COLORADO
Colorado Water Conservation Board
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Statewide Water Supply Initiative

Statewide Water Supply Initiative Update
Technical Memorandum

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From:	Barbara Biggs and Chris Kurtz, CDM Smith
Copy to:	SWSI Update Consulting Team

Prepared by:	Lauren Starosta, Chris Kurtz, and Devin Schultze, CDM Smith
Reviewed by:	Dan Rodrigo and Sue Morea, CDM Smith

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Section 1: Methodology Objectives

This memorandum describes the key methodologies that will be implemented during the Statewide Water Supply Initiative Update (SWSI Update) for the Finance component. As Colorado's Water Plan moves into implementation it is critical that the overall cost of proposed projects and methods is understood and presented in a way that enables easy comparison ("apples to apples"). This goal served as the guide for development of the SWSI Update Finance methodology presented in this memorandum.

Section 2 describes previous methodologies related to the Finance component of the SWSI Update. These methodologies are used, and in certain cases expanded, to inform the development of the Finance methodology. **Section 3** establishes the proposed Finance methodologies for the SWSI Update. This section focuses on tool development for use during the next round of Basin Implementation Plans (BIPs). **Section 4** discusses the interrelationship between the Finance components and the other components of the SWSI Update. Lastly, **Section 5** describes the impacts of schedule and budget on the proposed methodologies.

For the Finance component, an interactive workshop with Colorado Water Conservation Board staff and other SWSI Update team members will be held in August 2017 to discuss the proposed methodology. Feedback from this workshop will be used to refine the proposed Finance methodology prior to delivering to the CWCB board for additional feedback. After their review, the Finance methodology will be revised and considered complete for the purposes of beginning project execution; however, it is expected that some refinement will be necessary as the SWSI Update progresses.

Section 2: Background on Previous Methodologies

2.1 Overview of Methodologies used in SWSI 2010

Previous iterations of the Statewide Water Supply Initiative (SWSI) have incorporated costing mechanisms developed for strategy and cost analysis and portfolio comparison; however, the current update of SWSI seeks to provide an accessible cost estimating tool for distribution to the Basin Roundtables (BRT) for effective and uniform cost estimating of projects.

SWSI 2010 provided cost estimation methods in two ways: 1) reconnaissance level cost estimating for strategy development and evaluation, and 2) the CWCB Portfolio and Trade-off Tool. In addition, the recently published Basin Implementation Plans (BIPs) also included some cost estimates for various projects. These previous methods and efforts are described below.

Reconnaissance Level Cost Estimates

Reconnaissance level cost estimates were developed as a part of the SWSI 2010 evaluation of six water supply and delivery concepts:

1. Middle and Lower South Platte
2. Middle and Lower Arkansas
3. Yampa River
4. Flaming Gorge
5. Green Mountain Reservoir
6. Blue Mesa Reservoir

Cost estimates were developed on a unit cost-based methodology to determine capital costs on a year-long scale. However, these costs were developed only for planning level comparison of concepts to be used for initial planning.

CDM Smith developed a methodology for calculating pipeline, tunnel, pump station, diversion, and appurtenance costs using GIS and excel spreadsheets. Pipeline alignment, length and elevation were ascertained from preliminary GIS calculations to develop a ground elevation profile. The outputs of the ground elevation analysis include the ground profile, hydraulic grade line, pipe alignment and notes locations of potential pressure issues to be used in a pipeline cost estimator (See **Figure 1-1**). The pipeline cost estimator spreadsheet utilizes annual unit costs to estimate costs for land, easements, operations, maintenance, storage, pump stations and diversions and mobilization. The pipeline estimator spreadsheet can be used to compare costs from multiple scenarios of various alignments, pipe diameters or pipe materials. The spreadsheet presented total pipeline capital costs, total maintenance costs per year, total operations costs per year, and a summary of the alignment details.

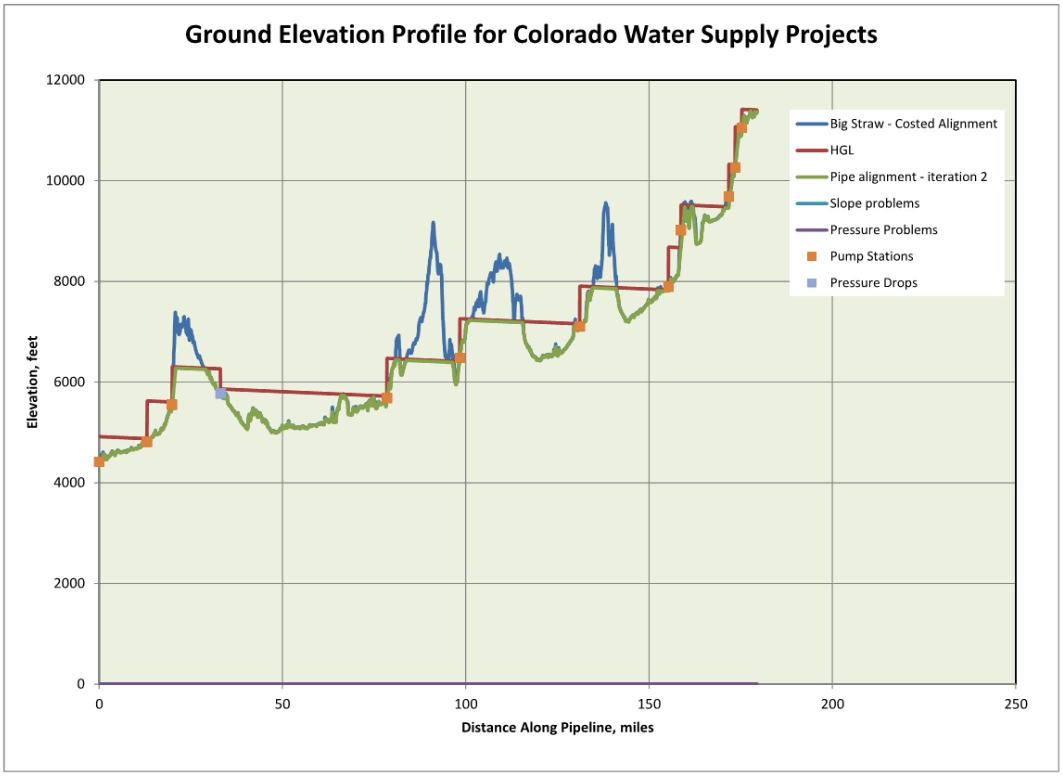

Figure 1-1 Example of SWSI 2010 Ground Elevation Analysis Tool

The concept evaluations also included cost estimations for diversion storage, water rights and water reuse. These estimates were determined by user-defined annual storage volumes and prescribed unit costs per acre-foot for storage, water rights and direct and indirect reuse. The diversion firming storage and water reuse modules also include an assumed firming storage percentage and maximum, assumed direct and assumed indirect reuse percentages, respectively.

Finally, a life cycle cost analysis spreadsheet was developed for each basin based on the 100,000 AF/year and 250,000 AF/year consumption scenarios. This spreadsheet included estimated capital and operation and maintenance costs for water rights, raw water firming storage, pipelines, pump stations and water treatment for the period between 2008-2070. The life cycle analysis was performed using current unit costs for the period (2009), a replacement frequency estimate and assumed percent of 2009 cost for replacement.

