 Acid Phase Digester
- 12 New Maintenance Building
- 13 Parking Lot Expansion
- 14 Fine Screens
- 15 MBR Equipment

**Legend**

- Liquid Stream Treatment Facilities
- Solids and Odor Control Facilities
- Support Facilities
- Existing Pipes



**PROPOSED LAYOUT FOR  
NEW FACILITIES**

FIGURE 8.2

### **8.5.1 Primary Sludge Thickening**

As described in Volume 8, Chapter 4 - Solids Production and Thickening Options, primary sludge thickening facilities using GBTs will be added as part of the RWQCP expansion to 52.2 mgd (annual averaged basis). As further described in Volume 4, Chapter 14, the thickeners will be included in the Plant 1 primary expansion project. Figure 8.3 shows the schedule of the Plant 1 Primary Expansion Project. Based on the schedule, assuming the low-growth scenario, the primary sludge thickeners will need to be completed by July 2013. Based on a 2-year planning/design period and a 2.5-year construction/start-up period as mentioned in Volume 4, Chapter 14 - Implementation Schedule and Cost, this project would need to begin at the beginning of 2008.

### **8.5.2 WAS Thickening**

The existing capacity of the two Dissolved Air Flotation Thickeners (DAFTs), with polymer addition, is estimated to be 48.4 mgd. As shown on Figure 8.4, the WAS thickening project does not need to start until July of 2023, in order to meet the January 2027 completion schedule assuming the low-growth scenario. This is based on a 2-year planning/design period and 1.5-year construction/start-up period.

### **8.5.3 Multi-Compartment Acid-Phase Digester**

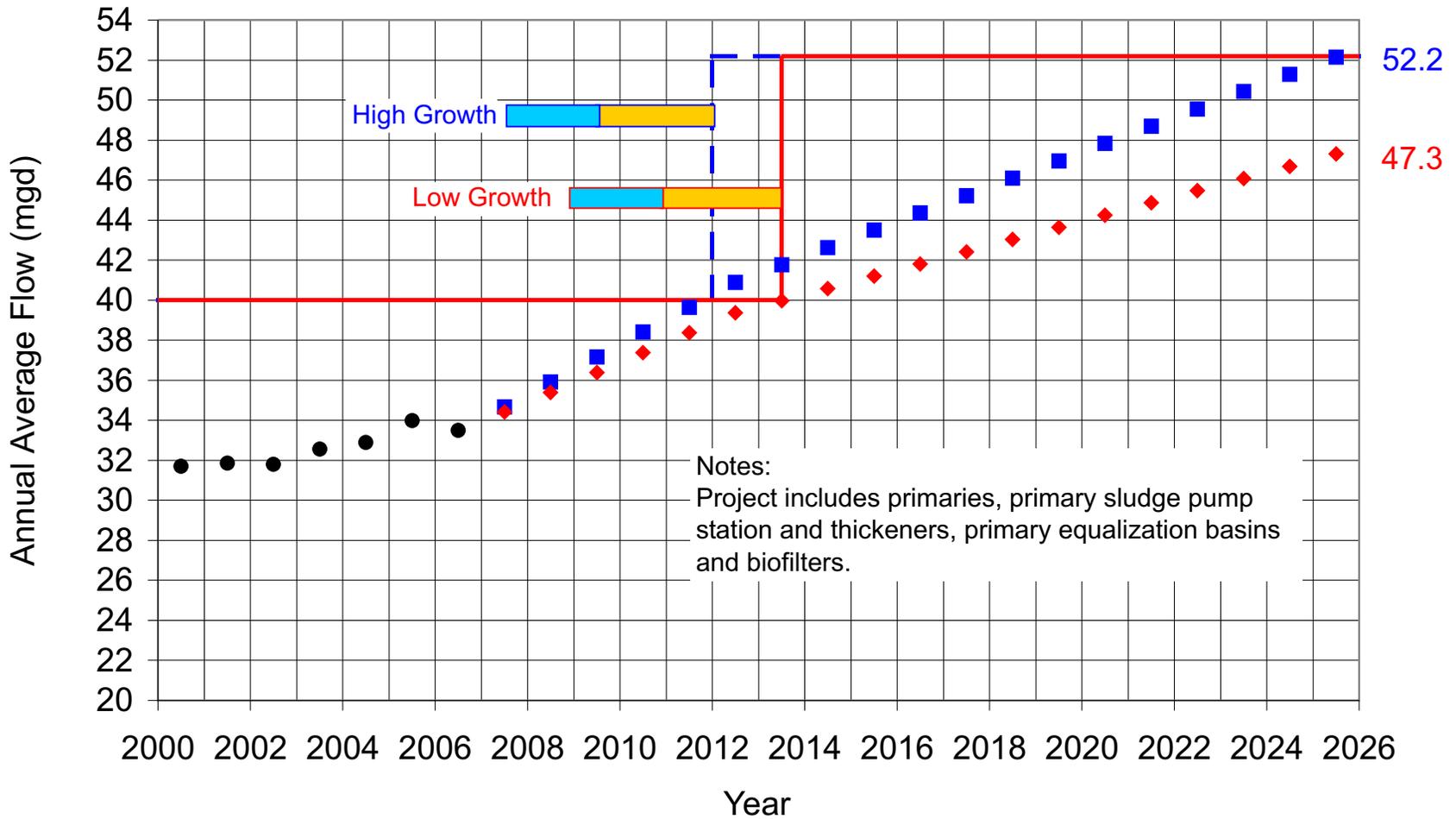
The calculations on anaerobic digestion in Volume 8, Chapter 5 - Solids Processing are based on the assumption that both primary sludge and WAS thickeners (GBTs) would be in use at the same time, resulting in a 6-percent solids sludge being fed to the digesters.

