

**APPENDIX A-2**

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**Technical Memorandum entitled “Water Treatment Cost Estimate”  
by Carollo Engineers**



City of Fresno

Master Plan Update

**Water Treatment Cost Estimates**

**DRAFT**

May 9, 2006





## **1.0 INTRODUCTION**

The purpose of this Technical Memorandum is to present cost estimates for two alternative approaches for adding surface water treatment capacity to the City's system. These two alternatives are as follows:

- **Alternative 1:** expansion of the existing Surface Water Treatment Plant (SWTP) by 30 mgd for a total capacity of 60 mgd
- **Alternative 2:** construction of a new 30 mgd surface water treatment plant, with expandability to 60 mgd

Cost estimates include both construction and operations & maintenance costs, for the treatment processes of both alternatives. Transmission pipe costs are considered under separate cover.

### **1.1 Treatment Processes**

It has been assumed that the treatment processes in the existing SWTP, that include carbon dioxide addition, ballasted flocculation, ozonation, and GAC/sand biologically active filters, will be retained for the plant expansion alternative. The treatment processes are appropriate for the source water and there is no reason to consider different processes, at this time. With respect to a new plant, it is anticipated to be located along the Gould Canal or Mill Ditch, in southeast Fresno or in the City of Clovis. The canal and ditch waters are similar to the source water for the existing SWTP, and therefore, the same treatment train would also likely be selected for the new treatment plant. Therefore, the treatment processes in the existing SWTP have been assumed to be included for both Alternative 1 and 2, for this cost comparison.

## **2.0 CONSTRUCTION COST ESTIMATES**

Construction cost estimates for both alternatives are based upon the cost to construct the existing SWTP, because construction was recently completed for that facility (i.e. commissioning in summer 2004) and the treatment processes are expected to be the same. That construction cost was modified appropriately, as described below for each alternative, and then escalated from the mid-point of construction (April 2003) to March 2006, the most current month for which an ENR Construction Cost Index is available. The 20-city average Construction Cost Index was used for this evaluation, as opposed to the index for the city nearest to Fresno, because it is generally considered the most appropriate and conservative approach for Master Plan cost estimating. The Construction Cost Index

increased from a value of 6635 in April 2003, to a value of 7692, in March 2006. All costs presented herein are in 2006 US Dollars.

## 2.1 Construction Cost Estimate for Alternative 1: Plant Expansion

Design criteria developed as part of the design of the existing SWTP formed the basis for the cost estimates presented herein, and are included in the Appendix of this Technical Memorandum. The plant design also included design criteria for expansion of the design capacity to 60 mgd and the hydraulic capacity to 100 mgd. The plant expansion alternative considered herein, increases the hydraulic capacity of the plant from 30 to 60 mgd, and not to 100 mgd. Therefore, the criteria used for estimating the cost of this expansion differ, in some cases, from those presented in the original plant design. The specific criteria and assumptions used to develop the costs are presented in the following paragraph.

The plant expansion includes the cost of the addition of two raw water pumps, for a total of six. The existing ozone generator was designed with excess capacity and therefore no new ozone generators have been included in the cost of the plant expansion. Two new clarification basins are included to provide a total of four basins. The existing backwash pump capacity is sufficient for the expansion, and therefore no new backwash pumps have been included. One additional treated water pump has been included (for a total of five) and two additional washwater pumps are included, for a total of four. Two additional ozone contact basins (eight-stage counter/co-current) are also included. The cost of the installation of six new GAC/sand filters and a new filter building has also been included. The cost of a 2.5 million gallon (MG) treated water reservoir has been included, to provide a total treated water storage capacity of 4 MG on site. The cost of a new washwater equalization basin has been included, for a total of two basins, and also the addition of two solids drying beds, for a total of six. The expansion does not include any significant changes to the plaza area or operations building. A construction cost estimate for Alternative 1 is presented in Table 2.1.

| <b>Table 2.1 Construction Cost Estimate for Expansion of the Existing Plant (30 to 60 mgd) Water Treatment Cost Estimates City of Fresno</b> |             |
|--|-------------|
| <b>Project Element</b>   | <b>Cost</b> |
| Mobilization and General Conditions  | \$4,400,000 |
| Submittals, Approvals, Fabrication and Delivery  | \$8,500,000 |
| Sitework   | \$5,600,000 |
| Clarification Basins   | \$1,500,000 |
| Chemical Storage Building  | \$2,300,000 |
| Filter Building  | \$3,900,000 |

