City of Oxnard

Public Works Integrated Master Plan

**OVERALL**

**PROJECT MEMORANDUM 1.4**
**BASIS OF COST**

**FINAL DRAFT**
December 2015

This document is released for the purpose of information exchange review and planning only under the authority of Hugh Steve McDonald, December 2015, State of California, PE No. 44074 and Tracy Anne Clinton, December 2015, State of California, PE No. 48199

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City of Oxnard

Public Works Integrated Master Plan

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# 1.0 INTRODUCTION

Cost estimates are often prepared at various stages during project planning and design. The cost estimate is one of the most sensitive products prepared for a project. The level of accuracy that can be expected is directly proportional to the level of engineering effort completed. Each cost estimate must be carefully prepared from the conceptual level to the facilities plan level, through the preliminary design and the final engineer's estimate.

## 1.1 Project Memorandums (PMs) Used for Reference

The basis of cost outlined in this PM is made in concert with recommendations and analyses from other related PMs:

- PM 1.1 - Master Planning Process Overview.

## 1.2 Other Reports Used for Reference

In developing the basis of cost in this PWIMP, the following reports were used:

- Cost Estimate Classification System, Association for the Advancement of Cost Engineering International, November 2011, (AACE, 2011).
- Construction Cost Index, Engineering and News Records (ENR, 2015).
- R.S. Means Building Construction Cost Data (RSMeans, 2015).

## 1.3 Scope and Level of Accuracy

The Association for the Advancement of Cost Engineering International (AACE International, formerly known as the American Association of Cost Engineers) has suggested levels of accuracy for five estimate classes. These five estimate classes are presented in the AACE International Recommended Practice No. 17R-97 (Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries). Table 1 presents a summary of these five estimate classes and their characteristics, including expected accuracy ranges (AACE, 2011).

The quantity and quality of the information required to prepare an estimate depends on the end use for that estimate. Typically, as a project progresses from the conceptual phase to the study phase, preliminary design and final design, the quantity and quality of information increases, thereby providing data for development of a progressively more accurate cost estimate. A contingency is often used to compensate for lack of detailed engineering data, oversights, anticipated changes, and imperfection in the estimating methods used. As the quantity and quality of data becomes better, smaller contingency allowances are typically utilized. For the projects developed as a part of this Public Works Integrated Master Plan

**Table 1 Classes of Cost Estimates[1]**
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| Estimate Class | Primary Characteristic | Secondary Characteristic | | | |
|---|---|---|---|---|---|
| | Level of Project Definition Expressed as % of Complete Definition | End Usage Typical Purpose of Estimate | Methodology Typical Estimating Method | Expected Accuracy Range Typical +/- Range Relative to Index of 1 (i.e., Class 1 Estimate)[1a] | Preparation Effort Typical Degree of Effort Relative to Least Cost Index of 1[1b] |
| Class 5 | 0% to 2% | Screening or Feasibility | Stochastic (factors and/or models) or judgment | 4 to 20 | 1 |
| Class 4 | 1% to 15% | Concept Study or Feasibility | Primarily stochastic | 3 to 12 | 2 to 4 |
| Class 3 | 10% to 40% | Budget, Authorization, or Control | Mixed but primarily stochastic | 2 to 6 | 3 to 10 |
| Class 2 | 30% to 75% | Control or Bid/Tender | Primarily deterministic | 1 to 3 | 5 to 20 |
| Class 1 | 65% to 100% | Check Estimate or Bid/Tender | Deterministic | 1 | 10 to 100 |

Notes:
(1) Table 1 comes from the AACE International Recommended Practices, No. 17R-97 (AACE, 2011):
(a) If the range index value of "1" represents +10/-5%, then an index value of 10 represents +100/-50%.
(b) If the cost index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.

(PWIMP), cost estimates are developed following the AACE International Recommended Practice No. 17R-97 estimate classes 5 and 4.

Class 5 estimates are prepared for any number of strategic business planning purposes, including, but not limited to: project screening, evaluation of resource needs and budgeting, and long-range capital planning. Very limited information is available at the time when a Class 5 estimate is developed. Therefore, Class 5 estimates virtually always use stochastic estimating methods such as cost to capacity curves and various scaling factors. Subsequently, estimated costs have wide accuracy ranges. Typical accuracy ranges for Class 5 estimates are -20 percent to –50 percent on the low side, and +30 percent to +100 percent on the high side, depending on the technological complexity of the project, availability and accuracy of appropriate reference information, and the inclusion of an appropriate contingency determination. The majority of capital costs for the PWIMP improvements are prepared based on Class 5 estimates using the methods outlined in the sections below.

