APPENDIX G

Cost Estimating Assumptions

This appendix provides the assumptions used by West Yost to estimate the probable construction costs for the planning and design of recommended water system facilities for the City's potable and recycled water systems. Construction costs were developed based on a combination of data supplied by manufacturers, published industry standard cost data and curves, construction costs for similar facilities built by the City and/or other public agencies, and construction costs previously estimated by West Yost for similar facilities with similar construction cost indexes.

Additionally, the costs presented in this appendix are for construction only and do not include estimating uncertainties or unexpected construction costs (*e.g.*, variations in final quantities) or cost estimates for engineering, legal costs, environmental review, inspections and/or contract administration. Some of these additional cost items are referred to as contingency costs or mark-ups, and are further described in the last section of this appendix. It should also be noted that the construction costs presented in this appendix represent capital infrastructure costs and do not include costs for purchase of additional surface water supplies, supply reliability, or for annual operation and maintenance.

All estimated construction costs have been adjusted to reflect 2012 dollars and should be used for conceptual cost estimates only and be updated regularly. Construction costs presented in this appendix are not intended to represent the lowest prices in the industry for each type of construction; rather they are representative of average or typical construction costs. These planning level construction cost estimates have been prepared for guidance in evaluating various facility improvement options, and are intended for budgetary purposes only, within the context of this master planning effort.

The following sections of this appendix describe the assumptions used to estimate the probable construction costs for the planning and design of recommended water system facilities for the City's potable and recycled water systems:

- Land Acquisition Costs
- Potable Water System Construction Costs
- Recycled Water System Construction Costs
- Contingency Costs or Mark-ups

LAND ACQUISITION COSTS

It is assumed that land for buildout potable and recycled water facilities will be acquired at $150,000 per acre. Costs for land acquisition will only be added to major facilities such as tank sites where a large parcel is required. Consequently, land acquisition costs do not include right-of-way acquisition costs for transmission and distribution mains.

POTABLE WATER SYSTEM CONSTRUCTION COSTS

The following sections present the construction cost estimates used to project probable construction costs for recommended water system facilities in the City's potable water system and are categorized by improvement project type.

John Jones Water Treatment Plant Expansion

To serve future potable water demands under buildout conditions, the City will need to expand the current John Jones Water Treatment Plant (JJWTP) and intake pumps to a new total treatment capacity of 51 mgd (*i.e.*, increase existing 30 mgd treatment capacity with 21 mgd of new treatment capacity). The new water treatment plant expansion must be designed to meet Federal and State drinking water regulations. The estimated construction cost for the water treatment plant expansion is $3.00 per gallon of treatment capacity.

Treated Water Storage Reservoirs

Table 1 summarizes the estimated construction costs for treated water storage reservoirs between the size range of 0.5 to 6.0 MG. These costs generally include the installation of the storage tank, site piping, earthwork, paving, instrumentation, and related sitework. It should be noted that these costs are representative of construction conducted under normal excavation and foundation conditions, and would be significantly higher for special or difficult foundation requirements.

It is recommended that new potable water storage reservoirs be partially buried prestressed concrete tanks to minimize impacts to developable land. These reservoirs could be located beneath City parks, allowing other uses of the land above the proposed reservoirs.

Table 1. Construction Costs for Treated Water Storage Reservoirs[a]

Capacity, MG	Estimated Construction Cost, million dollars[b]
	Partially Buried Prestressed Concrete
0.5	2.0
1.0	2.4
2.0	3.2
3.0	4.0
4.0	4.8
5.0	5.5
6.0	6.3

(a) Based on 2012 dollars.
(b) Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

Aquifer Storage and Recovery Production Wells

Aquifer Storage and Recovery (ASR) well construction consists of pilot hole drilling, water quality/soil sampling, pilot hole reaming, well construction, well development and providing the necessary housing, pump, motor, automatic control equipment (SCADA), discharge piping, and disinfection equipment. All new groundwater wells will be designed to allow for both injection and extraction of water supplies in conjunction with the City's proposed ASR Well Program. Construction costs for new groundwater wells are estimated to be approximately $3,100,000 per well (assuming a well capacity of 2,500 gpm). This cost is representative of construction

conducted under normal drilling conditions, and would be significantly higher for special or difficult locations.

