

Appendix G - Cost Estimating Guides

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Introduction

Project cost estimates are inherently - not exact. They represent a "best guess" or "educated guess". They are as the name implies - estimates. Developing quality estimates that can be relied on is however very important to both Program level and Project level management. Developing effective cost estimates is important for a variety of reasons, including:

- Department's programming and budgeting depends on reasonable project estimates.
- The Transportation Improvement Program (TIP) has limited funding and budgets all available dollars. Overruns in one project forces something else to be unfunded. Underruns leaves funding in the bank thereby neglecting potential important improvements.
- County budgeting affects local and regional planning.
- Budget estimates (TIP) are widely circulated to the Board, media and public.
- Poor estimates can cause a loss of credibility
- Estimates reflect on the Project Engineer, Project Manager, and the Directors Office. The Directors Office is often required to justify increasing funding amounts from funding agencies.

In summary, good engineering estimates put everyone in a winning situation. Take the time to do a quality estimate, consistent with the need, and everyone benefits.

Estimate Stages

As stated above, estimates represent our best guess. This means, that we use the best available data to develop an estimate. Consequently, estimates become inherently more accurate as a project develops and greater details are available. Typically, cost estimates are developed at three stages of a project.

Stage 1 - The Planning Estimate stage is when an improvement is desired and estimates are necessary to secure funding and to program the improvements in the TIP.

Stage 2 - Preliminary Estimate Stage is when technical engineering and environmental studies have been complete, various alternatives have been evaluated and decisions on the final alternative or scope of work is being determined.

Stage 3 - Engineers Estimate Stage is when engineering plans and project special provisions have been completed. The quantities of work and materials are determined from the final plans and used as the basis for calculating the Engineers Estimate.

The scope of this document will be to address the first two stages only. The Engineers estimate is a formal document that is used in the preparation of public works contracts. The accuracy of these documents is important enough that we have prepared a separate manual for the sole purpose of providing procedures and reference material necessary for the preparation of these final estimates. For further information related to the preparation of Engineers Estimates please refer the manual entitled Emgomeer Estimating Guidelines for Roadway Construction Projects .

Planning Estimates

Planning estimates are sometimes just an educated guess. Engineers may have experience with similar projects and can produce estimates relative to their experiences. Quick estimates can also be prepared by using cost-per-mile of comparable projects (sample list enclosed). These methods obviously use little time for preparation. If time is limited, then these methods may be your only solution. If adequate time is available to analyze a project on its specific merits it is recommend that the effort be made. It is also recommended that planning estimates be developed using the same format as is used for the Preliminary Estimates. Because of the lack of data available at this early stage, there will be a lot of empty items and a large number of assumptions will be required. The effort will however probably produce a more accurate estimate and will have the added benefit of documenting the reasoning and assumptions used to prepare the original estimate. This is valuable so that someone (possibly you) in the future can go back and understand the basis for the estimate and how it was prepared.

Preliminary Estimates

The preparation of preliminary estimates is facilitated by the use of standardized spreadsheet templates. These templates are made up of seven sheets containing the following information:

- 1 Project Summary Sheet
- 2 Administration, Design & Environmental
- 3 Right-of-way & Utilities
- 4 Construction - Roadway
- 5 Construction - Structures
- 6 Special Districts
- 7 Scratch Pad

Most projects will not require all seven sheets to complete an estimate. In fact, most projects will only use the first four sheets. Also, the first sheet is primarily summary data that is automatically compiled from sheets two through six.

Generally, the construction sheets are the most important estimate items due to the fact that the construction usually represents the largest dollar value of the project. If you are familiar with Caltrans Project Study Report and Project Report cost estimating procedures, then the construction sheets should seem familiar. We have essentially reduced the forms used by Caltrans down to these two sheets. For the roadway items, you need to calculate quantities for a few high dollar items typically used on roadway projects and then add adequate contingency funds for the current stage of the estimate (i.e. the earlier the stage, the higher the contingency). The roadway items are subdivided into the following categories:

- Earthwork
- Structural Section
- Drainage
- Traffic Items
- Specialty Items
- Minor items, Mobilization, Additions, and contingencies

The Structure estimates are developed by calculating the area of the structure and then multiplying by a cost per area from similar types of structures on

previously built projects.

Refer to the manual Engineer Estimating Guidelines for Roadway Construction Projects for instructions on determining unit prices to use in construction estimates.

Right of way and utilities costs are often the biggest unknown when it comes to estimating. Estimating usual involves the costing of land per some area unit (such as per square feet or per acre) and then applying this amount over the land to be acquired. Other items that are usually accounted for are the cost of buildings or houses including the costs of purchasing, demolition and the associated relocation expenses of the occupants.

Environmental estimates can also be difficult to produce at the early stage. The highest dollar costs of environmental activities is usually for mitigation costs and these are not know until after specific special studies are preformed that determine the need for mitigation. Estimates for the cost of preparing environmental documentation can be developed when a project has been field reviewed and it has been determined what type of environmental document is necessary and what special studies will be needed.