Class 4 estimates are prepared for any number of strategic business planning purposes including, but not limited to, detailed strategic planning, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage. Limited information is available at the time when a Class 4 estimate is developed. Therefore, Class 4 estimates virtually always use stochastic estimating methods such as parametric or other modeling techniques, and various factors. Subsequently, estimated costs have fairly wide accuracy ranges. Typical accuracy ranges for Class 4 estimates are –15 percent to –30 percent on the low side, and +20 percent to +50 percent on the high side, depending on the technological complexity of the project, availability and accuracy of appropriate reference information, and the inclusion of an appropriate contingency determination. Capital costs for the PWIMP improvements where a detailed study has been done or where specific design data is known are prepared based on Class 4 estimates. Class 4 estimates typically use lower contingencies than what is discussed in this memo due to better project definition.

## 1.4 Basis for Capital, Operations and Maintenance (O&M) and Annualized Costs

The costs presented in the PWIMP are based on preliminary layouts, preliminary unit process sizes, and conceptual alternative configurations. Construction costs are estimated for new capital, replacement, and repair and rehabilitation projects. Construction costs for new capital and replacement projects are estimated from unit costs developed from past Los Angeles construction contracts, estimating guides, unit prices, and construction costs of similar facilities and configurations at other locations. Construction costs for repair and rehabilitation are based on structural and equipment estimates. Equipment costs were developed from reference projects and R.S. Means data. The O&M costs are based on

historical and estimated operating costs, estimated labor needs, resource requirements, and equipment replacement and maintenance needs.

A summary of the economic criteria to be used for estimating costs is presented in Table 2. These economic criteria are applied to capital and O&M costs when developing annual costs.

**Table 2 Economic Criteria**
**Public Works Integrated Master Plan**
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| Item | Assumption |
|---|---|
| Costs in Time and Place(1) | Costs are based on Oxnard costs in February 2015 |
| Inflation Rate(2) | Annual inflation rate is assumed to be 3 percent |
| Interest Rate(2) | 5 percent for amortization purpose |
| Amortization Period | 20 years |

Note:
(1) 20-City Average Index ENR CCI of 9,962 was used for February 2015. A R.S. Means Location Factor of 106.6 for Oxnard was used (ENR, 2015) (RSMeans, 2015).
(2) The inflation and interest rate are based on past experience with and an understanding of the economic climate of this industry.

## 2.0 CAPITAL COSTS

While the estimated construction costs represent the average bidding conditions for many projects, variations in bidding climate at the time the facilities are constructed can affect actual construction costs. Further, the size and specific design details of the facilities may be refined during preliminary design based on the most current operational information available. For these reasons, the actual construction costs may be lower or higher than originally estimated. As mentioned earlier, Class 4 and Class 5 estimates are not as accurate as estimates prepared in conjunction with preliminary or final design.

Construction costs have historically escalated with time. This trend is expected to continue in the future. To record these trends in rising costs, several indices have been established for various fields of construction. The standard indicator of changes in heavy construction prices is the Engineering News Record Construction Cost Index (ENR CCI). Construction costs, largely developed in February 2015, are based on the 20-City Average Index ENR CCI of 9,962. To account for the project location, the corresponding R.S. Means Location Factor of 106.6 was used. The project location has been defined as Oxnard, California.

The construction costs presented typically include contractor's overhead and profit, mobilization and demobilization, permitting, and construction contingencies. Costs to the owner, such as engineering, legal, administrative, project contingencies, and construction management costs are added to the construction costs. Due to the differing nature of projects that occur within a treatment plant and projects that occur as part of a collection or distribution system, two different approaches were taken for cost estimation. The first

approach, outlined in Table 3, is the method used for all projects recommended within the fence-line of the OWTP and AWPF. The second approach, outlined in Table 4, is the method used for all other capital improvement projects recommended as part of this PWIMP. The main difference in these cost approaches is the construction contingency of 15 percent for the OWTP and AWPF projects and 30 percent for all other projects. This contingency difference reflects the fact that the projects for the OWTP and AWPF are better understood and therefore uncertainties are lowered due to the proximity with the plant fence line, and therefore, warranted a reduced contingency.

