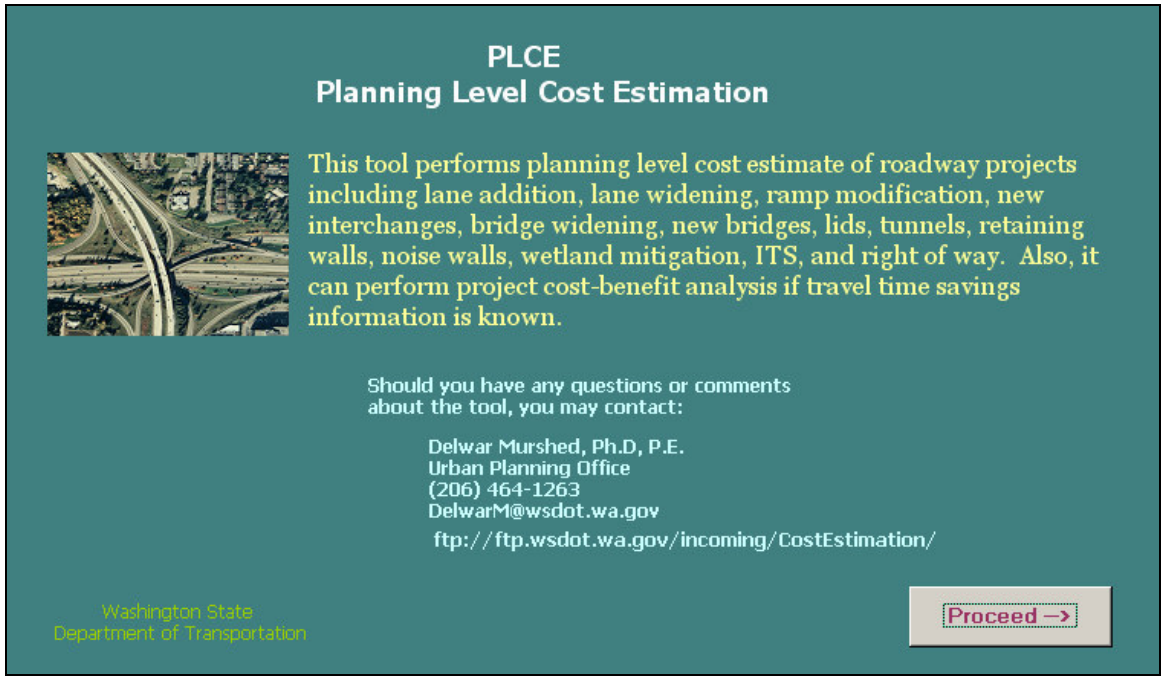
Planning Level Cost Estimation

Step by Step to Make it Easy



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Planning Level Project Cost Estimation

BACKGROUND

A planning level project cost estimation methodology was developed as part of Congestion Relief Analysis (CRA) for Washington State's three metropolitan areas – Central Puget Sound, Spokane, and Vancouver. The methodology was first developed in an EXCEL spreadsheet to quickly estimate the cost of planning level improvements analyzed in the CRA. This spreadsheet tool can analyze only one project at a time. If, for any reason, any assumption or input needs to be adjusted, it has to be done project by project. Significant time and labor would be involved in performing such revisions for a large number of projects, for example projects analyzed for Highway System Plan updates. In addition, this does not have capability to generate summary information for a portfolio of projects. Any summary report needs to be done manually which is again labor intensive and time consuming.

In order to overcome these problems and increase efficiency, the methodology has been converted to a MS Access database tool. This database tool has been developed with an objective of realizing a number of user benefits including:

- Broadening the applicability of the methodology to other areas of Washington State outside three metropolitan areas stated above;
- Designing user-friendly interface for project data entry;
- Easily updating the estimates of portfolio of projects when one or more input variables need to be revised;
- Preparing project cost summary; and
- Reporting of results by corridor, geographic area, or by various cost components such as construction cost, ROW cost, environmental mitigation cost, and so on.

OVERVIEW OF METHODOLOGY

Concept

This methodology is intended to perform cost estimation for projects that are very conceptual, often with no or minimum design. The methodology has been developed to estimate costs for varieties of projects namely widening existing roadways or bridges, building new roads or bridges, and modifying existing interchanges or building new ones.

It utilizes unit price approach that accounts for regional differences as well as differences in land use types and development density within a region. Since unit prices vary by geographic area, separate unit prices are used in the estimate depending on where the project is located. To keep the program manageable, four sets of unit prices representing Central Puget Sound, Vancouver, Spokane, and the rest of the state are used. Within each of these geographic areas, unit prices are

again function of density of development such as rural, suburban, urban, and dense urban.

Rural (R) – Where widening has no adverse construction or right of way (ROW) impacts associated with added lanes.

Suburban (S) – Where the character of the surrounding property development is largely undeveloped and where roadway expansion without the use of retaining walls can easily be accomplished with no impacts on buildings.

Urban (U) – Where development (homes and businesses) is evident immediately adjacent to the ROW where substantial ROW costs and retaining walls are likely to occur due to widening.

Dense Urban (D) – Where intense development next to the corridor would require unusual construction methods to avoid impacts, or extremely high ROW costs.

The tool comes with default quantities per lane-mile and unit costs obtained from historical data of WSDOT's past projects. Some unit prices were adjusted for differences in area prices, terrain, ground conditions, and design assumptions. The underlying assumption of the methodology is that little or no geotechnical data is known at the time of planning level estimate.

ROW cost is estimated based on amount of ROW needed and unit prices that vary by county as well as development density and land use such as vacant land, residential property, and commercial property.

Program Structure

The tool uses a number of related tables to store different types of data separately (Exhibit 1). A series of interfaces guide users to select what they want to do as well as to facilitate data entry. The program can store, perform calculations, and produce reports for numerous projects, so there is no need to save the program for each project. Edits can be easily made through another series of interfaces allowing the user to edit both project specific variables and program default variables. (see Editing Modules and User Inputs) The program is opened by double clicking the left mouse button on the program file "*PLCE.mdb.*" Exhibit 2 shows the options a user can choose from once the program has been initialized.