Based on the implementation schedule for WAS thickening presented above, the WAS would not be thickened to 6 percent, but to only 3.5 percent by the DAFTs. The capacity of the anaerobic digesters based on the 6-percent thickened primary sludge and 3.5-percent thickened WAS is estimated to be 39.7 mgd. As shown on Figure 8.5, assuming the low-growth scenario, the Multi-Compartment Acid-Phase Digester project will need to begin by the end of 2008 in order to meet the June 2012 completion schedule. This is based on a 2-year planning/design period and 1.5-year construction/start-up period.

### **8.5.4 Combination of Projects**

As described in Volume 4, Chapter 14 - Implementation Schedule and Cost, the Plant 1 Primary Expansion, MBR Facilities, and Acid-Phase Digester can be combined into one project, the 2008 Expansion Project. There are advantages and disadvantages of doing separate projects versus combined projects. These advantages and disadvantages are described in Volume 4, Chapter 14.

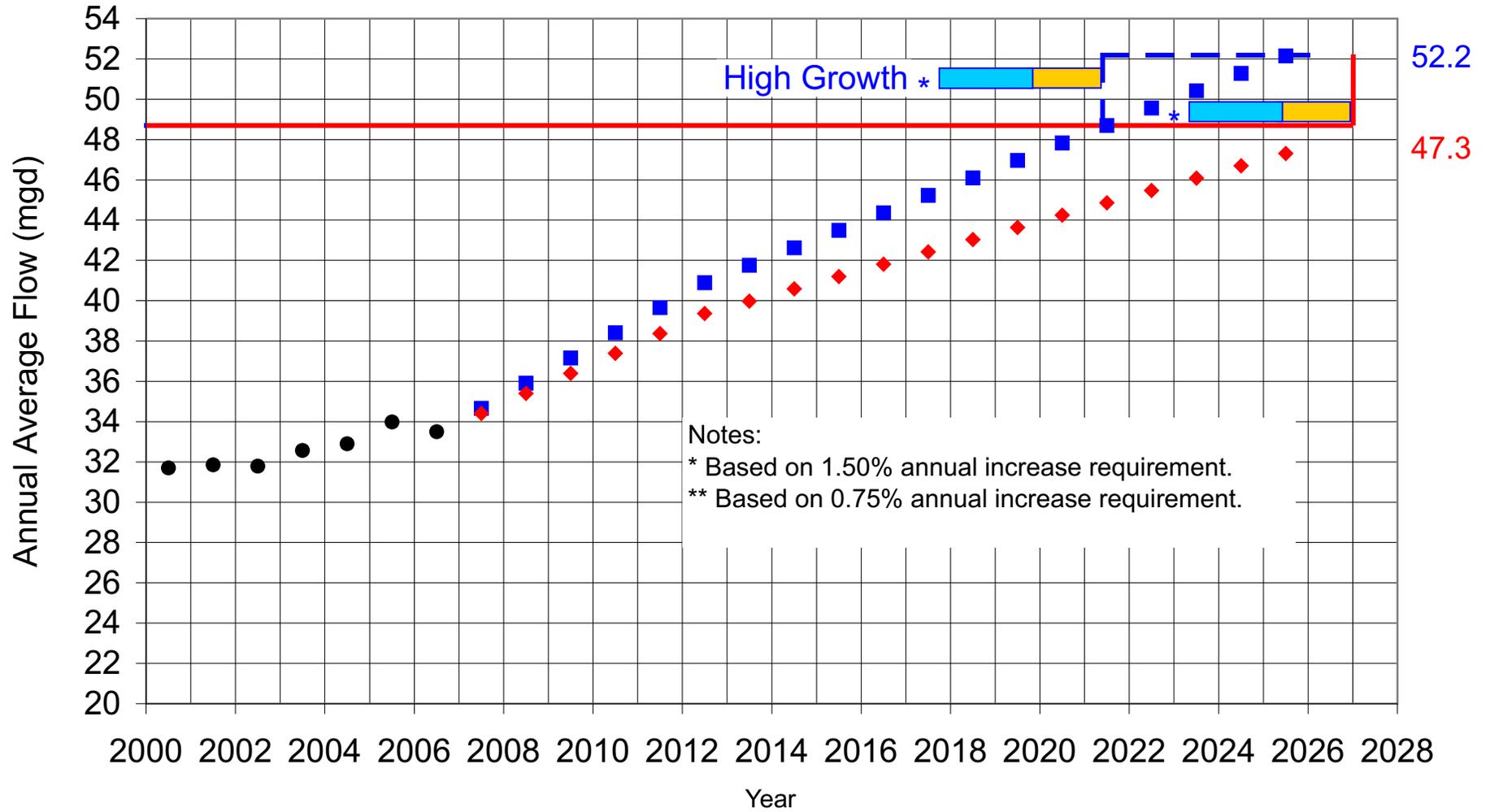
These advantages and disadvantages were presented to the City at a project meeting on March 21, 2007. Based on the discussion in the meeting, it was decided that a combined