**Table 3 Basis for Estimating Project Costs at the OWTP and AWPF**
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| Item | Estimated Cost | Estimated Cost of "A" |
|---|---|---|
| Base Construction Cost from Carollo Cost Curves and past projects (Bid Tabs)(1). | "A" | 100% |
| • Adjust base construction cost for field piping(2) | 15% of "A" | 15% |
| • Adjust base construction cost for electrical/instrumentation(2) | 20% of "A" | 20% |
| • Adjust base construction cost for sheeting/shoring/piles and painting(2) | 10% of "A" | 10% |
| **Subtotal** | **"B"** | **145%** |
| Construction Contingency | 15% of "B" | 15% |
| **Subtotal Construction Cost** | **"C"** | **167%** |
| Add 24% of Construction Cost to Cover Project Cost Factor(3) | 24% of "C" | 40%" |
| **Total Estimated Project Cost** | **"D"** | **207%** |

Notes:
(1) Adjust this cost to account for the time value of money and location using the 20-City Index ENR CCI of 9962 (February 2015) and city location adjustment factors, as needed.
(2) Costs are adjusted based on site-specific conditions.
(3) Includes all "soft" costs shown in Table 5, including engineering, administration, legal, and construction management.

**Table 4 Basis for Estimating All Other Project Costs**
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| Item | Estimated Cost | Estimated Cost of "A" |
|---|---|---|
| Base Construction Cost from Carollo Cost Curves and past projects (Bid Tabs)(1)(2) | "A" | 100% |
| **Subtotal** | **"B"** | **100%** |
| Construction Contingency | 30% of "B" | 30% |
| **Subtotal Construction Cost** | **"C"** | **130%** |
| Add 24% of Construction Cost to Cover Project Cost Factor(3) | 24% of "C" | 40%" |
| **Total Estimated Project Cost** | **"D"** | **161%** |

Notes:
(1) Adjust this cost to account for the time value of money and location using the 20-City Index ENR CCI of 9962 (February 2015) and city location adjustment factors, as needed.
(2) Costs are adjusted based on site-specific conditions.
(3) Includes all "soft" costs shown in Table 5, including engineering, administration, legal, and construction management.

Regardless of the type of project, all projects included a 24 percent project cost factor contingency. A breakdown of this 24 percent project cost factor is presented in Table 5.

**Table 5 Project Cost Factor Detail**
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| Item | Element |
|---|---|
| Project Cost Factor | Total of 24 percent which includes the following:<br>• 10 percent engineering design fees<br>• 8 percent construction management<br>• 2 percent for project management<br>• 2 percent for environmental planning and review<br>• 2 percent pre-design and planning |

## 2.1 Cost Estimating Approach

Some of the construction cost estimates are developed using past City and other Carollo Engineers project costs and the cost curve approach for estimating. The "cost curve approach" is the use of historical project cost data to estimate planning level costs for future capital improvement projects. In this approach, historical project cost data are used to develop plots of total cost versus process capacity, or "cost curves," for a given unit process. In the development of the cost curves, the project locations and dates of costs are accounted for with the application of "location factors" (R.S. Means Location Factors), and

ENR CCI values. The location factors are based upon the R.S. Means national average construction costs.

City-to-City location adjustment factors may be accurately derived by dividing the published factor for one location by the factor for another. By accounting for location factors and ENR CCI values, the cost curves are plots of “location-less” costs and in today’s dollars. Given a known required capacity for a capital improvement project, the estimated cost is extrapolated from the cost curve.

The project cost data behind the cost curves were partitioned from final project costs and contractors’ schedules of values. The cost curves were plotted based upon the fractionated costs and the unit process sizing criteria. Project costs of smaller capacity jobs were not considered in the cost curves because these data tend to skew cost curves due to the “economies of scale” relationship. However, smaller project costs are archived so that they are available for reference should the need arise to develop costs of small projects.

## 3.0 O&M COSTS

O&M costs were estimated for two different purposes within the PWIMP and thus, had differing estimating approaches. O&M costs used within alternatives analysis (i.e., treatment processes, water supply alternatives) were estimated to show differences between alternatives considered. Because of this, the O&M costs used in alternatives analyses do not represent the total O&M costs, but rather show the relative O&M costs of differences of new processes and facilities recommended. In this way, the alternatives can be compared and the potential new costs incurred by the City can be understood. These O&M costs were based on $ per MGD estimates as well as known costs of chemicals, power, and labor, when available. The PWIMP provides annualized costs for each alternative considered which again, were done to understand the relative differences of the new projects considered over the lifetime of the projects rather than the absolute costs.

Complete O&M costs that take into account both existing O&M as well as future additions to O&M costs based upon the Recommended Capital Improvement Program (CIP) were estimated for the Oxnard Cost of Service Study, developed in conjunction with this PWIMP.