Exhibit 1: Schematic of Data Structure and Calculation Flow

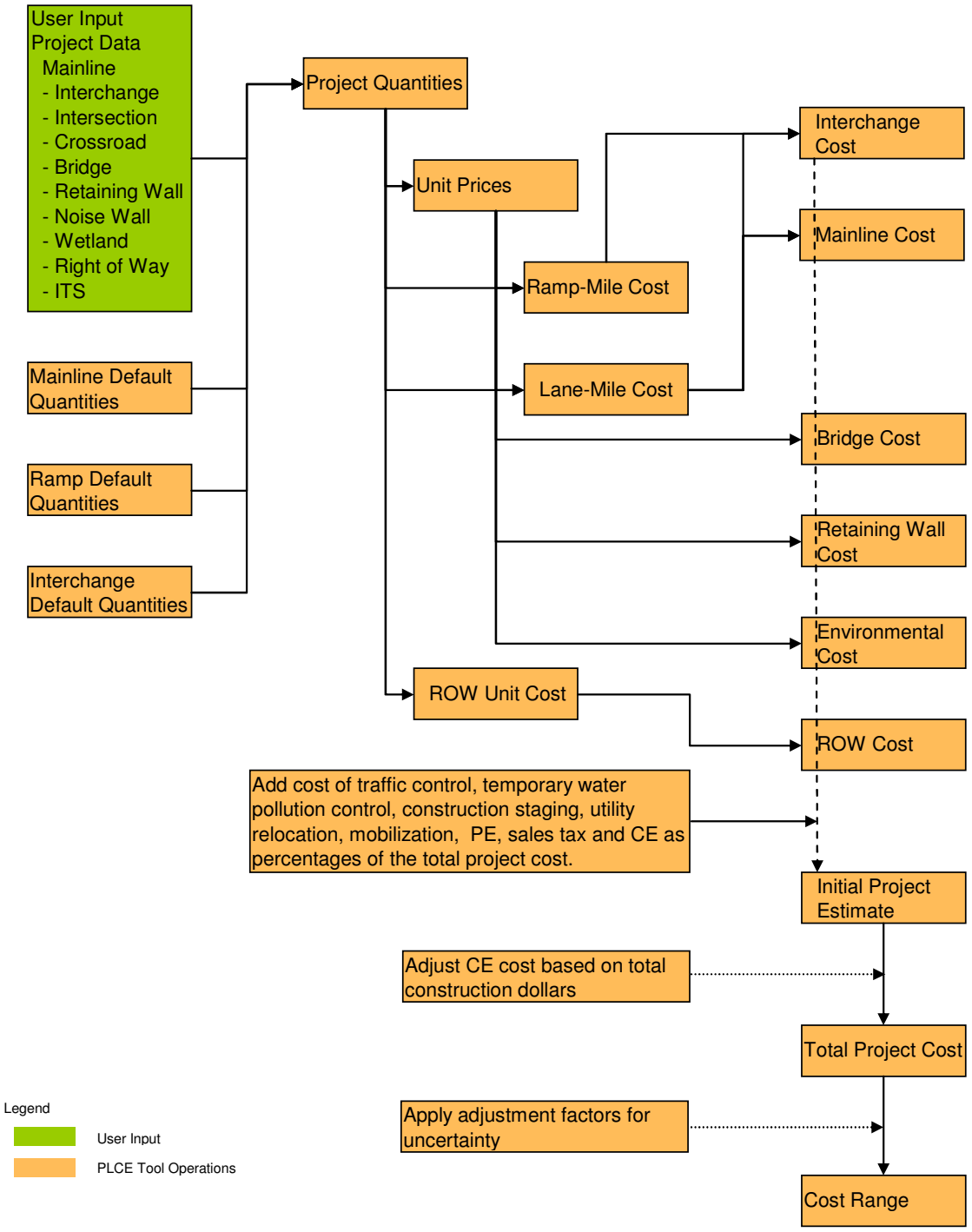
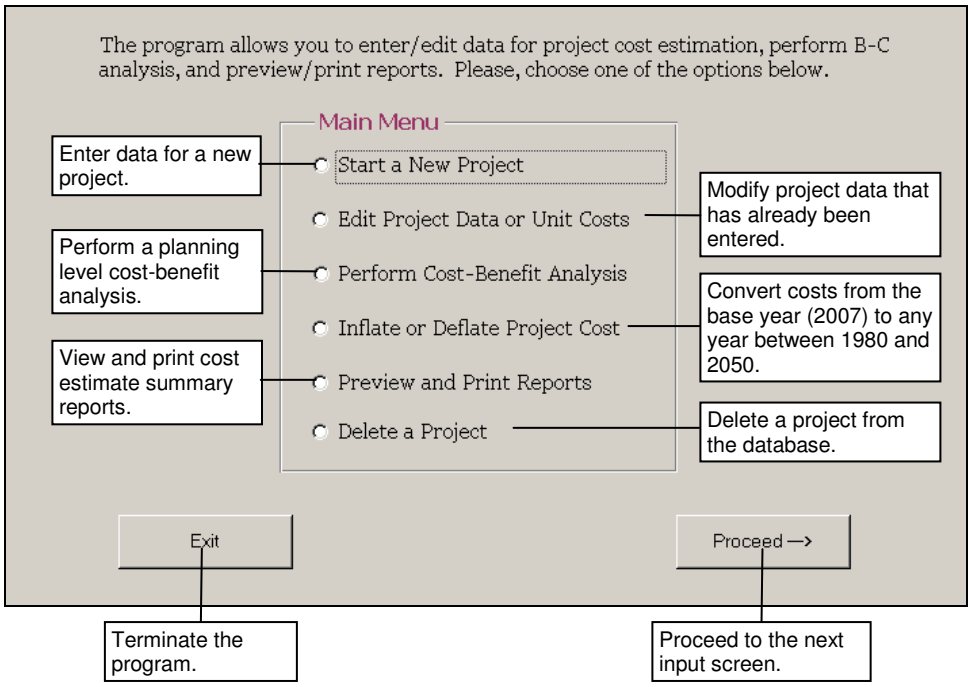
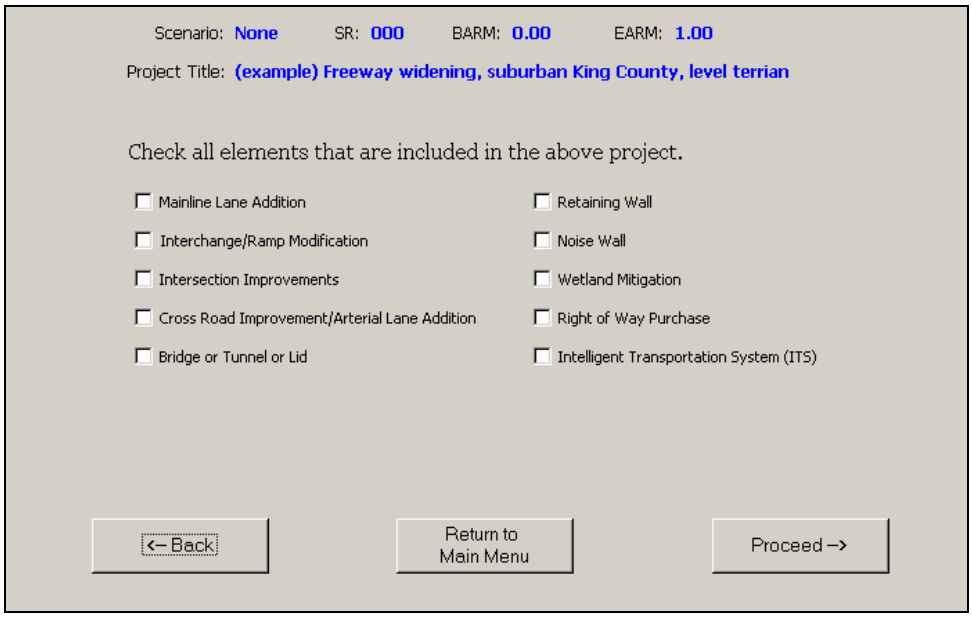


Exhibit 2: Program Structure



If a user has selected "*Start a New Project*" and then clicks the left mouse button once on *"Proceed"* the program will display a screen for entering project identification information (Exhibit 6). Then by following instructions and inputting project information the program advances through a number of screens depending on which project components the user selects from screen shown in the following exhibit (Exhibit 3). Those selections tell the program which calculation modules to use. The calculation modules are described in the following section. (See section Calculation Modules and User Inputs)

Exhibit 3: Project Components



By selecting "*Edit Project Data or Unit Costs*" from the screen shown in Exhibit 2, a user can modify any of the previously entered data or default values (e.g., unit costs, project quantities, etc) for one or more projects. Selecting "*Perform Cost-Benefit Analysis*" the user can do an analysis, edit an analysis, edit global variables, or print benefit-cost reports. Selecting "*Inflate or Deflate Project Cost*" the user can choose the year in which they want the costs reported. Selecting "*Preview / Print Reports*" users can either, preview and print a one page summary report for all projects in the database, or only the project of their interest. Selecting "*Delete a Project*" allows the user to delete individual projects from the database. Pressing "*Exit*" will save the data, terminate the program, and close all the opened files associated with this program.

Project Components and Data Need

The tool performs cost estimation requiring only very basic information regarding a project. The following table provides an overview of what data is needed for different components of a project. Please note that a particular project may or may not have all these components. The tool offers options to select any combination of components for a specific project.

Exhibit 4: User Inputs by Module

Module	User Input Data
Project Description	State route, beginning and ending ARM, county, roadway type (i.e., freeway or arterial), terrain (i.e., level, rolling or mountainous), and development density (i.e., rural, suburban, urban or dense urban)
Mainline	Existing and proposed number of lanes by direction, and length of proposed lanes
Interchange	Type and number of interchanges
Intersection	Number and length of left turn, right turn and two-way-left-turn lanes, number of new signalized intersections, and number and unit cost of roundabout
Crossroad	Length and number of lanes
Bridge, Tunnel or Lid	Square feet of existing bridges to be widened or removed, length and square feet of roadway bridges to be built, square feet of new lids, and length of new tunnels, pedestrian bridges and railroad bridges
Walls	Square feet of retaining walls, and length of noise walls
Wetland	Acres of wetlands to be mitigated by wetland category (i.e., Class I, II, III, and IV), number of stream culverts, and number of beach restorations
ROW	Acres of land required by landuse (i.e., vacant, residential, and commercial)
ITS	Number of WMS, CCTV, HARS, HART, data stations, fiber optic terminal cabinets, and ramp meters; number of signals to coordinate; length of ITS conduit and fiber optic cable. No input is required if the default cost per lane-mile option chosen.