CWCB Portfolio and Trade-off Tool

The CWCB Portfolio and Trade-off Tool presented in SWSI 2010 allows users to develop portfolios based on 2050 water needs for the low, medium and high consumption scenarios for municipal and industrial, self-supplied industrial and oil and shale development water needs. A function of the tool is to estimate user costs for the user-defined portfolio versus the status quo portfolio. This tool used known unit costs for status quo cost estimations and assumed cost ranges for user-defined portfolios.

Basin Implementation Plans (2015)

During Basin Implementation Plan development, Basin Roundtables were tasked with identifying completed, ongoing, and proposed projects and methods for addressing water supply needs. While all basins but one identified project cost as a key component of project execution, presentation of estimated costs for projects was not consistent among basins. **Table 1-1** provides a summary of projects with listed costs by basin.

Table 1-1 Basin Project Cost Summary

Basin	Number of Projects	Projects with Costs	Percent of Projects with Costs
Arkansas	185	17	9%
Colorado	31	14	45%
Gunnison	214	112	52%
North Platte	77	1	1%
Rio Grande	110	30	27%
South Platte & Metro	214	0	0%
Southwest	217	1	0%
Yampa	48	4	8%
Total	**1096**	179	16%

As **Table 1-1** shows, only 16% of presented projects throughout the eight Basin Implementation Plans provided any estimate of project costs. This demonstrates a need for an accessible costing tool for Basins to use during subsequent development of Basin Implementation Plans to determine potential funding needs. This information is also useful to CWCB for determining available funds through programs such as the Water Supply Reserve Fund. Of the 1096 inventoried projects, 117 identified the WSRF program as a current or planned funding source. It should be noted, that even if a project did not have an estimated cost, some basins still identified the WSRF program as a possible funding source.

2.2 Methodology Enhancements for SWSI Update

For the SWSI Update Finance Component, some of the calculation methods utilized in both the reconnaissance level cost estimating work and the CWCB Portfolio and Trade-off tool will be relied upon as a starting point for tool development. Details of the calculation methods are described below in **Section 3**. Also, the cost estimating work performed during the last round of BIPs will serve as a general guide for input and output of the proposed tool; however, it is anticipated that this tool will be more detailed while improving the ability of BRTs to perform high-level cost estimates during subsequent BIPs.

Section 3: Description of Methodologies

The Water Finance methodology consists of the following main components: 1) project modules that utilize input from the user on specific types of water projects to calculate the information needed to develop costs, and 2) a costing module that uses the output from the project modules and applies methods along with unit costs, cost curves, and percent values to develop direct, indirect, and annual costs in addition to other cost metrics. These components are combined in a Water Finance Tool that includes an interface and user guide to direct the user on developing planning-level costs for their projects. This tool will provide a common technical framework for BRTs to utilize when developing the next round of BIPs. It is recommended that some of the base cost assumptions outlined below be reviewed every SWSI cycle.

The Water Finance Tool will be developed in Excel and will utilize some VBA code to simplify navigation and use of the Tool. Given the extent of information and calculations that may be included in the Tool, a simple user interface will be integral to its success. Key aspects of the user interface include the following:

- An overview of the Tool
- A navigation table or map to direct the user to the appropriate modules
- A list of global inputs to be supplied or reviewed and adjusted by the user
- A list of basic key assumptions or disclaimers that direct the user on how to interpret the results

Global inputs to be used throughout the tool may include the following:

- Project yield
- Peaking factor
- Cost indices
- Life-cycle cost inputs
- Annual cost inputs

Figure 3-1 is schematic of the tool. This schematic is similar to what will be provided in the tool to direct the user to the appropriate modules.

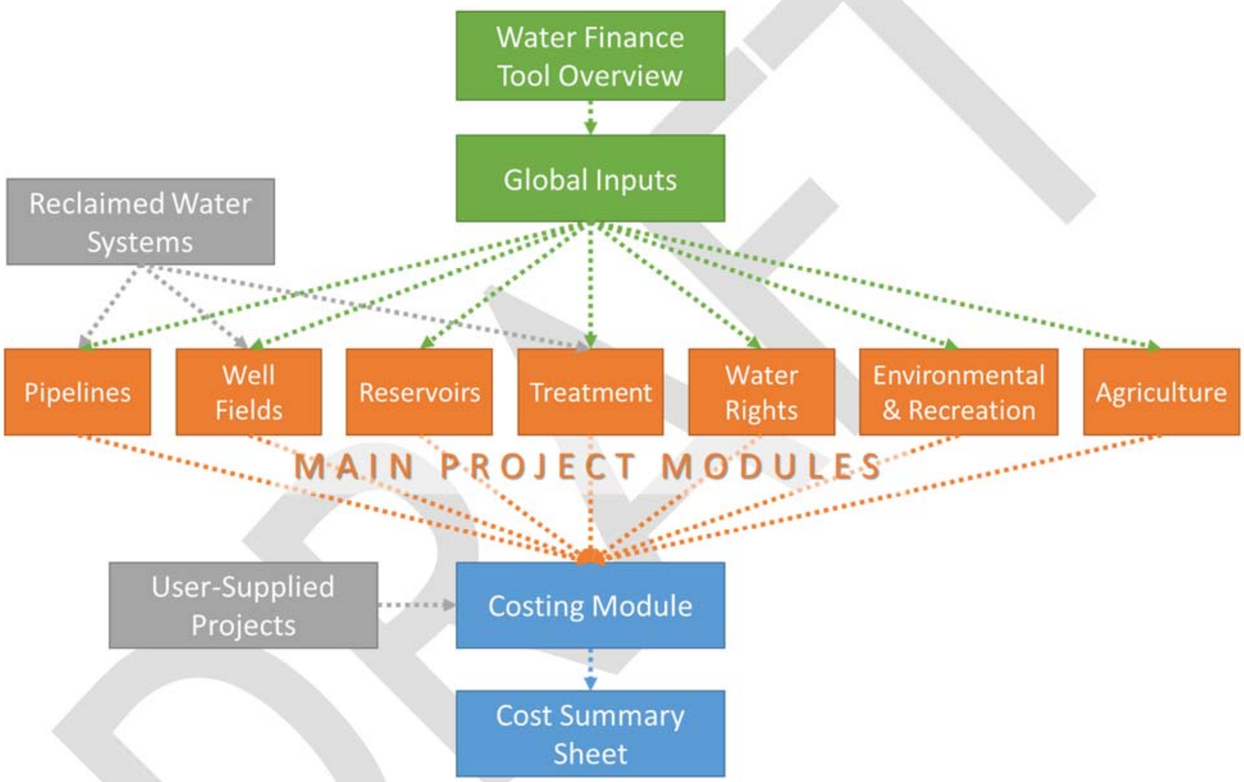

Figure 3-1 Water Finance Tool Schematic

The following sections describe each of the project modules and the overall costing module.

3.1 Project Modules Methodology

The project modules represent either an entire water project or a component of a project as determined by the level of complexity in developing particular costs. The project modules proposed are summarized in **Table 3-1** and were developed based on the types of projects that have been proposed previously in the Basin Implementation Plans (BIPs).