|   |                     |
|---|---------------------|
| Plaza, Tunnel, and Meter Facility   | \$42,000            |
| Operations Building   | \$0                 |
| Ozone Contact Basins  | \$1,400,000         |
| Raw Water Pump Station and Electrical   | \$100,000           |
| Treated Water Pump Station and Electrical   | \$25,000            |
| 2.5 MG Treated Water Reservoir  | \$2,900,000         |
| Waste Washwater Reclamation   | \$500,000           |
| Subtotal  | \$31,000,000        |
| Engineering and Administration @ 12%  | \$3,700,000         |
| <b>Total Construction Cost Estimate</b>   | <b>\$35,000,000</b> |
| Notes:  |                     |
| a. 2006 US dollars, indexed to ENR Construction Cost Index of 7,692.              |                     |
| b. Construction cost includes general conditions, contractor overhead and profit. |                     |

## 2.2 Construction Cost Estimate for Alternative 2: New Plant

For Alternative 2 construction of a new plant in the Southeast area of Fresno, construction costs have been based upon the design criteria for the existing SWTP, with a design capacity of 30 mgd, and a hydraulic capacity of 30 mgd. The main difference between the conceptual Southeast plant and the existing plant, is that it includes the cost of a 4 MG treated water reservoir, instead of a 1.5 MG treated water reservoir. A construction cost estimate for Alternative 2 is presented in Table 2.2.

| <b>Table 2.2 Construction Cost Estimate for a New 30 mgd Plant<br/>Water Treatment Cost Estimates<br/>City of Fresno</b> |             |
|--|-------------|
| <b>Project Element</b>   | <b>Cost</b> |
| Mobilization and General Conditions  | \$4,400,000 |
| Submittals, Approvals, Fabrication and Delivery  | \$9,800,000 |
| Sitework   | \$5,600,000 |
| Clarification Basins   | \$1,500,000 |
| Chemical Storage Building  | \$2,300,000 |
| Filter Building  | \$3,900,000 |
| Plaza, Tunnel, and Meter Facility  | \$142,000   |
| Operations Building  | \$2,500,000 |
| Ozone Contact Basins   | \$1,400,000 |

|   |                     |
|---|---------------------|
| Raw Water Pump Station and Electrical   | \$500,000           |
| Treated Water Pump Station and Electrical   | \$1,000,000         |
| 4 MG Treated Water Reservoir  | \$4,600,000         |
| Waste Washwater Reclamation   | \$500,000           |
| Subtotal  | \$38,000,000        |
| Engineering and Administration @ 12%  | \$4,600,000         |
| <b>Total Construction Cost Estimate</b>   | <b>\$43,000,000</b> |
| Notes:  |                     |
| a. 2006 US dollars, indexed to ENR Construction Cost Index of 7,692.              |                     |
| b. Construction cost includes general conditions, contractor overhead and profit. |                     |

The construction cost of expanding the new Southeast plant, from 30 to 60 mgd, would be essentially the same as that of expanding the existing SWTP. Without the addition of an additional treated water reservoir, the cost would be \$28 million plus \$3.4 million for engineering and administration, for a total of \$32 million (all costs US dollars, 2006).

### 2.3 Cost Summary

The construction and land costs for Alternatives 1 and 2 are summarized in Table 2.3. The cost of expanding the existing plant to 60 mgd has the lowest construction cost of the alternatives considered.

| Cost Element   | Alternative 1:      |                            | Alternative 2: New Plant         |  |
|--|---------------------|----------------------------|----------------------------------|--|
|  | Expansion to 60 mgd | 30 mgd <sup>b</sup>        | Expansion to 60 mgd <sup>c</sup> |  |
| Design and Construction  | \$35 million        | \$43 million               | \$32 million                     |  |
| Land Purchase  | \$0 <sup>d</sup>    | \$7.7 million <sup>e</sup> | \$6.0 million <sup>f</sup>       |  |
| Total Cost Estimate  | \$35 million        | \$51 million               | \$38 million                     |  |
| Notes:   |                     |                            |                                  |  |
| a. 2006 US dollars.  |                     |                            |                                  |  |
| b. Includes 4 MG treated water reservoir.  |                     |                            |                                  |  |
| c. Does not include additional treated water reservoir.  |                     |                            |                                  |  |
| d. Approximately 17 acres of land are required, however the City already owns sufficient land adjacent to the existing SWTP. |                     |                            |                                  |  |
| e. Approximately 22 acres is required, at an estimated cost of \$350,000/acre.   |                     |                            |                                  |  |
| f. Approximately 17 additional acres is required, at an estimated cost of \$350,000/acre                                     |                     |                            |                                  |  |



### 3.0 OPERATIONS & MAINTENANCE COST ESTIMATES

Operations & maintenance (O&M) costs for both alternatives are based upon the cost to operate and maintain the existing SWTP, because the treatment processes, chemical usage and power requirements are expected to be similar. The cost elements included in the O&M costs are chemicals, power, labor, and maintenance.