CALCULATION MODULES AND USER INPUTS

Cost estimation is performed in ten separate user selected calculation modules and a number of associated sub-modules. These user selected modules are:

- Roadway Mainline
- Interchanges
- Intersections
- Crossroads
- Bridges, Tunnels and Lids
- Retaining Walls
- Noise Walls
- Wetland Mitigation
- Right of Way
- Intelligent Transportation Systems

In addition to the user selected calculation modules the program performs additional calculations which require no additional user input. These calculations include:

- Grading
- Drainage
- Stormwater Treatment
- Paving
- Roadside Development
- Traffic
- Markups (Mobilization, Traffic Control, Temporary Water Pollution Control, Construction Staging, Utility Relocation, Sales Tax, Preliminary Engineering, and Construction Engineering)
- Uncertainty (cost range, see Uncertainty)

Roadway Mainline

Mainline widening costs are estimated using default quantities per lane-mile from past projects and 2007 unit costs. The quantities and costs vary according to development densities, roadway type, and geographic location. These variations result in 28 different mainline types (see Exhibit 5) that depend on:

- Development Density (rural, suburban, urban, and dense urban)
- Roadway Type (freeways and limited access highways; and arterials and non-limited access highways)
- Geographic Area (the Central Puget Sound Region, Vancouver Metro Area, Spokane Metro Area, and rest of the state).

Mainline estimates are performed based on a number of assumptions commonly experienced in past projects. For example roadways in the Puget Sound area are assumed to be in steeper terrain with greater environmental and right of way impacts. Default base estimates per lane-mile are shown below.

Exhibit 5: Base Cost* of Roadway Mainline (2007$)

Freeways and Limited Access Highways

	Puget Sound ($/lane-mile)	Vancouver ($/lane-mile)	Spokane ($/lane-mile)	Other Areas ($/lane-mile)
Rural	3.66 M	1.48 M	1.48 M	1.12 M
Suburban	3.90 M	1.48 M	1.48 M	1.11 M
Urban	5.53 M	2.29 M	2.00 M	1.12 M
Dense Urban	7.88 M	4.24 M	-----	-----

Arterials and Non-Limited Access Highways

	Puget Sound ($/lane-mile)	Vancouver ($/lane-mile)	Spokane ($/lane-mile)	Other Areas ($/lane-mile)
Rural	3.53 M	1.20 M	1.20 M	1.11 M
Suburban	3.89 M	1.26 M	1.26 M	1.11 M
Urban	5.46 M	2.16 M	1.87 M	1.19 M
Dense Urban	7.11 M	3.99 M	-----	-----

*Does not include interchanges, bridges, walls, wetland mitigation, right of way, or intelligent transportation systems.

The minimum inputs required for producing a mainline estimate are beginning and ending accumulated route mileposts (ARM), number of lanes in build and no-build conditions by direction, roadway type, terrain type, land development density, and geographic location. Two input screens with some example data are shown in Exhibit 6 and Exhibit 7.

Exhibit 6: Data Input Screen for Project Identification Information

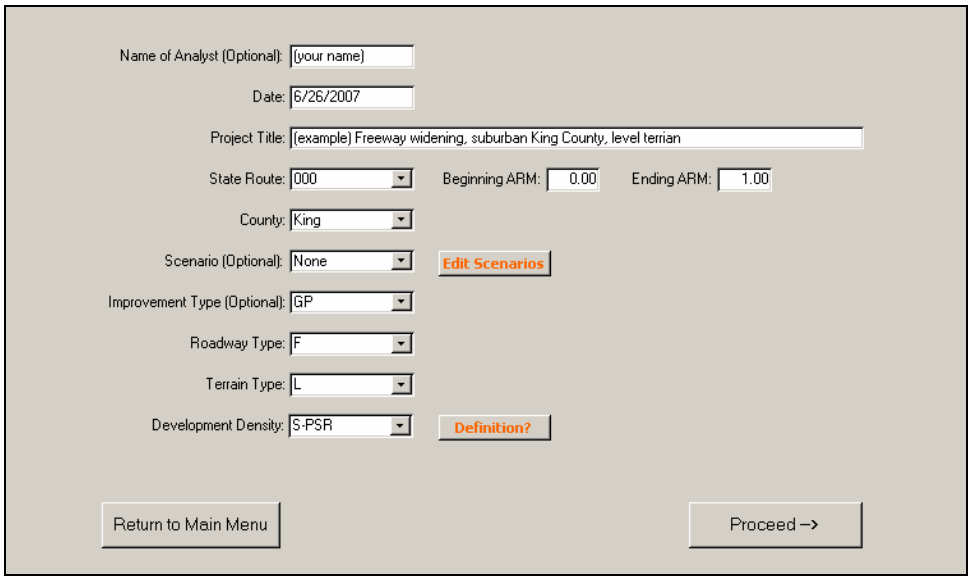
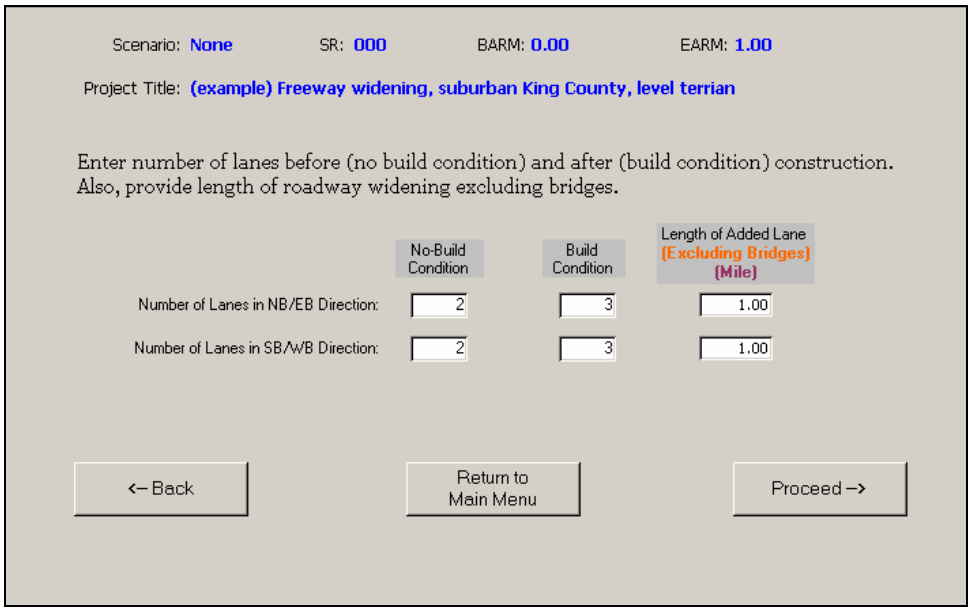


Exhibit 7: Data Input Screen for Mainline Widening



Selection of geographic area, roadway type, terrain, and development density allows the use of appropriate per-mile quantities and costs to reflect that particular roadway segment characteristics. (see APPENDIX A: Unit Prices and APPENDIX B: Default Quantities)

Interchanges

An interchange may involve mainline widening or shift, as well as construction of ramps, bridges and retaining walls, and installation of signals. Mainline widening costs come from mainline estimates described above. For ramps, a typical ramp-mile is estimated using quantities (Exhibit 25) from past projects and default 2007 unit costs (Exhibit 18 and Exhibit 19). Basic assumptions for number of lanes were used for each interchange ramp. A percent of ramp for bridges and for earthwork was assumed based on previous project information and applied to the estimated length of new ramps.

As unit costs and material quantities required for an interchange vary by geographic area and development density, interchange costs vary from area to area and from one development density to other. Exhibit 8 shows default estimates for an urban level of development density.