- — Primary Treatment Capacity (1.50% Annual Increase – High-Growth Scenario)
- Primary Treatment Capacity (0.75% Annual Increase – Low-Growth Scenario)
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- ◆ Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)
- Planning/Design
- Construction/Startup

**PLANT 1  
PRIMARY EXPANSION SCHEDULE**

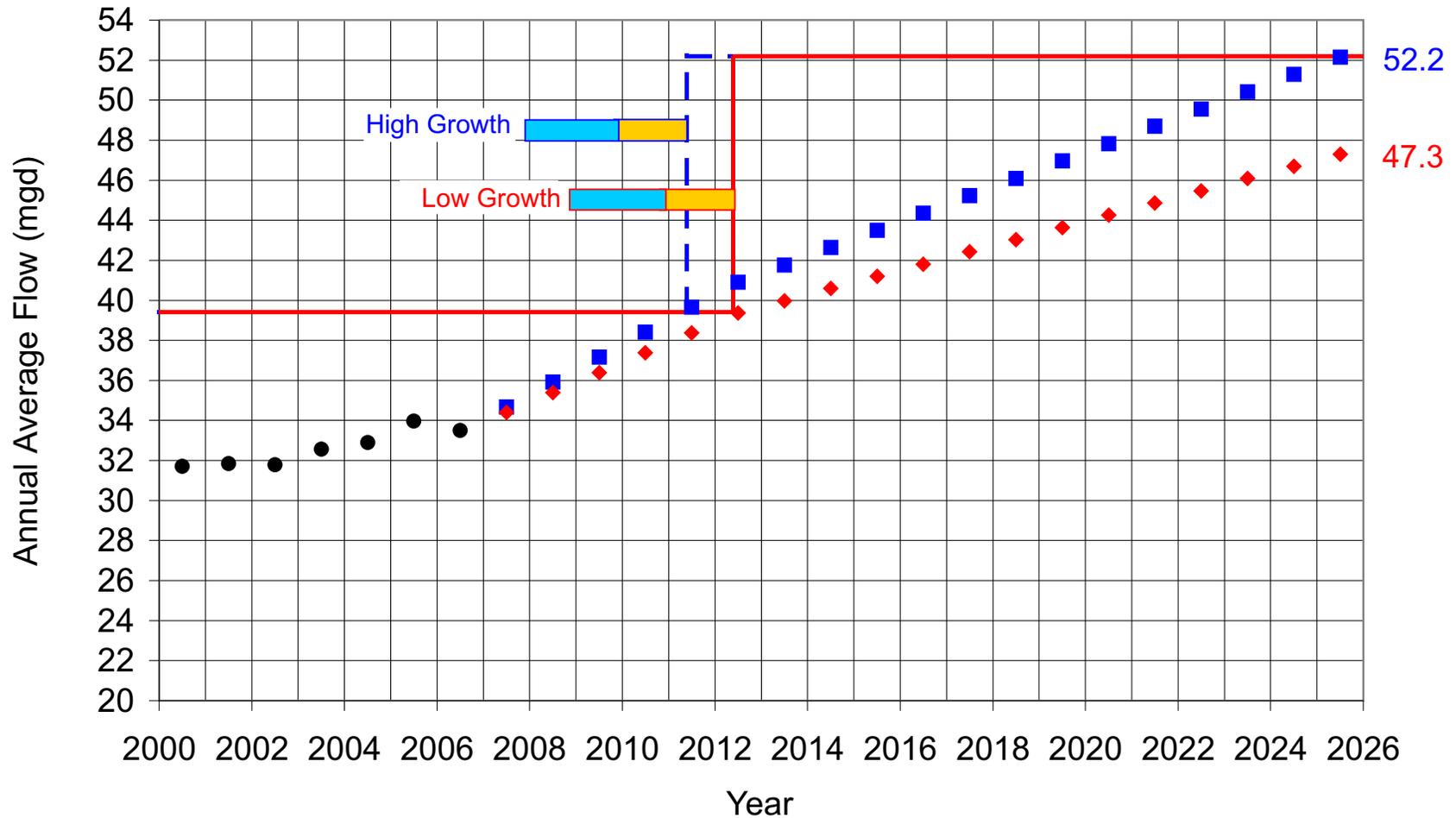
FIGURE 8.3



- WAS Thickening (1.50% Annual Increase – High-Growth Scenario)
- WAS Thickening (0.75% Annual Increase – Low-Growth Scenario)
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- ◆ Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)
- Planning/Design
- Construction/Startup

## WAS THICKENER SCHEDULE

FIGURE 8.4



- — Digester Capacity (1.50% Annual Increase – High-Growth Scenario)
- Digester Capacity (0.75% Annual Increase – Low-Growth Scenario)
- Master Plan Flow Projections (1.50% Annual Increase – High-Growth Scenario)
- ◆ Master Plan Flow Projections (0.75% Annual Increase – Low-Growth Scenario)
- Planning/Design
- Construction/Startup