Table 3-1 Summary of Project Modules

Project Module	Types	Components	General User Inputs
Pipelines	Raw, Treated, Reclaimed	Pipelines, Pump Stations, Storage	Avg. Annual Yield, Max Day Factor, Pipeline Profile Components
Well Fields	Water Supply, Aquifer Storage and Recharge, Aquifer Storage and Recovery, Injection	Wells, Pumps, Pipe Networks, Transmission Pipes, Power Generation, Equalization Storage	Static Depth and Drawdown, Avg. Annual Yield, Max Day Factor, Yield per Well or Number of Wells, Pipeline Profile Components, Flow Rate Differences (equalization storage)
Reservoirs	New, Enlargement, Rehabilitation, Power Generation	Embankment/Dam, Land Acquisition, Permitting, Hydropower Station	Normal-Pool Volume, High-Pool Volume, High-Pool Area, Embankment/Dam Dimensions, Avg. Head and Flow for Releases (Hydropower)
Treatment	Treatment with Various Source Water Quality, Potable and Non-Potable Reuse	Treatment	Source Water TDS, Treated Water TDS, Avg. Annual Yield, Max Day Factor
Water Rights	Instream Flow Requirements, Recreational In-Channel Diversion, Water Supply	Cost	Cost of Water Right Purchase
Environment and Recreation	Stream Restoration, Conservation, Habitat Restoration/Species Protection, Acid Mine Drainage Water Treatment	Land Acquisition, Channel Improvements, Channel Structures, Treatment	Channel Type, Channel Length, Types of Structures, Flow Rate
Agriculture	Diversion Gates, Canals/Ditches, Irrigation	Channel Improvements, Channel Structures	Channel Type, Channel Length, Types of Structures

Each project module is described in further detail in the following sections, which are systematically organized using the following section/subsection structure:

- **Section 3.1.X** gives an overview of the specific project module

- **Section 3.1.X.1** presents the calculations and tools or models that are used in the project module
- **Section 3.1.X.2** outlines the inputs and outputs and specifies which inputs are supplied by the user, adjustable by the user, hard-coded, or optionally supplied by the user
- **Section 3.1.X.3** discusses any significant assumptions

Additional modules that follow a different structure than the project modules include a reclaimed water systems module and user-supplied project module. Finally, **Section 3.1** ends with a discussion of data limited components that are being considered for the Water Finance Tool.

3.1.1 Pipelines Module

The pipelines module will be used in developing costs for different types of projects that include a pipeline component. Types of pipeline projects may include transmission of raw, treated, or reclaimed water. The main components of a pipeline project include the pipeline itself, pump stations, and storage at the pump stations.

The basic inputs will be pipeline profile information and anticipated flow, which is used to calculate the needed pipeline diameter and pumping requirements. The basic outputs for developing the costs are the pipeline diameters and lengths and the pump station power (or flow and total dynamic head) and energy use. This module will include optional inputs for complex calculations of a pipeline project depending on the information available from the user. The following sections provide additional details on the process, user inputs, outputs, and assumptions.

3.1.1.1 Calculation processes and tools/models to be used

The basic module will calculate pipeline and pump station parameters relevant to establishing capital and operations and maintenance costs. Pipeline diameters will be calculated using the Continuity equation expanded and rearranged to solve for diameter. The resulting equation is shown as Equation 1.

$$D = \left(\frac{4q}{V\pi}\right)^{1/2} \qquad \text{[Equation 1]}$$

Where D = diameter in feet (to be converted to inches),
q = flow in cubic feet per second (cfs), and
V = velocity in feet per second (ft/s)

Total dynamic head and flow are needed to determine the necessary pump station power. Total dynamic head is the static head (total lift) plus the friction head. The friction head is calculated using the Hazen-Williams equation rearranged to solve for the friction head. The equation for total dynamic head is shown as Equation 2.

$$h_t = h_s + \frac{10.4LQ^{1.85}}{C^{1.85}D^{4.8655}} \qquad \text{[Equation 2]}$$

Where h_t = total dynamic head in feet (ft)
h_s = static head in ft
L = pipe length in ft
Q = flow in gallons per minute (gpm)
C = the Hazen-Williams friction factor
D = pipe diameter in inches (in)

Pump station power is calculated in terms of Horse Power (Hp) using the desired flow rate and total dynamic head as shown in Equation 3.

$$P = \frac{(h_t)Q}{3960\mu} \quad \text{[Equation 3]}$$

Where P = power in Hp
h_t = total dynamic head in ft
Q = flow in gpm
μ = efficiency as a fraction

Pumping energy required to pump the annual flow rate is calculated to determine the annual cost of pumping. Energy use is assumed to be constant over the year except for specified pump downtime. Total pumping energy per year is calculated by converting Hp to kilowatts (kW) and multiplying by the hours of pumping in the year.

The last basic calculation for this module is the number of pump stations that is likely needed. This is determined based on the maximum allowable pipeline pressure. An additional pump station is needed when the total pumping head exceeds the maximum allowable pipeline pressure.

A more complex version of the pipeline module will include most of the components above, except that the user has more control over the number and location of pump stations and the size of the pipeline for multiple segments. There may also be options for more detailed cost analysis if additional information concerning the pipeline route is available. This may include information about significant crossings (highways, streams, etc.), soil conditions, and constructability at locations along the length of the pipeline.

The annual pumping energy may also be calculated using an alternative method in a more complex version of the pipeline module. Although a pipeline may be designed to convey the maximum flow anticipated, the pipeline may not be used at that maximum flow rate for many years. Alternative flow rates representing the expected usage each decade out to the ultimate planning year may be used to develop expected energy use per decade. This information can be used in the cost calculations to develop more accurate annual costs.

3.1.1.2 Source data, information, and outputs

This section describes the inputs and outputs involved in the process described in the previous section. The pipeline module process requires several inputs that will either be required to be supplied by the user, adjustable by the user, or optionally supplied by the user. For the pipeline module, there are no inputs that are “hard-coded”. Default typical values will be included for those inputs that are adjustable by the user. There will also be lists of typical values and ranges of values that the user can select from, but there are no inputs that the user is forced to use in this module. This puts the responsibility on the user to appropriately design the pipeline system that is being costed.

Each of the following tables lists and describes the inputs. **Table 3-2**, **Table 3-3**, and **Table 3-4** describe the user-supplied inputs, the user-adjustable inputs, and the optional inputs, respectively.

Table 3-2 Pipelines Module User-Supplied Inputs

Input	Units	Description
Average Annual Flow	AFY	The average annual flow ultimately planned for the pipeline
Peaking Factor		Used to determine a maximum flow rate that may occur
Pipeline Length	ft	Total pipeline length
Pipeline Starting Elevation	ft MSL	Elevation at start of pipeline used in determining the static head
Pipeline Ending Elevation	ft MSL	Elevation at end of pipeline used in determining the static head
Ending Pressure	psi	Residual pressure needed at the end of the pipeline (converted to elevation to add to the static head)

Table 3-3 Pipelines Module User-Adjusted Inputs

Input	Units	Description
Maximum Pipeline Pressure	psi	Dictates the number of pump stations needed for the entire pipeline and should be based on the classification of pipe intended for the project. Typical classifications will be provided for user selection.
Hazen-Williams C Friction Factor		Used in calculating the total dynamic head. Typical values will be provided for user selection.
Target Pipeline Flow Velocity	ft/s	Used to determine the diameter of the pipeline. Default value is 5 ft/s.
System Downtime	%	Used in determining the actual maximum flow rate expected if the peak factor is 1, and used in calculating the total annual pumping energy. Default value is 5%.
Pump Efficiency		This efficiency encompasses mechanical and electrical efficiency used in calculating power and energy use

Table 3-4 Pipelines Module Optional Inputs

Input	Units	Description
Type of pipeline		Raw or treated water
Detailed Pipeline Profile		Information by station along the pipeline including the elevation, soil type, and constructability. This information would be used in a complex version of the pipeline module where the user has more control over sizing segments of the pipeline and locating pump stations.