Treated Water Booster Pump Stations

Booster pump stations will be required at ground-level and below-grade reservoirs in order to lift water to the appropriate pressure zones. Estimated average construction costs for distribution pumping stations, as shown in Table 2, are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. It should be noted that booster pump station costs can vary considerably, depending on factors such as architectural design, pumping head, and pumping capacity. Therefore, these costs presented below are representative of construction conducted under common or normal conditions, and would be significantly higher for special or difficult conditions.

Booster pump station cost estimates include the installation of the booster pumps, site piping, earthwork, paving, a chemical feed system (hypochlorite), on-site backup/standby power generator, SCADA, and related sitework. Station designs will be based on the City's typical booster pump station configurations, which include 2 to 4 variable speed booster pumps installed in parallel to accommodate varying water demand conditions.

Table 2. Construction Costs for Treated Water Booster Pump Stations[a]

Firm Capacity[b], mgd	Estimated Construction Cost, million dollars[c]
0.5	1.0
1	1.1
2	1.2
3	1.4
5	1.6
10	2.3

(a) Based on 2012 dollars.
(b) Equal to the total pumping capacity with the largest pump out of service or on standby.
(c) Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

Pipelines

Unit construction costs for potable water pipelines 8 through 36-inches in diameter are provided in Table 3. These unit costs are categorized either by typical pipeline construction in developed areas or typical pipeline construction across open fields or areas that have not yet developed (*i.e.*, undeveloped areas). These costs are representative of pipeline construction conducted under common or normal conditions, and would be significantly higher for special or difficult conditions.

The unit construction costs presented below generally include pipeline materials, trenching, placing and jointing pipe, valves, fittings, hydrants, service connections, placing imported pipe bedding, native backfill material, and partial asphalt pavement replacement, if required. However, the costs presented in Table 3 do not include the cost of boring and jacking pipe. Pipeline bore and jack costs are shown in Table 4 and should be added where required for this purpose.

Table 3. Unit Construction Costs for Pipelines[a,b]

Pipeline Diameter, inches	Unit Construction Cost, $/linear foot[c]	
	Developed Areas	Undeveloped Areas
8	155	130
10	175	150
12	210	180
14	240	205
16	270	230
18	300	255
20	320	275
24	375	320
30	455	390
36	530	450

(a) Based on 2012 dollars.
(b) Costs based on ductile iron cement-lined pipe.
(c) Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

Table 4. Unit Construction Costs for Bore and Jack[a]

Pipeline Size	Unit Construction Cost, $/linear foot[b,c]
8-inch pipe (16-inch casing)	420
12-inch pipe (21-inch casing)	480
16-inch pipe (24-inch casing)	555
20-inch pipe (30-inch casing)	685
54-inch pipe (66-inch casing)	1,370
Tunnel	2,850

(a) Based on 2012 dollars.
(b) Conductor pipe is not included in cost.
(c) Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

Pressure Regulating Stations (PRS) and Pressure Reducing Stations

Interconnections (*i.e.*, pressure regulating station or pressure reducing (PRV) station) are required to provide water supply between pressure zones during peak demands and/or emergency conditions. The construction cost for a pressure regulating station is estimated to be approximately $200,000, and for a pressure reducing station, the construction cost is estimated to be approximately $100,000. These costs are representative of construction conducted under normal conditions, and would be significantly higher for special or difficult conditions.

Construction cost estimates for a pressure regulating station include the installation of a 12-inch diameter control valve, a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework. Construction cost estimates for a pressure reducing station include the similar items as a pressure regulating station; however, a pressure reducing station requires a less complicated control valve and does not include the installation of SCADA because it will be typically used for emergency conditions.