### MULTI-COMPONENT ACID PHASE DIGESTER SCHEDULE

FIGURE 8.5

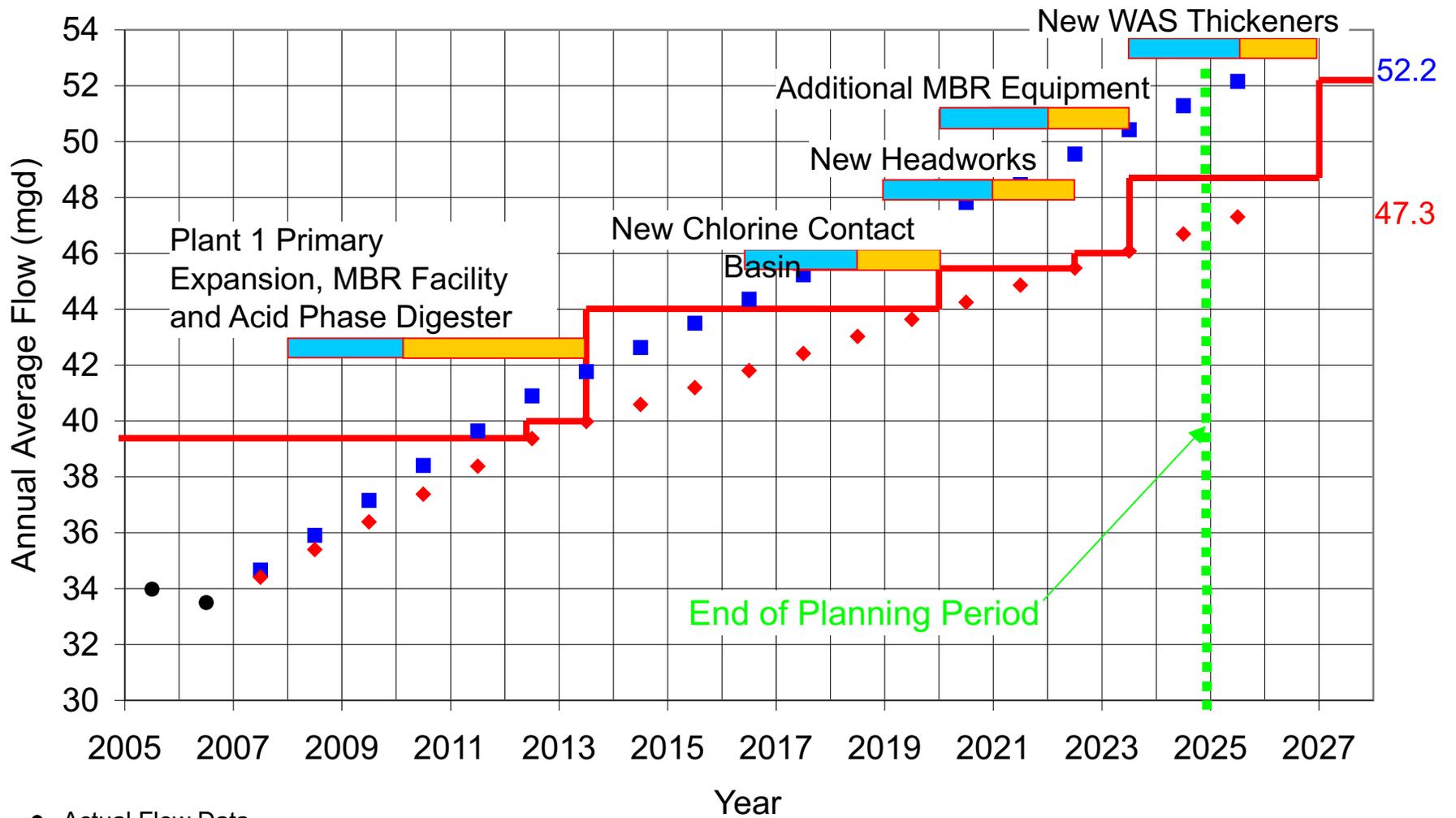
project consisting of the Plant 1 Primary Expansion, MBR Facilities, and Acid-Phase Digester would be completed, instead of completing the projects separately.

At the meeting, it was also decided that the WAS thickeners will be constructed as a separate project. Assuming the low-growth scenario, the combined project needs to begin in January of 2008, based on a 2-year planning/design period and a 3.5-year construction/start-up period (Figure 8.6). Figure 8.7 shows the schedule of the combined project with the high-growth scenario.

## 8.6 IMPLEMENTATION COST

The total project costs of the new liquid and solids stream facilities are summarized in Table 8.1. This is also presented in Volume 4, Chapter 14 - Implementation Schedule and Cost. The costs are based on an Engineering News-Record (ENR) value of 8,570 (Los Angeles, August 2006). The midpoint construction costs, adjusted for the phasing and schedule, are presented in Volume 10 - CIP and Overall Implementation Schedule.