The calculated outputs and some of the inputs from the pipeline module are all collected as outputs that are supplied to the costing module. Each is described in **Table 3-5**.

Table 3-5 Pipelines Module Outputs

Output	Units	Description
Pipeline Length	ft	Supplied by user
Pipeline Diameter	in	Calculated by module and adjusted by user as needed
Soil Conditions		High-level estimate of soil type. Specific categories will be provided.
Constructability		High-level estimate of the difficulty in constructing the project. Specific categories will be provided.
Pump Station Size	Hp or gpm and ft	Calculated as the power needed or the flow and feet of dynamic head.
Annual Pump Station Energy Use	kW-hr	Average annual energy use from all pump stations

3.1.1.3 Assumptions

The assumptions for the pipeline module mostly relate to whether a basic or complex process is undertaken by the user. The basic process will assume the following:

- Same diameter along the entire pipeline
- Pipe diameter and pump station size(s) determined from a single peak flow rate
- Evenly distributed pump stations (and associated storage as needed) with the same power and using the same amount of energy

For a complex process, the above assumptions become aspects that the user can adjust. In other words, multiple segments along the entire pipeline can be defined and analyzed differently if the information is available from the user.

The remaining assumption for the basic and complex process is that the pipeline is assumed to be used continuously (with the exception of downtime) throughout the year at the average day flow rate to calculate energy use.

3.1.2 Well Field Module

The well field module may include all the components of a well field or other modules (e.g. pipeline module) may be used in conjunction with this module to represent a complete project. Types of well field projects may include municipal water supply, irrigation, or aquifer storage and recovery (ASR). The main components of a well field project include the wells, connecting pipelines, and transmission pipeline.

This module may be used to cost all of the main components or the transmission pipeline may be excluded with the user opting to use the pipeline module. The basic user inputs for this module include well hydraulic information and production, well field pipeline network information, and transmission pipeline information. These inputs will be used to calculate well and pipeline diameter and pumping needs. The basic outputs for developing the costs are the well and pipeline diameter and length, the well pump power (or flow and total head pumped) and energy use. The following provide additional details on the process, inputs, outputs, and assumptions.

3.1.2.1 Calculation processes and tools/models to be used

The well field module will use similar processes and the same equations as the pipeline module to develop the outputs needed to cost the pipelines and pump station energy use. The differences in how the pipeline outputs are developed include the following:

- A well field pipe network will be set up to determine diameters for multiple segments that account for the connectivity of the well field
- No additional pumps are included beyond the well pump

No processes or equations are needed to develop outputs for costing the wells and well pumps as the needed information will be direct inputs from the user as discussed in the next section.

3.1.2.2 Source data, information, and outputs

This section describes the inputs and outputs involved in the process described in the previous section. The well field module process requires several inputs that will either be required to be supplied by the user, adjustable by the user, or optionally supplied by the user. For the well field module, there are no inputs that are hard-coded to one value. Default typical values will be included for those inputs that are adjustable by the user. There will also be lists of typical values and ranges of values that the user can select from, but there are no inputs that the user is forced to use in this module. This puts the responsibility on the user to appropriately design the well field system that is being costed.

Each of the following tables lists and describes the inputs. **Table 3-6**, **Table 3-7**, and **Table 3-8** describe the user-supplied inputs, the user-adjustable inputs, and the optional inputs, respectively.

Table 3-6 Well Field Module User-Supplied Inputs

Input	Units	Description
Average Annual Well Field Flow	AFY	The average annual flow ultimately planned for the well field
Peaking Factor		Used to determine a maximum flow rate that may occur
Pipeline Length	ft	Length of each pipeline in the well field and/or the transmission line
Pipeline Starting Elevation	ft MSL	Elevation at start of each pipeline
Pipeline Ending Elevation	ft MSL	Elevation at end of each pipeline
Delivery Point Elevation	ft MSL	Elevation for delivery at end of the transmission pipeline
Field Connectivity		Tool-directed inputs that describe how the pipelines in the well field are connected
Number of Wells		Number of wells in the well field or the average flow per well
Well Static and Drawdown Elevations	ft MSL	The static elevation is groundwater elevation when the well is not in use. The drawdown is the elevation when the well is in use.
Individual well depths	ft	The total depth of each well

Table 3-7 Well Field Module User-Adjusted Inputs

Input	Units	Description
Hazen-Williams C Friction Factor		Used in calculating the total dynamic head. Typical values will be provided for user selection.
Other Head Losses	ft/s	Other losses not calculated in the module that should be considered in determining the total dynamic head
Target Pipeline Flow Velocity	ft/s	Used to determine the diameter of the pipeline. Default value is 5 ft/s.
System Downtime	%	Used in determining the actual maximum flow rate expected if the peak factor is 1, and used in calculating the total annual pumping energy. Default value is 5%.
Well Pump Efficiency		This efficiency encompasses mechanical and electrical efficiency used in calculating power and energy use

Table 3-8 Well Field Module Optional Inputs

Input	Units	Description
Type of Well Field		Municipal water supply, irrigation, or ASR
Inputs Related to a Special Type of Well Field		For special types of well fields (e.g. ASR), the tool may include specific inputs related to that type

The outputs from the well field module that feed into the costing module are similar to the pipeline module and are described in **Table 3-9**. The additional output from the well field module used in the costing module, which are direct inputs from the user, are the individual well depths.

Table 3-9 Well Field Module Outputs

Output	Units	Description
Pipe Segments Lengths	ft	Supplied by user and is the length of each segment of pipe in the well field and transmission system.
Pipe Segments Diameters	in	Calculated by module and adjusted by user as needed for each of the pipe segments described above.
Soil Conditions		High-level estimate of soil type. Specific categories will be provided.
Constructability		High-level estimate of the difficulty in constructing the project. Specific categories will be provided.
Well Pump Size	Hp or gpm and ft	Calculated as the power needed or the flow and feet of dynamic head.
Individual well depths	ft	The total depth of each well
Annual Well Pump Energy Use	kW-hr	Average annual energy use from the entire well field

3.1.2.3 Assumptions

- It is assumed that no additional booster pumps are needed in the well field beyond the well pumps. If additional pumping is needed, the pipeline module should be used as a compliment to represent the entire project.

- Currently it is assumed that other types of well fields (irrigation or ASR) would have similar processes and calculations for developing the necessary outputs for cost.