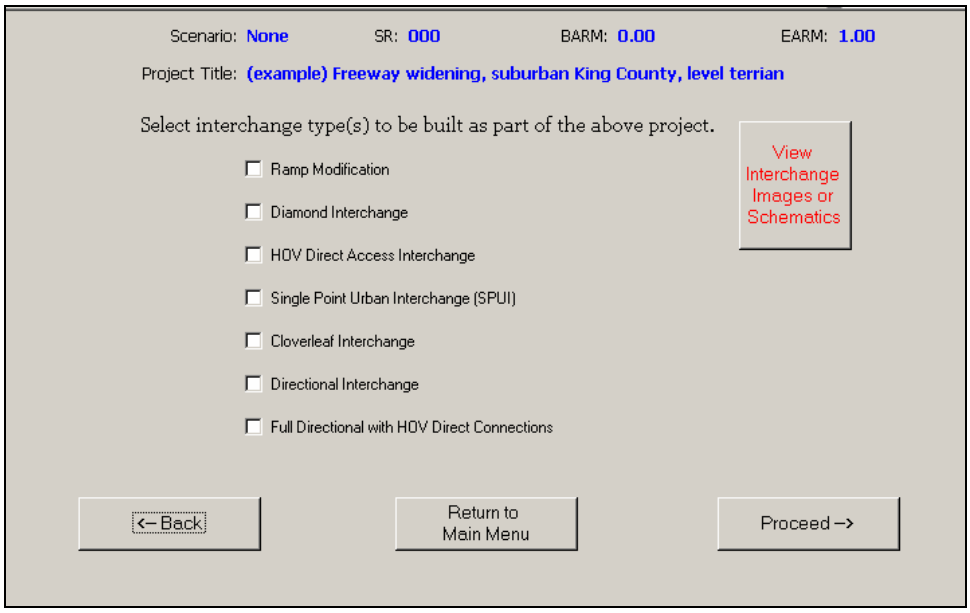
Exhibit 8: Base Cost* of Interchanges in Urban Areas (2003$)

Interchange Type	Puget Sound	Vancouver	Spokane	Other Areas
Ramp modification	$11.71 M	$5.00 M	$5.00 M	$3.56 M
Diamond at rural/minor crossroad	$21.76 M	$13.00 M	$12.29 M	$10.75 M
Diamond at urban/arterial crossroad	$30.54 M	$17.83 M	$ 16.64 M	$13.81 M
Diamond at urban/braided ramps	$37.47 M	$21.83 M	$20.52 M	$17.40 M
Half-diamond	$14.81 M	$9.09 M	$8.66 M	$7.68 M
HOV direct access interchange – one directional	$37.96 M	$23.96 M	$23.44 M	$22.22 M
HOV direct access interchange – bidirectional	$68.21 M	$43.08 M	$42.28 M	$40.47 M
HOV direct access interchange – bidirectional with freeway shift for median widening	$77.01 M	$47.95 M	$46.50 M	$42.48 M
HOV direct access interchange – with flyover ramp to HOV facility	$35.74 M	$21.62 M	$21.04 M	$19.84 M
Single point urban interchange at minor arterial crossroad	$47.06 M	$28.15 M	$27.40 M	$25.77 M
Single point urban interchange at major arterial crossroad	$52.72	$31.15 M	$29.96 M	$27.13 M
Partial cloverleaf with 1 to 2 loop ramps and small footprint	$37.12 M	$19.59 M	$17.54 M	$12.70 M
Partial cloverleaf with 3 loop ramps and large footprint	$43.08 M	$22.53 M	$20.19 M	$14.56 M
Full cloverleaf with small footprint in sparsely developed location	$46.42 M	$27.13 M	$25.22 M	$20.47 M
Full cloverleaf with large footprint in highly developed location	$56.42 M	$31.79 M	$29.27 M	$23.07 M
Partial directional with 1 flyover ramp	$72.16 M	$39.08 M	$35.88 M	$28.22 M
Partial directional with 2 flyover ramps	$88.55 M	$49.17 M	$45.79 M	$37.76 M
Full directional with 2 flyover ramps	$97.31 M	$57.98 M	$54.50 M	$43.88 M
Full directional with 3 flyover ramps	$138.98 M	$82.04 M	$77.64 M	$65.14 M
Full directional with 4 flyover ramp	$160.85 M	$95.34 M	$90.68 M	$77.63 M
Fully directional with some HOV direct connections	$202.60 M	$120.07 M	$114.73 M	$100.31 M
Fully directional for all GP and HOV movements	$245.11 M	$145.11 M	$139.01 M	$123.30 M

*Does not include right of way or wetland mitigation.

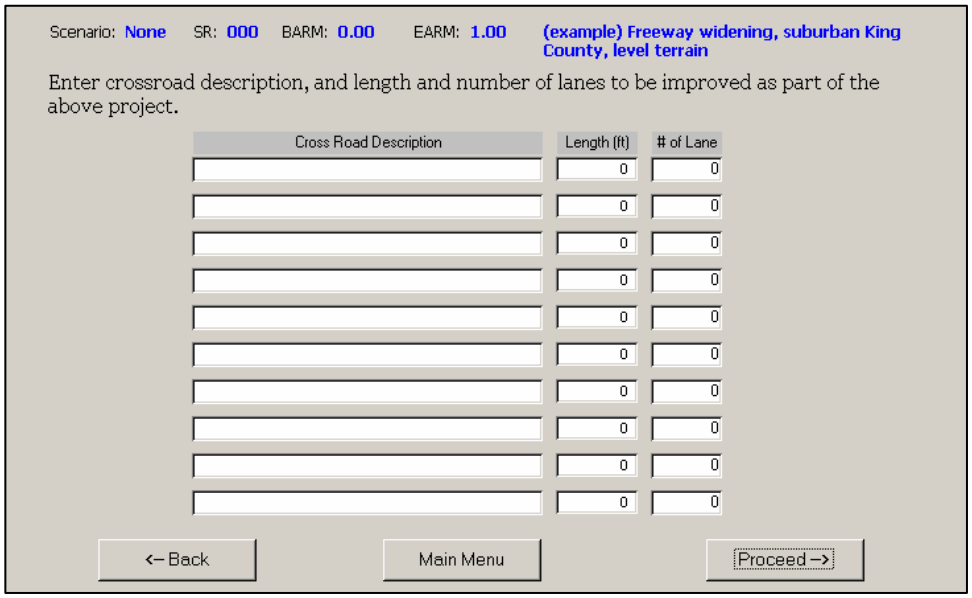
Most of the interchange cost estimation is done using default data, requiring little user input. What a user needs to do is to select an appropriate type of interchange from a menu of seven interchange types and then several sub categories for each type. The seven interchange types are selected from the input screen shown in Exhibit 9.

Exhibit 9: Interchange Selection Input Screen



Often connecting crossroads would be widened to meet the added demand for access to the improved freeway or arterial. To account for this, crossroad improvement costs are estimated only when users select this item to be included in the cost estimates. Crossroad widening costs are estimated in a separate calculation module using the mainline widening costs for undivided arterial roadways and the related assumptions. Only two pieces of information are needed for crossroad estimates – length and number of lanes of crossroad to be improved. Exhibit 10 shows an example of data input screen.

Exhibit 10: Data Input Screen for Crossroad Improvements



Bridges, Tunnels and Lids

Cost estimation of bridges, tunnels, and lids involves user input for dimensions (Exhibit 11 and Exhibit 12) and default unit costs (Exhibit 19). Existing bridge widening or removal, and all types of new bridges except railroad bridges require user input of square feet of bridges. Square feet of bridges are multiplied by unit costs to calculate cost of a bridge.