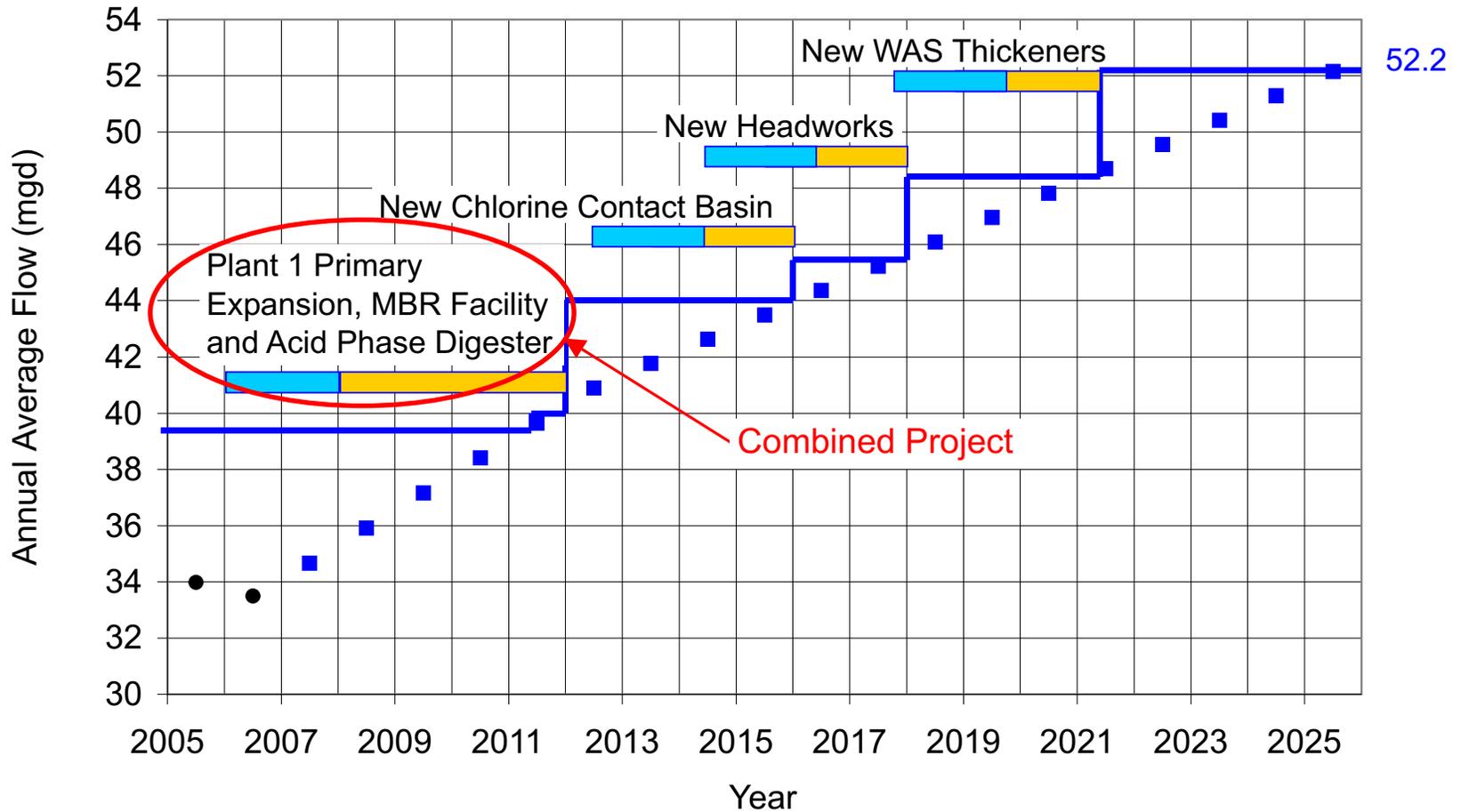
<b>Table 8.1 Total Project Cost for Proposed Expansion - Liquid and Solids Stream Facilities Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside</b>			
<b>Separate Projects</b>	<b>Project Cost<sup>(1)</sup></b>	<b>Combined Projects</b>	<b>Project Cost<sup>(1)</sup></b>
Plant 1 Primary Expansion	\$64 M	Primary, MBR, and Digester	\$185 M
Primary Clarifiers		Primary Clarifiers	
Primary Sludge Pump Station		Primary Sludge Pump Station	
Primary Sludge Thickening Facility <sup>(2)</sup>		Primary Sludge Thickening Facility <sup>(2)</sup>	
Primary Effluent Equalization Basins		Primary Effluent Equalization Basins	
Biofilters		Biofilters	
MBR Facility	\$108 M	MBR Facility	
Acid-Phase Digester <sup>(2)</sup>	\$13 M	Acid-Phase Digester <sup>(2)</sup>	
New Chlorine Contact Basin	\$4 M	New Chlorine Contact Basin	\$4 M
New Headworks	\$10 M	New Headworks	\$10 M
Additional MBR Equipment	\$12 M	Additional MBR Equipment	\$12 M
WAS Thickening Facility <sup>(2)</sup>	\$17 M	WAS Thickening Facility <sup>(2)</sup>	\$17 M
<b>Total Cost</b>	<b>\$228 M</b>	<b>Total Cost</b>	<b>\$228 M</b>
<b>Notes:</b>			
(1) As present value (ENR value of 8,570 for Los Angeles in August 2006).			
(2) Details discussed in Volume 8 - Solids Treatment and Handling.			



- Actual Flow Data
- ◆ Master Plan Flow Projections
- Treatment Capacity
- Planning/Design
- Construction/Startup

**COMBINED PROJECTS SCHEDULE FOR LOW GROWTH SCENARIO**

FIGURE 8.6



- Actual Flow Data
- Master Plan Flow Projections
- Treatment Capacity
- Planning/Design
- Construction/Startup

**COMBINED PROJECTS SCHEDULE FOR HIGH GROWTH SCENARIO**

FIGURE 8.7