3.1.3 Reservoirs Module

The reservoirs module includes components related to different types of reservoir projects including the construction of a new reservoir, reservoir expansion, or reservoir rehabilitation. A hydropower generation system can be added to any of the above types of reservoir

projects. Transmission of water from a reservoir is not included in this module, thus the pipeline module should be used for that aspect of a reservoir project.
The main components of a reservoir project include the dam dimensions and materials (earthen or concrete), the reservoir area (related to impacted land, utility and road relocation, clearing needs), spillway, outlet works, and hydropower. The user may not have sufficient information to provide inputs on all of these components, and thus basic calculations will be employed using cost curves and basic inputs. If the user can provide additional input that covers all the main components, a more complex calculation of reservoir costs can by utilized.

The following provide additional details on the process, inputs, outputs, and assumptions.

3.1.3.1 Calculation processes and tools/models to be used

This module may incorporate multiple levels of calculations from basic to complex depending on the information available from the user. The following lists the proposed levels of calculations:

- The basic-level process for this module will incorporate cost curves using inputs on the type of reservoir project and reservoir volume. The inputs are discussed in detail in **Section 3.1.3.2**. The cost curves will incorporate the cost of the dam, spillway, outlet works, and costs related to the impacted area.

- The medium-level process for this module will include the basic-level inputs in addition to inputs on dam dimensions to quantify and cost materials needed for the dam. The cost curves would then only incorporate the spillway, outlet works, and costs related to the impacted area.

- The complex-level process for this module will include the medium-level inputs in addition to information related to the spillway and outlet works. In this case, each component would have individual calculations and outputs to feed into the costing module.

No calculations are involved in the basic-level process. The user inputs will be supplied directly to the costing module where the cost curves reside.
The medium-level process includes calculations of material volume. Up to three typical types of dams will be programmed into the module to calculate material volume given the dam height and length. The specific calculations will be determined based on the types of dams selected.

The complex-level process will include the material volume calculations for the dam as well as calculations for the spillway and outlet works. For the spillway, the user will input an estimated maximum spill flow for the reservoir and cost curves will be used in the costing module to develop a spillway cost. For the outlet works, the orifice equation for free flow under a sluice gate will be used to calculate the opening of the outlet works given a desired flow rate at normal pool elevation. The equation was rearranged to solve for area as shown in Equation 4.

$$A = \frac{q}{K\sqrt{2gy}}$$ [Equation 4]

Where A = the gate opening area in square feet (sf)
q = flow in cfs
K = is the sluice or orifice coefficient
g = gravity in feet per square second (ft/s^2)
y = the depth from normal pool in ft

The calculated opening area will be used to estimate the size and/or number of gates based on available information from the user. This is described with the inputs discussion in **Section 3.1.3.2**.

Differences in the calculations for a new reservoir, reservoir expansion, or reservoir rehabilitation will be applied where it is possible to identify a specific difference (e.g. in material quantity calculations for a dam). Alternatively, a different cost curve will be applied or a percent change in the unit cost will be used based on the project type.
Hydropower calculations can be added to any of the proposed levels of calculation. The hydropower infrastructure includes a hydropower generation station, which will be costed based on the size of the turbines. Turbine size is related to the power production, which is calculated using Equation 5.

$$P = \frac{(h_w)Q}{3960\mu}$$ [Equation 5]

Where P = power in Hp
h_w = height of falling water in ft
Q = flow in gpm
μ = efficiency as a fraction

The power generated is converted to an annual amount of energy produced based on user input regarding the frequency of production over a typical year. Energy production per year is calculated by converting Hp to kW and multiplying by the hours of generation in the year. In the costing module, the unit value of energy is multiplied by the annual energy produced to calculate an annual credit that can be subtracted from other annual costs.

3.1.3.2 Source data, information, and outputs

This section describes the inputs and outputs involved in the process described in the previous section. The reservoirs module process requires minimal inputs for the basic process or several inputs for a more complex process. The inputs will either be required to be supplied by the user, adjustable by the user, or optionally supplied by the user. Default typical values will be included for those inputs that are adjustable by the user. There will also be lists of typical values and ranges of values that the user can select from.

Each of the following tables lists and describes the inputs. **Table 3-10**, **Table 3-11**, and **Table 3-12** describe the user-supplied inputs, the user-adjustable inputs, and the optional inputs, respectively. The user-supplied inputs are limited to those necessary to do the basic calculations. All other inputs are optional for doing more complex calculations. The optional inputs also include inputs for hydropower generation.

Table 3-10 Reservoirs Module User-Supplied Inputs

Input	Units	Description
Project Type		Types include new reservoir, reservoir expansion, or reservoir rehabilitation
Reservoir Volume	AF	The total volume of the reservoir at high-pool elevation

Table 3-11 Reservoirs Module User-Adjusted Inputs

Input	Units	Description
Outlet Gate Height	ft	Typical gate heights provided for outlet works. Assumed that gate width is equal to gate height. User would need to adjust the value if the calculated length of the outlet exceeds the dam length. Default value is XX ft.

Table 3-12 Reservoirs Module Optional Inputs

Input	Units	Description
High-Pool Surface Area	acres	Maximum anticipated surface area of the reservoir to determine land area impacted (may be used in place of reservoir volume with Maximum Depth from High-Pool)
Maximum Depth from High-Pool	ft	Approximate anticipated maximum depth (may be used in place of reservoir volume with High-Pool Surface Area)
Dam Type		Types will be limited to typical structural and material types
Dam Height	ft	Total height of the dam
Dam Length	ft	Length of the top of the dam
Spillway Capacity	cfs	Anticipated maximum flow that would be conveyed by a spillway
Average Outlet Flow	cfs	Required average annual flow from the outlet works
Peaking Factor for Outlet		Peaking factor to determine the maximum flow that may be released through the outlet works

Input	Units	Description
Outlet Head from Normal Pool	ft	The head on the outlet works as the difference between normal pool elevation to the bottom of the outlet opening
Hydropower: Water Height	ft	The height of the falling water used in hydropower generation
Hydropower: Flow	gpm	The flow of the water used in hydropower generation
Hydropower: Turbine Efficiency		This efficiency encompasses mechanical and electrical efficiency used in calculating power and energy production
Hydropower: Turbine Use	%	Percent of time over the year that a hydropower generation station will be utilized

The calculated outputs and some of the inputs from the reservoirs module are all collected as outputs that are supplied to the costing module. Each is described in **Table 3-13**.

Table 3-13 Reservoirs Module Outputs

Output	Units	Description
Project Type		Supplied by user
Reservoir Volume	AF	Supplied by user or estimated given High-Pool Surface Area and Maximum Depth from High-Pool
Material Volumes	cy	Volumes calculated from dam type and dimensions if information is supplied by the user
Spillway Capacity	cfs	Optionally supplied by user
Number and Size of Outlet Works Gates		Calculated if outlet works information is supplied by user
Hydropower Turbine Size	Hp	
Hydropower Energy Production	kW-hr	Average annual energy production from hydropower turbines to be used as a credit in the annual costs

Reservoir rehabilitation outputs may include similar outputs to new reservoirs and expansions, or cost curves developed from similar projects will be used. Input variables to the cost curves may include material type (earthen or concrete) and normal pool water surface area or volume.

3.1.3.3 Assumptions

Several assumptions may be required for this module depending upon the available user information. The assumptions will be developed further with development of the tool.