Backup Power Generators

On-site backup power generators are recommended to provide power to pumps so that water can be pumped into the distribution system in the event of a power outage. These generators should be sized to meet the power demands of the pumps. The construction cost for a new on-site backup power generator is estimated to be approximately $200,000. This cost is representative of construction conducted under normal conditions, and would be significantly higher for special or difficult conditions.

SCADA System Improvements

SCADA system improvements are recommended to provide operators with real-time system data and flexibility in system operations. The construction cost for the installation of SCADA monitoring is estimated to be approximately $100,000. This cost is representative of construction conducted under normal conditions, and would be significantly higher for special or difficult conditions. Any discrepancies or inaccurate data tags should also be corrected to provide accurate real-time system flow and pressure monitoring.

RECYCLED WATER SYSTEM CONSTRUCTION COSTS

The following sections present the construction cost estimates used to project probable construction costs for recommended water system facilities in the City's recycled water system and are categorized by improvement project type.

The construction cost estimates of the recycled water system are based on similar assumptions as the construction cost estimates of the potable water system.

Recycled Water Storage Reservoirs

The estimated cost of the recycled water reservoirs is the same as for the potable water storage reservoirs. The data are repeated herein for reference. The estimated construction costs for recycled water storage reservoirs between the size range of 0.5 to 6.0 MG are summarized in Table 5. These costs generally include the installation of the storage tank, site piping, earthwork,

paving, instrumentation, and related sitework. It should be noted that these costs are representative of construction conducted under normal excavation and foundation conditions, and would be significantly higher for special or difficult foundation requirements.

It is recommended that new recycled water storage reservoirs be partially buried prestressed concrete tanks to minimize impacts to developable land. These reservoirs could be located beneath City parks, allowing other uses of the land above the proposed reservoirs. Cost estimates of recycled water storage tanks are therefore based on partially buried prestressed concrete tanks.

Table 5. Construction Costs for Recycled Water Storage Reservoirs[a]

Capacity, MG	Estimated Construction Cost, million dollars[b]
	Partially Buried Prestressed Concrete
0.5	2.0
1.0	2.4
2.0	3.2
3.0	4.0
4.0	4.8
5.0	5.5
6.0	6.3

(a) Based on 2012 dollars.
(b) Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

Recycled Water Booster Pump Stations

Booster pump stations will be required at the Holly Drive WWTP and at several other locations in the recycled water distribution system to lift recycled water to the appropriate pressure zones. Estimated average construction costs for distribution pumping stations, as shown in Table 6, are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. It should be noted that booster pump station costs can vary considerably, depending on factors such as architectural design, pumping head, and pumping capacity. Therefore, these costs presented below are representative of construction conducted under common or normal conditions, and would be significantly higher for special or difficult conditions.

Costs presented in Table 6 are the same as the costs presented in Table 2. Booster pump station cost estimates include the installation of the booster pumps, site piping, earthwork, paving, on-site backup/standby power generator, SCADA, and related sitework. Station designs will be based on the City's typical booster pump station configurations, which include 2 to 4 variable speed booster pumps installed in parallel to accommodate varying water demand conditions.

Table 6. Construction Costs for Recycled Water Booster Pump Stations[a]	
Firm Capacity[b], mgd	Estimated Construction Cost, million dollars[c]
0.5	1.0
1	1.1
2	1.2
3	1.4
5	1.6
10	2.3

[a] Based on 2012 dollars.
[b] Equal to the total pumping capacity with the largest pump out of service or on standby.
[b] Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

Recycled Water Pipelines

Unit construction costs for recycled water pipelines 8-inches and 12-inches in diameter are slightly less than for potable water pipelines because the 8-inch and 12-inch diameter recycled water pipelines are assumed to be constructed of PVC instead of ductile iron. Unit construction costs for recycled water pipelines 16-inches through 36-inches in diameter are the same as for potable water pipelines because the cost of PVC pipelines increases faster with larger diameters than the cost for ductile iron pipelines and, depending on conditions at the time of project bidding, could be more or less than the cost of ductile iron pipelines. A summary of the estimated pipeline unit costs are provided in Table 7. These unit costs are categorized either by typical pipeline construction in developed areas or typical pipeline construction across open fields or areas that a have not yet developed (*i.e.*, undeveloped areas). These costs are representative of pipeline construction conducted under common or normal conditions, and would be significantly higher for special or difficult conditions.