Exhibit 11: Data Input Screen for Bridges

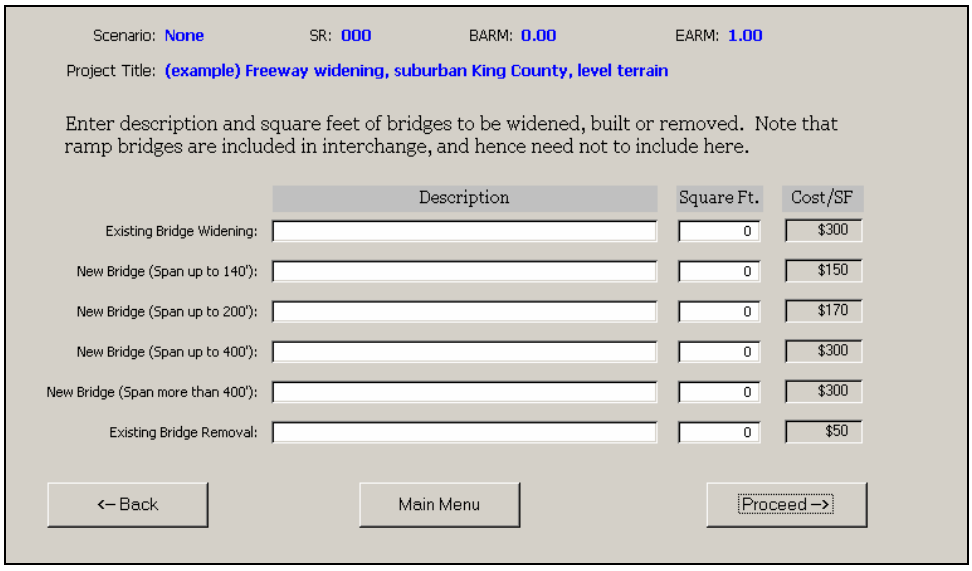
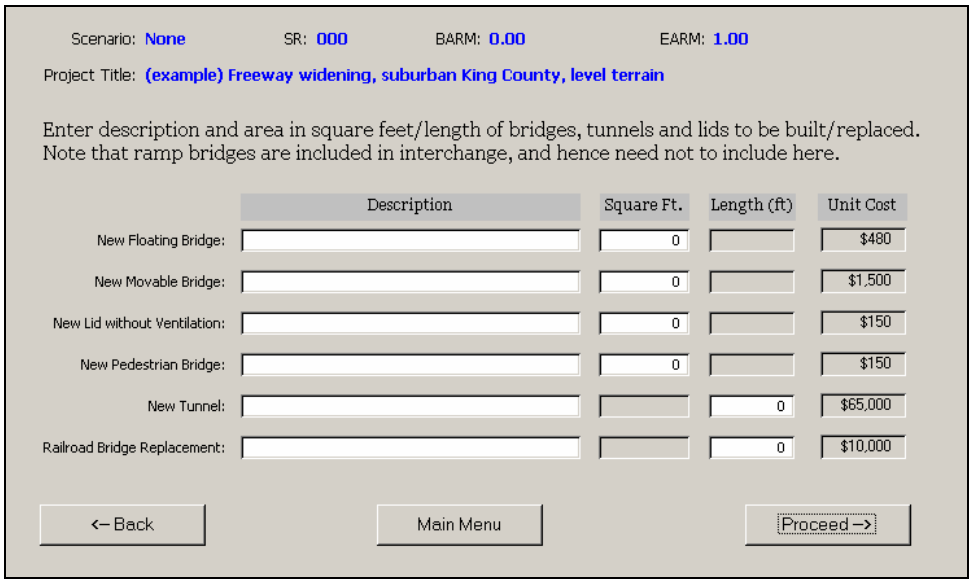


Exhibit 12: Data Input Screen for Special Bridges, Tunnels, and Lids

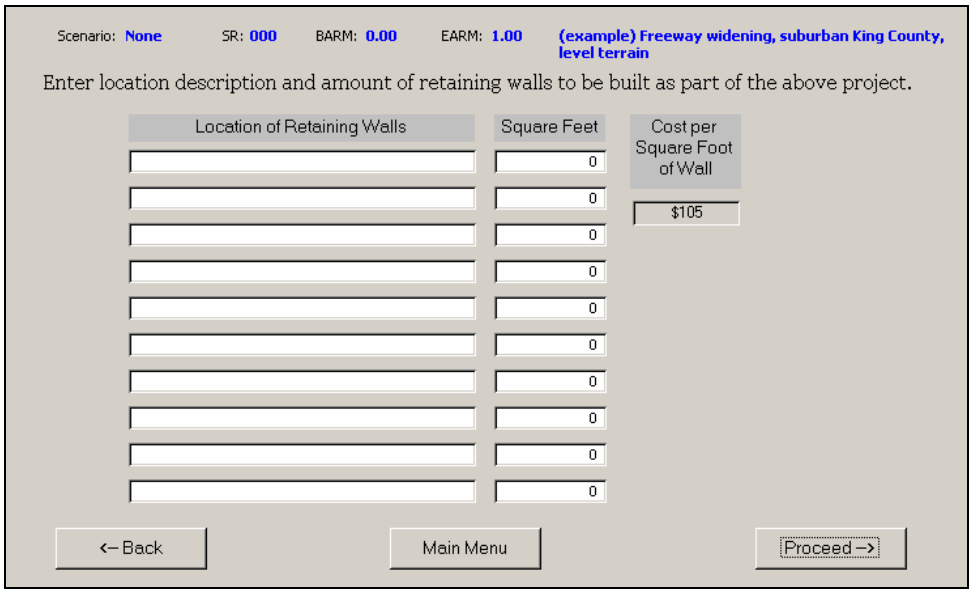


Cost of tunnels and railroad bridge replacement is estimated using user input of length in feet and default unit cost per feet.

Retaining Walls

Retaining wall estimate is straightforward. It requires only user input of square feet of each wall. Retaining wall costs are calculated by multiplying wall surface area by unit cost per square foot of wall. Exhibit 13 provides an example of the data input screen for retaining walls which can accommodate up to 10 retaining walls.

Exhibit 13: Data Input Screen for Retaining Walls



Environmental

Environmental estimates include a number of items such as wetland and streams, drainage system, stormwater detention and treatment, noise walls, roadside restoration, and temporary water pollution control during construction. A brief description of each of these items follows.

Wetland and Streams

The cost of wetland mitigation is based on the rating of the wetland and/or the type of wetland. Unit costs are assigned differentiating between wetlands based on their sensitivity to disturbance, rarity, the functions they provide, and whether they can be replaced or not. Exhibit 14 describes wetland types considered in this tool.

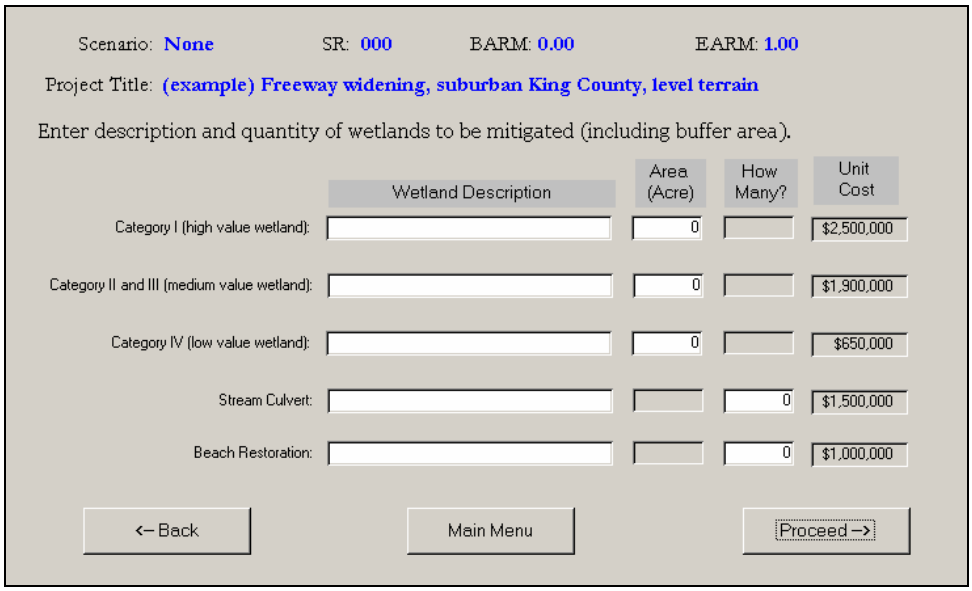
Exhibit 14: Wetland Classification

Wetland Category	Description	Mitigation Ratio
Category I	Wetlands that • Represent a unique or rare wetland type, **or** • Are more sensitive to disturbance than most wetlands, **or** • Are relatively undisturbed and contain ecological attributes that are impossible to replace, **or** • Provide a high level of functions.	6:1
Category II & III	Wetlands that are • Difficult, though not impossible, to replace, and provide high levels of some functions, **or** • Between 0.1 and 1 acre in size with a moderate level of functions.	2:1 to 3:1
Category IV	Wetlands that have lowest levels of functions and are heavily disturbed. These are wetlands that people should be able to replace and in some cases be able to improve.	1.25:1

Source: Environmental Procedures Manual (EPM Manual) M31-11, September 2004, Section 437 (Wetland); Washington State Dept. of Ecology publication # 04-06-025 "Washington State Wetland Rating System" http://www.ecy.wa.gov/pubs/0406025.pdf

For estimating the cost associated with wetlands, streams, and beaches; users have to enter the amount (in acre) of wetland to be impacted as well as number of stream culverts to install and beaches to restore. Exhibit 15 provides an example of data input screen.