3.1.4 Treatment Module

The treatment module has two sub-modules: the Conventional Treatment sub-module includes conventional treatment methods for treating various levels of source water quality, and the Treatment for Reuse sub-module includes advanced treatment of wastewater for potable or non-potable use.

The Conventional Treatment sub-module allows the user to supply inputs for costing typical treatment technologies given different levels of source water quality, the planned treatment capacity, average day demand, and peaking factor. This sub-module allows for a wide variety of source water quality to be considered using indicator parameters such as total dissolved solids (TDS) concentration of the source water as an input (especially important for impaired water sources). Guidance may be provided on typical water quality parameter ranges for different source water types such as snow melt, reservoirs, or brackish groundwater, to name a few. The treated water use would be assumed to be potable drinking water.

The Treatment for Reuse sub-module assumes wastewater (direct or indirect) as the source water and the treatment level or technology is based on the end-use being either potable or non-potable. This sub-module would assume a standard TDS value for the wastewater that can be adjusted by the user as needed. The user would input the desired treated water TDS concentration based on the desired use. Guidance may be provided on typical TDS ranges for non-potable use while a standard TDS value for potable drinking water quality will be provided as a default based on current regulations.

3.1.4.1 Calculation processes and tools/models to be used

The process will utilize inputs on treatment capacity, source water quality, and treated water quality to develop the inputs needed for the costing module. Different cost curves will be developed based on treatment capacity and TDS removal. The user may also need to specify a specific treatment type.

This module will include two simple calculations. TDS removal will be calculated as the difference between the source water quality and the treated water quality. Treatment capacity will be the average day water demand multiplied by the peaking factor.

3.1.4.2 Source data, information, and outputs

This section describes the inputs and outputs involved in the process described in the previous section. The treatment module process requires minimal inputs. The inputs for this module will either be required to be supplied by the user or adjustable by the user.

Each of the following tables lists and describes the inputs. For the Conventional Treatment sub-module, **Table 3-14** and **Table 3-15** describe the user-supplied inputs and the user-adjusted inputs, respectively. For the Treatment for Reuse sub-module, **Table 3-16** and **Table 3-17** describe the user-supplied inputs and the user-adjusted inputs, respectively.

Table 3-14 Conventional Treatment Sub-Module User-Supplied Inputs

Input	Units	Description
Source Water Quality (e.g. TDS)	mg/L	The water quality of the source water
Average Day Water Demand	gpm	The average annual demand ultimately planned for the treatment plant
Peaking Factor	gpm	Used to determine a maximum day capacity

Table 3-15 Conventional Treatment Sub-Module User-Adjusted Inputs

Input	Units	Description
Treated Water Quality (e.g. TDS)	mg/L	The treated water quality, which will have a default value based on standards
Treatment Technology		TBD

Table 3-16 Treatment for Reuse Sub-Module User-Supplied Inputs

Input	Units	Description
Treated Water Quality (e.g. TDS)	mg/L	The treated water quality based on potable use or the type of non-potable use
Average Day Water Demand	gpm	The average annual demand ultimately planned for the treatment plant
Peaking Factor	gpm	Used to determine a maximum day capacity

Table 3-17 Treatment for Reuse Sub-Module User-Adjusted Inputs

Input	Units	Description
Source Water Quality (e.g. TDS)	mg/L	The wastewater quality, which will have a default value based on typical values
Treatment Technology		TBD

The calculated outputs and some of the inputs from the treatment module are all collected as outputs that are supplied to the costing module. Each is described in **Table 3-18**.

Table 3-18 Treatment Module Outputs

Output	Units	Description
Treatment Capacity	gpm	Calculated as the average day demand multiplied by the peaking factor
TDS Removal	mg/L	Calculated as the difference between the source water TDS and the treated water TDS
Treatment Technology		User supplied

3.1.4.3 Assumptions
It will be necessary to assume certain treatment technologies for each of the sub-modules. These assumptions will be determined as the cost curves are developed.

3.1.5 Water Rights Module
The water rights module will require user input on the cost of acquiring a water right. This may include water rights for any type of use including water supply, instream flow requirements, or recreational in-channel diversions. No calculations will be included. The module may provide some direction on how the user can obtain information to develop the cost.

3.1.6 Environment and Recreation Projects Module
The environment and recreation module includes projects related to improving the environment, preserving or improving flow regimes, and sustaining an area for recreational purposes. These types of projects may vary greatly, which makes developing a costing tool to fit all projects more complicated. This module will require some piloting to determine if it is meeting the needs of the users.

Project types may include the following:

- Stream restoration
- Recreational in-channel diversions (see also Water Rights Module)
- Habitat restoration/species protection
- Remediation
- Acid mine drainage water treatment

This module will collect user input for these types of projects to feed into the costing module. Users should be aware that inputs for the environmental and recreation cost module may require at the minimum an aerial analysis of the project area, however the level of analysis will depend on the level of stream degradation and desired restoration. Specifics of this module are discussed in the following sections.

3.1.6.1 Calculation processes and tools/models to be used
The types of projects considered in this module may include several tasks depending on the current condition of the project area, degree of restoration, and project area size and location. Calculation of cost can be based on length of the stream within a project area

(linear-feet), area restored (acres), or per installation (lump sum). It may not be feasible to include all types of activities and unit costs possible within the Environment and Recreation module; therefore, general unit costs will be included for a basic calculation and common activities associated with Environmental and Recreation projects will be included with unit costs for a more complex cost calculation.

The user will determine the appropriate cost process for the proposed project given an analysis of available information on current conditions and required level of restoration or protection as described in **Table 3-19** The environment and recreation module will guide the user to the data that needs to be collected as inputs for the costing calculation.

Cost of stream restoration projects can vary greatly depending on project location, size and condition; therefore, it may be prudent to define stream restoration at varying levels. Costs for each level of restoration will also depend on the flow capacity of the water resource (i.e. mainstem vs. tributary).

Table 3-19 Proposed Levels of Stream Restoration

Level of Restoration	Restoration Components
Level 1 – Basic Restoration	Bank stabilization, vegetation restoration
Level 2 – Rural Stream Restoration	Bank stabilization, vegetation restoration, habitat improvements and in-channel improvements
Level 3 – Urban Stream Restoration	Bank stabilization, vegetation restoration, habitat improvements and in-channel improvements

The level of restoration required should be based on an assessment of stream conditions. This assessment may be performed using a range of resources available to the user from aerial imagery to monitoring data, if available. The assessment may include bank erosion, level of aggradation, level of degradation and survey of vegetation; however, this list is not inclusive and further assessments may be required, as determined by the user.

Habitat restoration/species protection and remediation goals may overlap with stream restoration projects; however, they may also be considered separately, or in addition to, stream restoration. Habitat restoration/species protection projects should identify the attribute addressed or protection provided by the project and determine the required minimum conservation area as part of the costing process.

Remediation projects may include fire protection/control to reduce or mitigate the effects of potential or past forest fires on runoff quantity or quality to water sources and invasive species removal. The process for determining costs should investigate the quantity or area of remediation actions and potential environmental risks/benefits to water supply and quality.