The unit construction costs presented below generally include pipeline materials, trenching, placing and jointing pipe, valves, fittings, hydrants, service connections, placing imported pipe bedding, native backfill material, and partial asphalt pavement replacement, if required. However, the costs presented in Table 7 do not include the cost of boring and jacking pipe. Pipeline bore and jack costs are shown in Table 8 and should be added where required for this purpose.

Table 7. Unit Construction Costs for Recycled Water Pipelines[a,b]

Pipeline Diameter, inches	Unit Construction Cost, $/linear foot[c]	
	Developed Areas	Undeveloped Areas
8	138	118
12	205	174
16	270	230
24	375	320
36	530	450

(a) Based on 2012 dollars.
(b) Costs based on PVC pipe for 8-inch and 12-inch diameter, and ductile iron cement-lined pipe for 16-inch diameter and larger.
(c) Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

Table 8. Unit Construction Costs for Bore and Jack[a]

Pipeline Size	Unit Construction Cost, $/linear foot[b,c]
8-inch pipe (16-inch casing)	420
12-inch pipe (21-inch casing)	480
16-inch pipe (24-inch casing)	555
20-inch pipe (30-inch casing)	685
54-inch pipe (66-inch casing)	1,370
Tunnel	2,850

(a) Based on 2012 dollars.
(b) Conductor pipe is not included in cost.
(c) Estimated construction costs do not yet reflect an adjustment, as discussed with the City's Engineer, to account for the current economic bidding climate.

CONTINGENCY COSTS OR MARK-UPS

Contingency costs or mark-ups must be reviewed on a case-by-case basis because they will vary considerably with each construction project. However, to assist City staff with budgeting for these recommended water system facility improvements, standard mark-ups have been added to the planning budget as percentages of the estimated base construction cost.

Standard mark-ups are divided into four subcategories, totaling 40 percent:

- General Contingency: The construction costs presented above are representative of the construction of water system facilities under normal construction conditions and schedules; consequently, it is appropriate to allow for estimating and construction uncertainties unavoidably associated with the conceptual planning of projects. Factors such as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are only a few of the items that can increase project

costs. An allowance of 15 percent of the base construction cost will be included to cover such project related general contingencies.

- Design and Planning: Design and planning services associated with new facilities include preliminary investigations and reports, right-of-way acquisition, foundation explorations, preparation of drawings and specifications for construction, surveying and staking, sampling of testing material, and start-up services. The cost of these items may vary, but for the purpose of this study, it is assumed that engineering design and planning costs will equal 10 percent of the base construction cost.
- Construction Management: Construction management covers items such as contract management and inspection during construction. The cost of these items may vary, but for the purpose of this study, it is assumed that construction management costs will equal 10 percent of the base construction cost.
- Program Administration: Program administration covers items such as legal fees, environmental/CEQA compliance requirements, financing expenses, and interest during construction. The cost of these items may vary, but for the purpose of this study, it is assumed that program administration costs will equal 5 percent of the base construction cost.

An example application of these standard mark-ups to a project with an assumed base construction cost of $1.0 million is shown in Table 9. As shown, the total cost of all project construction contingencies (general contingency, design and planning, construction management, and program administration costs) is 40 percent of the base construction cost for each construction project.

Table 9. Example Application of Mark-ups

Cost Component	Percent	Cost
Estimated Base Construction Cost before Mark-ups[(a)]		$1,000,000
Mark-ups:		
General Contingency	15%	$150,000
Design and Planning	10%	$100,000
Construction Management	10%	$100,000
Program Administration	5%	$50,000
Estimated Total Project Cost		$1,400,000

(a) Assumed cost of an example project.