Exhibit 15: Data Input Screen for Wetlands



Cost of wetlands is calculated based on users' input of areas of impact and default unit cost per acre. Stream culvert and beach restoration are assigned a lump sum cost per each.

Drainage System

Drainage costs were calculated from past project experience. The treatment and conveyance costs were determined based on the four project setting types (dense-urban, urban, suburban, and rural). Rural areas were assumed to be 100 percent ditch conveyance and open pond treatment, as opposed to dense urban which were assumed to be 100 percent pipe conveyance systems with enclosed treatment vaults. The intermediate conditions were proportioned with percentage splits of these two methods and their relative costs. The program calculates drainage systems cost based on the user input data entered elsewhere, no additional input is required.

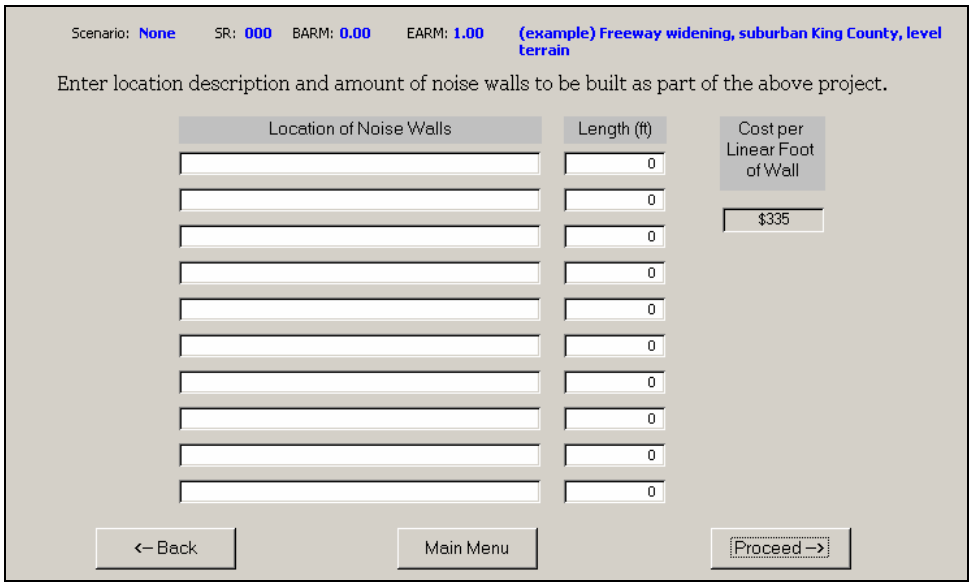
Stormwater Detention and Treatment

Stormwater treatment system is assumed to be detention pond and water quality pond for rural and suburban areas. Stormwater treatment costs are calculated using: 50% by ponds and 50% by vaults in urban areas, and 10% by ponds and 90% by vaults in dense urban areas. Costs are estimated using default quantities per lane-mile and default unit costs. No additional user input is necessary.

Noise Walls

Noise wall costs are estimated with an average height (25 feet) and a unit cost associated with this average height. Therefore, it requires only user input of length (in feet) of each wall. Exhibit 16 provides an example of data input screen, which can accommodate up to 10 noise walls.

Exhibit 16: Data Input Screen for Noise Walls



Costs for noise walls are calculated based on user input of wall length and the default cost per linear foot. (See Exhibit 19)

Roadside Restoration

A lump sum cost is assigned to roadside restoration per lane-mile. This cost varies by geographic area as well as development density in each geographic area. Default costs are shown in Exhibit 18. No user input required.

Temporary Water Pollution Control

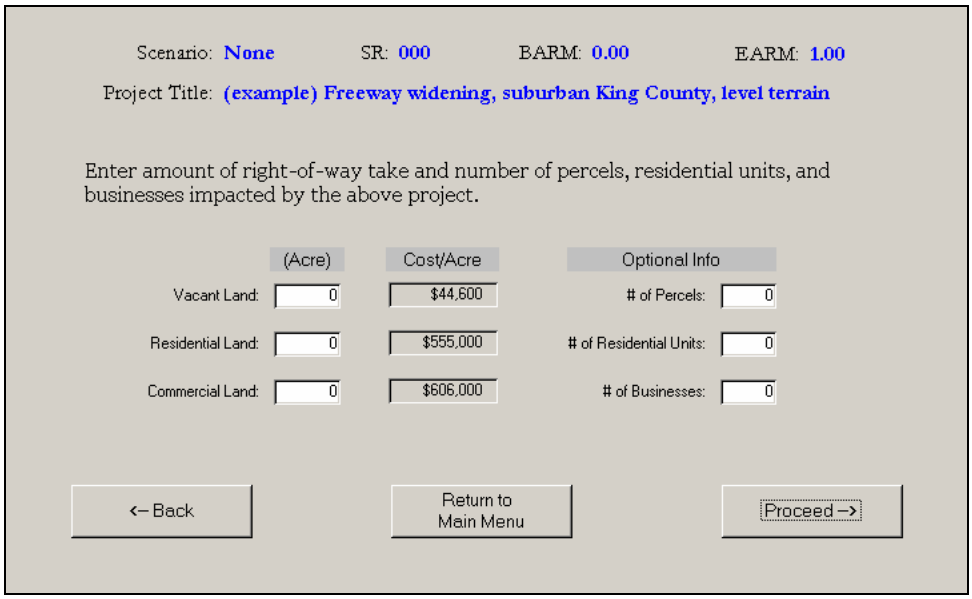
Cost of temporary water pollution control during construction is estimated as a percent of construction cost. This percent is a function of development density – 5% for rural, suburban and urban areas, whereas 4% for dense urban areas (Exhibit 22). No user input is required.

Right of Way

Right of way costs are estimated by using per acre unit costs for vacant land, and residential and commercial properties that accounts for variations not only by county, but also by development density within each county.

In order to estimate project cost, users need to enter amount of right of way needs (ROW) in acres by vacant land, residential, and commercial properties (Exhibit 17). In addition to inflation ROW costs will increase due to build out condition with respect to zoning, therefore, it is suggested to use zoned classifications not visual opinions to classify the ROW type. Number of impacted parcels, residential units, and businesses are not part of the calculation and hence it is optional to enter such data.

Exhibit 17: Example of Right of Way Data Input Screen



The amount of right of way need is multiplied by the default unit costs in Exhibit 21. However, users would be able to change the default values to reflect the local conditions, if needed. Right of way default unit costs can be updated using the button "*Edit Project Data or Unit Cost*" shown in Exhibit 2.

Other Items

Due to lack of design and construction details, costs of a number of items are estimated as percent of project construction cost. These items include mobilization, utility relocation, construction staging, traffic control, preliminary engineering, construction engineering, and sales tax. Default percentage values of these items are shown in Exhibit 22.

Construction engineering costs depends on total dollar amount of project construction. As total cost of construction goes up, percent of total cost for construction engineering goes down. Since construction dollars is not known until the estimate is complete, all projects are estimated on the basis of 15% as a beginning point for construction engineering and then adjusted them up or down using the numbers in Exhibit 23 (as per Plans Prep Manual, June 2003, Page 8-5).