Acid mine drainage water treatment is a specific type of project to improve water quality in the environment. This treatment is not for a specific use; therefore, it is not included in the Treatment module. Treatment approaches are linked to flow rate. Low flow scenarios typically use lime for precipitation of heavy metals and post-treatment to remove lime residue while high-flow scenarios may employ passive treatment using biochemical reactors or in-situ treatment. The basic input will be flow rate, which will be used as the input to the costing module.

3.1.6.2 Source data, information, and outputs

This section describes the inputs which will be compiled and used as input to the costing module. The environment and recreation projects module requires inputs that will be mostly optional depending on the types of projects being included and existing site conditions compared to proposed site conditions.

The user inputs for stream restoration may be distinct from those for habitat restoration/species protection or remediation. The inputs for acid mine drainage water treatment will simply be flow rate, which will also be the input to the costing module, and thus a table was not included for that type of project.

The following is a list of the potential inputs to be supplied by the user for stream restoration. These inputs are further discussed and defined in **Tables 3-20** and **3-21**.

- Length of stream to be restored: Used to calculate costs of multiple stream restoration projects including bank stabilization, channel restoration, riparian and wetland planting and seeding, dam removal, fishways, and culvert removal or replacements (source: http://www.habitat.noaa.gov/restoration/techniques/srrestoration.html).
- Stream classification: The Straylor Stream Order will be used to adjust the cost of the work to be performed.
- Area of habitat restoration: Used to calculate cost of restoration on a per-area basis.
- Type and number of structures installed: This will include structures for which unit costs are readily available and may include rock vanes, weirs, current deflectors, channel constrictors, cross-channel logs, and/or cattle guards.

Table 3-20 Environment and Recreation Module User-Supplied Inputs

Level of Restoration	Input	Units	Description
Level 1	Stream classification		Straylor Stream Order. This will be used to adjust the unit costs.
	Length of bioengineered bank stabilization	LF	Total length of stream requiring bank stabilization using rootwad or biological bank protection methods. The length should include the sum of left and right bank stabilization.
	Length of conventional bank stabilization	LF	Total length of stream requiring conventional bank stabilization methods such as riprap. The length should include the sum of left and right bank stabilization
	Regrading	AC	Area requiring regrading of floodplain (terracing, berms, etc.)
	Riparian restoration	AC	Area of stream banks and/or floodplain requiring revegetation
Level 2/ Level 3	Stream classification		Straylor Stream Order. This will be used to adjust the unit costs.
	Habitat Improvements	LS	Species specific habitat improvements including fish passages, deep pools, or rootwads, or vegetation
	Channel Realignment	LF	Length of in-channel realignment
	Debris Removal	CF	Removal of excess sediment deposition in-channel due to aggradation
	Bar construction	CF	Addition of in-channel fill for to construct point bars, sand bars, etc.
	Riffles	EA	Number of riffles to be installed in-channel
	Diversion Structures	EA	Construction or modification of Recreational In-channel Diversion Structures, irrigation diversion structures, etc.
	Flow Control Structures	EA	Other flow control measures weirs, spillways, spurs, rock vanes or dikes.
	Structure Removal	LS	Removal of existing in-channel structures.
Level 3	Stream classification		Straylor Stream Order. This will be used to adjust the unit costs.
	Stream Crossing	LS	Construction, relocation or replacement roads, bridges or culverts for pedestrian and/or transit use.

Table 3-21 Environment and Recreation Module Optional Inputs

Input	Units	Description
Land Acquisition	AC	Land acquisition may be required for conservation of the floodplain
Species Protected	Type	Type of aquatic, amphibious or vegetative species being restored or protected.
Manning's n	Unitless	Representation of channel roughness. Optional depending on level of stream analysis and level of restoration desired by user.
Current Bank Slope	FT/FT	Method of determining existing bank stability. Optional depending on level of stream analysis and level of restoration desired by user.
Proposed Bank Slope	FT/FT	Desired bank slope to determine degree of regrading required for sufficient bank stabilization. Optional depending on level of stream analysis and level of restoration desired by user.
Remediation Action	AC	Removal or prevention of pollution to water sources or habitat degradation. Examples include tree thinning for forest fire prevention or control and invasive species removal.

The outputs from the environment and recreation project costing module are defined in **Table 3-22** and represent summaries of direct inputs from the user and total cost for proposed projects.

Table 3-22 Environment and Recreation Outputs

Input	Units	Description
Stream Classification		Straylor Stream Order. This will be used to adjust the unit costs.
Length of Bank Stabilization	LF	Supplied by user and provides total length of bank stabilization (bioengineered and conventional)
Total Required Fill Material	CF	Supplied by user and represents the total quantity of fill material needed
Total Vegetation Requirements	AC	Protection of estimated plant coverage required for vegetation restoration and habitat restoration, if applicable.
Constructability		High-level estimate of the difficulty in constructing the project. Specific categories will be provided.

3.1.6.3 Assumptions

- It is assumed that users will at least have access to aerial imagery or data for stream condition assessment (e.g. Google Earth or GIS).
- Currently, methodology assumes flow rate does not affect cost, but may be included, if applicable. Stream classification may be enough information to develop costs without flow rate.

3.1.7 Agriculture Projects Module

The agriculture projects module includes projects related to water used in irrigation. Agriculture water projects mostly involve irrigation channels or ditches. Types of channel projects can be grouped into two categories:

- Channel improvements and
- Channel structures

Such projects may be new or rehabilitation projects. Agriculture projects may also include some components from the environment and recreation, pipeline, reservoir, and wellfield modules.

This module will collect user input for these types of projects to supply to the costing module. Specifics of this module are discussed in the following sections.

3.1.7.1 Calculation processes and tools/models to be used

The types of projects considered in this module can mostly be costed based on the length of the project or per installation. It may not be feasible to include all the types of activities possible with unit costs; therefore, general unit costs will be included for a basic calculation and well-known activities will be included with unit costs for a more complex calculation. It will be up to the user to determine which process is most appropriate for the project given the information available.

The agriculture projects module will essentially collect the information above to use as input for the costing module.

3.1.7.2 Source data, information, and outputs

This section describes the inputs which will be compiled and used as input to the costing module. The agriculture projects module requires inputs that will be mostly optional depending on the types of projects being included. The following is a list of the potential inputs to be supplied by the user:

- Length of channel to be developed or improved: Used to calculate costs of multiple channel development or improvement projects including bank stabilization, channel restoration, and culvert removal or replacements
- Type and number of structures installed: This will include structures for which unit costs are readily available and may include diversion structures, intake structures, flow monitors, weirs, and/or channel constrictors.

3.1.7.3 Assumptions

Several assumptions may be required for this module depending upon the available user information. The assumptions will be developed further with development of the tool.

3.1.8 User-Supplied Projects Module

This module will be included for users with projects that already have cost estimates for capital (i.e. direct costs) that may go beyond what can feasibly be calculated with the project modules provide in the Water Finance Tool. The user will be able to input the information on direct costs and this will be supplied to the costing module of the Water Finance Tool to develop indirect, annual, and other costs described in **Section 3.2**. Additional inputs beyond direct costs will be required by the user to perform these other calculations and the required inputs are discussed further in **Section 3.2.1**. To calculate normalized cost (**Section 3.2.1.4**), the average annual water supply produced is needed.