For this cost estimate, it is assumed that the expanded portion of the existing plant and the new 30 mgd plant will both have an average annual production of 20 mgd. O&M costs are based upon the average annual production, rather than design capacity, because plants are not typically operated at the design flow year-round, due to seasonal patterns in water use. Although it is recognized that actual plant production may deviate from 20 mgd, especially during the first few years of operation of new treatment facilities, the unit O&M cost of treated water is expected to be representative for this comparison of alternatives, regardless of plant production.

Chemical usage for both alternatives is expected to be essentially the same because both options include the same treatment processes and would be treating similar source waters. A single estimate of chemical costs has been developed, based upon chemical usage at the existing SWTP (Table 3.1), because no significant differences between the alternatives is anticipated.

| <b>Table 3.1 Estimated Chemical Usage and Costs for Both Alternatives<br/>Water Treatment Cost Estimates<br/>City of Fresno</b> |                                       |                          |                                  |
|---|---------------------------------------|--------------------------|----------------------------------|
| <b>Chemical</b>   | <b>Average Annual<br/>Dose (mg/L)</b> | <b>Unit Cost (\$/lb)</b> | <b>Estimated Annual<br/>Cost</b> |
| Aluminum Sulfate  | 40                                    | 0.17                     | \$413,466                        |
| Sodium Hydroxide  | 10                                    | 0.40                     | \$243,215                        |
| Sodium Hypochlorite   | 5                                     | 0.30                     | \$91,206                         |
| Magnafloc LT22S   | 1                                     | 1.40                     | \$85,125                         |
| Carbon Dioxide  | 10                                    | 0.40                     | \$243,215                        |
| Ortho/Polyphosphate   | 5                                     | 0.50                     | \$152,010                        |
| Calcium Thiosulfate   | 2                                     | 0.75                     | \$91,206                         |
| <b>Total Annual Chemical Cost Estimate</b>  |                                       |                          | <b>\$1,300,000</b>               |

Power costs were estimated based upon power usage data for the existing SWTP and also an analysis of power costs for similar plants. Power costs are higher for the new plant alternative because that plant would require construction of a new operations building that

will require lighting and climate control. Expansion of the existing plant does not include construction of a new operations building.

Labor will likely be different between the two alternatives, because the existing SWTP already has operations and maintenance staff on-site, whereas, the new facility would require additional staffing. For the plant expansion alternative, it is anticipated that no new operations staff would be required because operations will be performed from the existing building with the new treatment facilities integrated into the SCADA system. It is assumed that one additional maintenance person will be required to service the new facilities.

For the new plant alternative, it may be possible to share some operations and maintenance staff with the existing plant, however, the new plant will require dedicated staffing. The existing plant has a total of five operations staff (with four persons on duty at any time) and one maintenance staff member. For this estimate, a total of four persons have been included to perform operations and maintenance at the new plant.

A summary of the operations & maintenance cost estimate for each alternative is presented in Table 3.2.

| <b>Table 3.2 Operations &amp; Maintenance Cost Estimate Summary<br/>Water Treatment Cost Estimates<br/>City of Fresno</b>  |  |                                    |
|--|--|------------------------------------|
| <b>Cost Element</b>  | <b>Estimated Annual Cost</b>             |                                    |
|  | <b>Alternative 1<br/>Plant Expansion</b> | <b>Alternative 2<br/>New Plant</b> |
| Chemicals  | \$1,300,000                              | \$1,300,000                        |
| Power @ \$0.10 per kWh <sup>a</sup>  | \$500,000                                | \$600,000                          |
| Labor  | \$80,000 <sup>b</sup>                    | \$330,000 <sup>c</sup>             |
| Maintenance (0.25% of construction cost estimate)  | \$78,000                                 | \$95,000                           |
| <b>Total Annual O&amp;M Cost Estimate</b>  | <b>\$2,000,000</b>                       | <b>\$2,300,000</b>                 |
| <b>O&amp;M Cost Estimate (\$/1000 gal)</b>   | <b>\$0.27</b>                            | <b>\$0.32</b>                      |
| Notes:   |  |                                    |
| a. Power cost estimated based upon existing SWTP power usage and comparison to data for similar plants. The higher cost for the new plant alternative reflects additional costs for lighting and climate control of a new operations building. |  |                                    |
| b. One full-time operations/maintenance staff at \$40/hr.  |  |                                    |
| c. Four full-time operations/maintenance staff at \$40/hr.   |  |                                    |