Uncertainty

Generally planning level estimates are performed with no design information. Therefore, many unknown factors may lead to changes in the estimates later on. This is why the project costs are estimated as a range of probable costs and not as a single cost number. The single project cost value is only one possibility within the entire range of probable costs assigned to the estimate. The cost risk factors are applied to all projects in all regions regardless of project or corridor type. The final costs range from minus 5 percent to plus 25 percent of the initial estimated amount.

INFLATION MODULES AND USER INPUTS

(Under Construction)

BENNIFIT/COST MODULES AND USER INPUTS

(Under Construction)

EDITING MODULES AND USER INPUTS

(Under Construction)

PRINTING REPORTS

(Under Construction)

WHAT STILL NEEDS TO BE DONE?

There are a number of things that can be improved or added for statewide application of the tool. These are:

- Currently, rural and suburban areas have the same default data for all items such as unit costs, mainline quantity, ROW cost, etc. Work is needed to validate/fine tune and differentiate data for rural and suburban areas;
- Continue to validate and update all default values as additional information becomes available from newly completed projects and other sources; and

APPENDIX A: UNIT PRICES

Exhibit 18: Default Unit Costs for Central Puget Sound Region

Items	Unit	Unit Cost (2007 $)			
		Rural	Suburban	Urban	Dense Urban
Grading					
Clear and grub	Acre	$7,400	$7,400	$7,400	$7,400
Building demolition	LS/lane-mile	$8,000	$10,000	$70,000	$100,000
Removal of structure	LS/lane-mile	$40,000	$40,000	$80,000	$125,000
Pavement removal	SY	$6	$7	$9	$10
Roadside cleanup	LS/lane-mile	$5,000	$5,000	$5,000	$10,000
Roadway excavation	CY	$8	$10	$11	$13
Gravel borrow/embank. compaction	Ton	$8	$10	$11	$13
Drainage					
Remove drainage structures	Each	$200	$300	$300	$400
Conveyance: 24” RCSSP	LF	$65	$65	$70	$80
Catch basin type 2 – 48”	Each	$3,000	$3,000	$3,000	$3,500
Collection pipe: 12” PCSSP	LF	$45	$45	$45	$50
Large culverts	LF	$1,600	$1,600	$1,600	$1,600
Ditch excavation	LF	$16	$16	$16	$16
Stormwater Treatment					
Detention pond	SF of Imp.	$1.22	$1.22	$1.38	$1.49
Water quality pond	SF of Imp.	$0.52	$0.52	$0.55	$0.56
Detention vaults	SF of Imp.	$8.55	$8.55	$8.55	$9.15
Filtration treatment	SF of Imp.	$0.73	$0.73	$0.73	$0.73
Paving					
Asphalt concrete pavement	SF	$19	$19	$21	$21
Portland cement conc. pavement	SF	$25	$25	$27	$27
Roadside Development					
Fencing	LF	$19	$19	$19	$19
Seeding, mulching and fertilizing	Acre	$1,000	$1,500	$1,500	$2,000
Roadside restoration	LS/lane-mile	$125,000	$125,000	$150,000	$250,000
Traffic Services and Safety					
Guardrail	LF	$20	$20	$20	$20
Guardrail terminals	Each	$1,800	$1,800	$1,800	$1,800
Concrete barrier	LF	$35	$35	$35	$35
Impact attenuator	Each	$25,000	$25,000	$25,000	$25,000
Signals	Each	$125,000	$150,000	$150,000	$150,000
Illumination	Each	$8,000	$8,000	$8,000	$8,000
Intelligent transportation system	LS/lane-mile	$165,000	$165,000	$165,000	$165,000
Signing	LS/lane-mile	$10,000	$25,000	$30,000	$80,000
Cantilever sign bridge	Each	$50,000	$50,000	$50,000	$50,000
Sign bridge	Each	$125,000	$125,000	$185,000	$250,000
Traffic markings	LF	$1	$1	$1	$1
Raised channelization	LF	$19	$19	$19	$19
Curb, gutter and sidewalk	LF	$46	$46	$46	$46

Exhibit 19: Default Unit Cost of Structures in Central Puget Sound Region

Items	Unit	Unit Cost (2007 $)			
		Rural	Suburban	Urban	Dense Urban
Widening existing bridge	SF	$300	$300	$300	$330
Roadway bridge (span up to 140')	SF	$150	$150	$150	$170
Roadway bridge (span up to 200')	SF	$170	$170	$170	$185
Roadway bridge (span up to 400')	SF	$300	$300	$300	$330
Roadway bridge (span more than 400')	SF	$300	$300	$300	$330
Removal of existing bridge	SF	$50	$50	$50	$50
Floating bridge	SF	$480	$480	$480	$480
Movable bridge	SF	$1,500	$1,500	$1,500	$1,500
Lid without ventilation	SF	$150	$150	$150	$165
Tunnel	LF	$65,000	$65,000	$65,000	$65,000
Railroad bridge replacement	LF	$10,000	$10,000	$10,000	$10,000
Pedestrian bridge	SF	$150	$150	$150	$150
Retaining wall	SF	$105	$105	$110	$115
Noise wall	LF	$335	$335	$335	$335

Exhibit 20: Default Unit Cost for Wetland and Streams

Wetland Category	Unit Cost (Acre)
I	$2,500,000
II & III	$1,900,000
IV	$650,000
Stream Restoration	**Unit Cost (Each)**
Stream Culvert	$1,500,000
Beach restoration	$1,000,000

Stream culvert and beach restoration have default unit costs of $600 K and $750 K per each, respectively.

Exhibit 21: Default Right of Way Costs

County	Development Density	Land Value (2007 $/Acre)		
		Vacant Land	Residential	Commercial
King	Rural	$44,600	$555,000	$606,000
	Suburban	$44,600	$555,000	$606,000
	Urban	$1,173,000	$2,488,000	$6,125,000
	Dense Urban	$3,317,000	$5,742,000	$30,000,000
Kitsap	Rural	$57,000	$420,000	$540,000
	Suburban	$57,000	$420,000	$540,000
	Urban	$525,000	$1,233,000	$2,100,000
Pierce	Rural	$62,000	$962,000	$1,128,000
	Suburban	$62,000	$962,000	$1,128,000
	Urban	$590,000	$1,795,000	$3,960,000
Snohomish	Rural	$95,000	$1,086,000	$1,313,000
	Suburban	$95,000	$1,086,000	$1,313,000
	Urban	$616,000	$2,318,000	$4,140,000
Clark	Rural	$37,000	$579,000	$680,000
	Suburban	$37,000	$579,000	$680,000
	Urban	$414,00	$1,087,000	$2,380,000
	Dense Urban	$1,200,000	$2,000,000	$2,940,000
Spokane	Rural	$27,000	$336,000	$368,000
	Suburban	$27,000	$336,000	$368,000
	Urban	$255,000	$582,000	$1,322,000
Other Counties	Rural	$27,000	$336,000	$368,000
	Suburban	$27,000	$336,000	$368,000
	Urban	$255,000	$582,000	$1,322,000

Exhibit 22: Default Unit Cost as Percent of Construction Costs

	Development Density			
Items	**Rural**	**Suburban**	**Urban**	**Dense Urban**
Mobilization	8%	8%	5%	5%
Traffic Control	6%	6%	7%	8%
Temporary Water Pollution Control	3%	3%	3%	3%
Construction Staging	2%	3%	4%	4%
Utility Relocation	0%	2%	3%	4%
Sales Tax *	8.8%	8.8%	8.8%	8.8%
Preliminary Engineering	10%	10%	10%	10%
Construction Engineering	----------Varies with construction cost (see below)----------			

* PLCE tool uses an 8.8% sales tax. The actual sales tax varies slightly over the State.