3.1.9 Data Limited Components

Additional components being considered for the Water Finance Tool include projects that are not typical, clear in scope, or easily costed. Projects typically considered that may be data limited included water conservation plans, drought management, and alternative transfer methods for water rights. This also includes a component that calculates avoided cost for certain types of projects. A simple example of this would be choosing to implement a reclaimed water system instead of building a new reservoir. The Water Finance Tool will attempt to include these projects and calculate avoided cost, but it will be in a limited capacity.

3.2 Project Cost Development Methodology

The cost development will be a separate module from the individual project module and will bring together information supplied or calculated from the modules to develop planning-level cost estimates. The costs will be broken out into direct, indirect, and annual costs. Each of these costs will be developed using the output from the project modules and applying unit costs or cost curves where available. These unit costs or cost curves will be adjustable to account for current market conditions using readily available indices. Other costs will be based on industry standard or researched percent values of a direct cost. Such values can be adjusted by the user as needed.

The final cost sheet will include a summary outline of all the costs by type along with a present-worth calculation and a normalized cost that can be used for project comparison.

3.2.1 Calculation processes and tools/models to be used

The process for the costing module includes calculating costs for each type of cost, developing annual costs, calculating present-worth, and normalizing the project costs for comparison purposes. Each of these aspects are discussed in the following sections.

3.2.1.1 Direct Costs

The direct costs, also referred to as capital costs, of each component of a module will be calculated, at a basic level, using a cost curve or multiple cost curves representing different variables of the component. Each type of cost and the curves considered are outlined in **Table 3-23**.

Table 3-23 Summary of Variables Used to Cost Infrastructure Types

Infrastructure/Project Type	Variable(s) for Costing	Optional Additional Variables	Alternative Variables
Pipelines	Length and Diameters	Soil Type and Constructability	
Intake Pump Stations	Power		Flow and Head
Booster Pump Stations	Power		Flow and Head
Crossings	Diameter	Construction Method	
Storage Tanks	Volume	Type	
Wells (including the pump)	Depth and Capacity	Type	Flow and Head
Treatment	Max Day Capacity and Source Water Quality	Type	
Reservoirs	Normal Pool Area		
Reservoir Dams/Embankments	Volume of Material		
Reservoir Spillways	Spillway Design Flow		
Reservoir Outlet Works	Number and Dimension of Gates		
Hydropower Generation Station	Production Power		Flow and Head
Channel Diversion Structure	Type and number		
Stream Restoration	Stream Classification, Stream Length, Fill Quantity,	Constructability	
Channel Improvements	Type and number	Constructability	
Channel Structures	Type and number	Constructability	
Habitat Restoration	Area	Constructability	
Water Rights	User-Supplied Cost		

Other direct costs that may be included are listed below:

- Power connection fee
- Pipeline crossings
- Integration/Relocation/Other

3.2.1.2 Cost Adjustments for Direct Costs

The Water Finance Tool will calculate costs that represent the current-market value. The unit costs and cost curves programmed into cost module will be in year 2017 dollars, but calculations will be included that adjust those unit costs and cost curves to represent the current year as specified by the user. This is accomplished using readily available cost indices such as the Engineering News-Record (ENR) Construction Cost Index, Building Cost Index, or the Producer Price Index.

Any user-supplied costs must also be entered or converted to 2017 dollars to develop comparable cost estimates. The cost module will include calculations that will allow the user to convert user-supplied costs to 2017 dollars.

3.2.1.3 Indirect Costs

The indirect costs, also referred to as associated project costs or soft costs, include all the other types of costs related to constructing the project. These types of costs are included in the costing module and may comprise of the following:

- Engineering Services
- Surveying
- Legal Services
- Financing and Bond Assistance
- Environmental and Cultural Studies
- Land Acquisition
- Contingency

Each indirect cost will be calculated as percentage of specific direct costs. For most, it will be a percentage of the total project direct costs. An exception is land acquisition which may be calculated based on the total acreage and a cost per acre. Market values for land would be included in the tool for this purpose.

3.2.1.4 Annual Costs

The annual costs are the costs that will continue beyond project completion. The annual costs to be considered in the costing module are as follows:

- Standard project debt service: calculated using the annual cost equation with user input on interest and duration (See Equation 6 below)
- Special project debt service: same calculation as above, but the duration is extended to account for the larger cost of a more complex or more expensive project
- Operations and maintenance: calculated as a percent of the direct cost of the facility or project
- Pumping energy costs: the energy use calculated in each module multiplied by the cost of energy per unit
- Water supply payment: user-supplied information on the unit cost of water and the amount of water for the specific project

The annual cost equation for calculating debt service is shown as Equation 6.

$$A = \frac{i(1+i)^n}{(1+i)^n - 1} \qquad \text{[Equation 6]}$$

Where A = annual cost (in current-market dollars)
i = interest rate
n = the duration of the debt service in years

3.2.1.5 Normalized Cost

Normalized cost converts the project cost to a unit cost for the purposes of comparison. For water projects, normalized cost typically divides the total cost by the amount of water produced by the project. For this Water Finance Tool, normalized cost may be presented using different units or project yield amounts to give the user flexibility in comparing project costs.

Normalized cost might not be applicable for certain projects included in this tool, thus it will be calculated if the appropriate inputs are supplied by the user. These inputs include the total project yield and the project peaking factor.

3.2.1.6 Overall Cost Sheet Outline

The overall cost sheet includes all the components discussed in the previous sections. An example cost sheet is presented as **Figure 3-2**.

[Basin]
[Project Name]
[Year Prices]
[Cost Estimator]
[Date]

	Item	Cost
Direct Costs		
	[Any of the items listed in Table 3-X]	*$*
	[Any of the items listed in Table 3-X]	*$*
	[Any of the items listed in Table 3-X]	*$*
	Direct Costs Subtotal	***$***
Indirect Costs		
	Engineering Services	*$*
	Surveying	*$*
	Legal Service	*$*
	Financing and Bond Assistance	*$*
	Environmental and Cultural Studies	*$*
	Land Acquisition	*$*
	Contingency	*$*
	Total Project Cost	***$***
Annual Cost		
	Standard or Special Project Debt Service	*$/yr*
	Operations and Mainenance	*$/yr*
	Pumping Energy Costs	*$/yr*
	Water Supply Payment	*$/yr*
	Total Annual Cost	***$/yr***
	Future Worth	***$***
Normalized Cost		
	Project Cost Divided by Factor	*$/AFY*

Figure 3-2 Example Cost Sheet

3.2.2 Source data and information

Source data and information will include unit costs and cost curves in 2017 dollars for direct costs. These values will be developed from project experience and input from CDM Smith's CCI group. Percentages for indirect costs will be determined from project experience. Default interest rates will be included from CWCB.

3.2.3 Assumptions

Assumptions used in the costing module will be outlined in detail with the development of the tool.

Section 4: Connections with Other Calculation Processes

Under development, but generally, this is independent of other SWSI Update technical work. Project and Methods inventory and Economy component may have some interaction.

Section 5: Impacts of Schedule and Budget

The above methodology for developing a cost estimating tool was designed with consideration for the schedule and budget of the SWSI Update. This methodology is still under development and CWCB staff review so level of detail is likely to vary some from the current presentation. A detailed proposal for executing this work, including project schedule and budget, will be developed after the Finance workshop meeting.