Exhibit 23: Construction Engineering Cost

Project Construction Cost	**CE (% of Construction Cost)**
Below $2,000,000	17%
$2,000,000 - $5,000,000	14%
$5,000,000 - $10,000,000	12%
Above $10,000,000	10%

(Source: Plan Preparation Manual)

APPENDIX B: DEFAULT QUANTITIES

Exhibit 24: Default Quantities per Lane-Mile for Limited Access Roadways in Central Puget Sound Region

Item	Unit	Quantities per Lane-Mile			
		Rural	Suburban	Urban	Dense Urban
Grading					
Clear and grub	Acre	3.00	3.00	3.00	0.00
Building demolition	LS/lane-mile	1	1	1	1
Removal of structure	LS/lane-mile	1	1	1	1
Pavement removal	SY	0	0	0	0
Roadside cleanup	LS/lane-mile	1	1	1	1
Roadway excavation *	CY	-	-	-	-
Gravel borrow/embank. Compaction *	Ton	-	-	-	-
Drainage					
Remove drainage structures	Each	4	4	9	14
Conveyance: 24” RCSSP	LF	500	500	2,640	3,960
Catch basin type 2 – 48”	Each	3	3	9	14
Collection pipe: 12” PCSSP	LF	400	400	500	900
Large culverts	LF	200	200	150	200
Ditch excavation	LF	1,400	1,400	2,640	600
Stormwater Treatment					
Detention pond	SF of Imp.	79,200	79,200	39,600	7,920
Water quality pond	SF of Imp.	95,040	95,040	47,520	9,504
Detention vaults	SF of Imp.	0	0	39,600	71,280
Filtration treatment	SF of Imp.	0	0	47,520	85,536
Paving					
Asphalt concrete pavement	SF	63,360	63,360	63,360	31,680
Portland cement conc. pavement	SF	0	0	0	31,680
Structures					
Bridge	SF	User input	User input	User input	User input
Retaining wall	SF	User input	User input	User input	User input
Noise wall	LF	User input	User input	User input	User input
Roadside Development					
Fencing	LF	700	700	1,400	2,700
Seeding, mulching and fertilizing	Acre	3	3	3	3
Roadside restoration	LS/lane-mile	1	1	1	1
Traffic Services and Safety					
Guardrail	LF	700	700	5,280	2,700
Guardrail terminals	Each	10	10	10	10
Concrete barrier	LF	150	150	5,280	8,000
Impact attenuator	Each	1	1	1	2
Signals	Each	User input	User input	User input	User input
Illumination	Each	0	0	0	11
Intelligent transportation system	LS/lane-mile	1	1	1	1
Signing	LS/lane-mile	1	1	1	1
Cantilever sign bridge	Each	0.0	0.0	0.5	1.0
Sign bridge	Each	0.0	0.0	0.5	1.0
Traffic markings	LF	10,560	10,560	10,560	15,900
Raised channelization	LF	0	0	0	0
Curb, gutter and sidewalk	LF	0	0	0	0

* See table below for Roadway Excavation and Embankment Compaction by terrain type (i.e. Level, Rolling or Mountainous)

Exhibit 25: Default Quantities per Ramp-Mile

Items	Unit	Quantities per Lane-Mile			
		Rural	Suburban	Urban	Dense Urban
Grading					
Clear and grub	Acre	3	3	3	0
Building demolition	LS/lane-mile	0	1	1	1
Removal of structure	LS/lane-mile	0	1	1	1
Pavement removal	SY	3,667	3,667	3,667	3,667
Roadside cleanup	LS/lane-mile	1	1	1	1
Drainage					
Remove drainage structures	Each	0	10	10	10
Conveyance: 24” RCSSP	LF	500	1,000	3,000	3,000
Catch basin type 2 – 48”	Each	0	26	26	26
Collection pipe: 12” PCSSP	LF	0	2,500	2,500	2,500
Ditch excavation	LF	4,000	4,000	4,000	0
Stormwater Treatment					
Detention pond	SF of Imp.	79,200	79,200	39,600	7,920
Water quality pond	SF of Imp.	95,040	95,040	47,520	9,504
Detention vaults	SF of Imp.	0	0	39,600	71,280
Filtration treatment	SF of Imp.	0	0	47,000	85,000
Paving					
Asphalt concrete pavement	SF	63,360	63,360	63,360	63,360
Roadside Development					
Fencing	LF	3,000	3,000	3,000	3,000
Seeding, mulching and fertilizing	Acre	9	9	9	9
Roadside restoration	LS/lane-mile	1	1	1	1
Traffic Services and Safety					
Guardrail	LF	4,224	4,224	4,224	0
Guardrail terminals	Each	10	10	10	0
Concrete barrier	LF	0	4,224	4,224	4,224
Impact attenuator	Each	10	10	10	10
Illumination	Each	22	22	22	22
Intelligent transportation system	LS/lane-mile	0	1	1	1
Signing	LS/lane-mile	1	1	1	1
Cantilever sign bridge	Each	4	4	4	4
Traffic markings	LF	5,280	5,280	5,280	5,280
Raised channelization	LF	2,000	2,000	2,000	2,000
Curb, gutter and sidewalk	LF	0	1,000	1,000	1,000

Exhibit 26: Default Quantities for Interchange Cost Estimate

Interchange Type	Ramp Typical Section	Freeway Typical Section	Cross Road Typical Section	Roadway Excavation	Gravel Borrow & Embankment Compaction	Existing Bridge Removal	New Bridge	Retaining Wall	Signals	Sign Bridge
	LM	LM	LM	CY	TON	SF	SF	SF	Each	Each
Ramp modification	1.00	0.00	0.45	17,670	155,620	0	0	0	0	0
Diamond interchange at rural/minor crossroad	2.00	0.00	0.45	17,670	431,000	14,280	13,525	0	2	0
Diamond interchange at urban/arterial crossroad	2.00	0.00	1.89	17,670	431,000	22,400	23,520	0	2	0
Diamond interchange at urban/braided ramps	2.50	0.00	1.89	26,500	538,800	22,400	25,500	15,000	2	0
Half-diamond interchange	1.00	0.00	0.45	8,830	215,520	22,400	13,525	0	2	0
HOV direct access interchange – one directional	0.96	0.00	0.76	8830	214,000	14,280	98,300	17,150	1	0
HOV direct access interchange – bidirectional	2.00	0.00	0.76	17,670	428,000	14,280	181,400	34,300	1	0
HOV direct access interchange – bidirectional with freeway shift for median widening	1.93	2.00	0.76	17,670	428,000	14,280	181,400	34,300	1	0
HOV direct access interchange – with flyover ramp to HOV facility	2.15	0.00	0.00	8,830	214,000	0	87,880	17,150	1	0
Single point urban interchange at minor arterial crossroad	2.19	0.00	0.45	26,000	538,000	22,400	27,200	108,430	2	0
Single point urban interchange at major arterial crossroad	2.00	0.00	1.89	26,000	538,000	22,400	27,200	108,430	2	2
Partial cloverleaf with 1 to 2 loop ramps and small footprint	2.84	0.00	3.79	17,670	214,000	21,530	21,600	0	0	2
Partial cloverleaf with 3 loop ramps and large footprint	3.91	0.00	3.79	26,000	321,000	21,530	21,600	0	0	2
Full cloverleaf with small footprint in sparsely developed location	2.33	0.00	3.79	34,000	856,000	23,088	17,810	0	0	4
Full cloverleaf with large footprint in highly developed location	3.93	0.50	3.79	34,000	856,000	23,088	25,440	0	0	4
Partial directional with 1 flyover ramp	5.57	0.00	5.00	17,670	214,000	23,088	91,930	13,330	2	4
Partial directional with 2 flyover ramps	6.24	0.00	5.00	26,000	321,000	23,088	133,680	26,660	1	4
Full directional with 2 flyover ramps	2.88	8.00	0.00	34,000	856,000	20,560	119,760	20,000	0	6
Full directional with 3 flyover ramps	6.26	8.00	0.00	45,000	900,000	47,130	229,280	20,000	0	7
Full directional with 4 flyover ramp	7.24	8.00	0.00	56,000	900,000	70,700	291,890	26,660	0	8
Fully directional with some HOV direct connections	9.72	8.00	0.00	34,000	900,000	70,700	409,610	53,320	0	10
Fully directional for all GP and HOV movements	12.20	8.00	0.00	56,000	900,000	70,700	527,330	79,980	0	12