Design costs are calculated in various ways. Sometimes Design budgets are created as a percentage of construction. Sometimes they are prepared by determining the number of plan sheets and assigning a cost per sheet. Sometimes a detailed list of tasks is prepared along with the man-hours required and an associated cost per man-hour applied. Using a percentage of construction is obviously easier then creating a list of tasks, however, when time permits it is recommend that costs be determined using the task/man-hour method. This is also consistent with the requirements of consultants submitting cost proposals in response to County RFQ/RFPs.

Special District sheets are generally not required on County projects. Development of estimates for special district proceedings should be done with input from legal counsel and other administrative personnel necessary to complete this process.

Preliminary Estimate Template Instructions

The summary Sheet is primarily completed automatically. The only items generally input on this sheet is related to construction management and engineering. These are usually calculated as a percentage of construction.

The previous section entitled Preliminary Estimates provides a general overview of the template and how it is segmented. As with other templates in this manual this template has been developed so that if information is provided on one sheet that is needed on the other sheets, you will only enter the information once. Color coding has also been provided to help identify which location to enter the data at. In general, the color scheme is as follows:

- Purple These cells are intended to be filled in only once when the templates are set up at the beginning of a project.
- Blue These cells are updated by the engineer for each invoice submittal.
- Green These cells are automatically calculated by the template and are generally not filled in by the consultant.
- Black Static information.

Review the attached sample cost estimate to become familiar with which cells that require data input and which cells are calculated automatically. Also, review the Estimate Data Backup located at the back of this appendix to become familiar with a standard calculation methodology for the information provided in the roadway construction estimate sheet.

PRELIMINARY PROJECT COST ESTIMATE

PRINTED: 12/29/98

PROJECT: <sample project>

PROJECT NO.: <A0-0000>

SCOPE: <Construct New Road on Main Street>

LABOR TYPE: CONTRACT

LENGTH (miles) 10.00

WIDTH (feet) 110

BY: <name of estimator>

DATE: <00/00/00>

NO. OF LANES: 6

TASK	NOTE	RCTD STAFF	CONSULTANT / CONTRACTOR	OTHER FEE	TOTAL ESTIMATE
TOTAL PROJECT COSTS		\$758,900	\$8,954,000	\$5,808,500	\$15,521,000

ADMINISTRATION

<Place relevant notes here as needed>

\$155,000

Project Management / General Administration / Contract Prep.		144,400		11,000	155,400
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SPECIAL DISTRICTS

<Place relevant notes here as needed>

Formation / Assessment Engineer / Counsel / Bonds					
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DESIGN

<Place relevant notes here as needed>

\$1,324,000

Preliminary Survey / Alternative Concepts / Project Study Report		82,500	150,000		232,500
Technical Studies / Permits / Preliminary Engineering / Project Report		16,000	165,000		181,000
Design Survey / Plan Checking / Final Plans, Specs & Estimates / Award Processing		102,500	658,000		760,500
Other			150,000		150,000

ENVIRONMENTAL

<Place relevant notes here as needed>

\$240,000

Environmental Assessment		20,000	200,000		220,000
Studies					
Mitigations					
Permit Fees		2,000	18,000		20,000
Other					

RIGHT-OF-WAY

<Place relevant notes here as needed>

\$4,935,000

Right-of-Way Engineering / Research / Appraisal Fees / Title Fees / Certs					
Acquisition, Condemnation Settlements, Base Cost				4,935,000	4,935,000
Clearance/Demolition					
Acquisition of Off-site Mitigation Sites					
Other					

UTILITIES

<Place relevant notes here as needed>

\$75,000

Research / Plans / Coordination					
Relocation				75,000	75,000
Other					

CONSTRUCTION

<Place relevant notes here as needed>

\$8,792,000

Construction Management	3.5% of Construction Items	26,600		239,400	266,000
Construction Survey	2% of Construction Items	152,000			152,000
Materials Testing	2% of Construction Items	152,000			152,000
Construction Inspection	8% of Construction Items	60,900		548,100	609,000
Roadway Construction Items	<Place relevant notes here >		5,803,000		5,803,000
Structure Construction Items	<Place relevant notes here >		1,810,000		1,810,000

COST ANALYSIS

Administration cost as a percentage of Design & Environmental	10%	Construction Cost Per Mile	\$1,552,100
Design cost as a percentage of Construction	15%	Construction Cost Per Lane Mile	\$258,683
Environmental cost as a percentage of Construction	3%	Construction Cost Per Square foot	\$2.67

PRELIMINARY PROJECT COST ESTIMATE

PRINTED: 12/29/98

PROJECT: <sample project>

PROJECT NO.: <A0-0000>

TASK	NOTE	RCTD STAFF	CONSULTANT / CONTRACTOR	OTHER FEE	TOTAL ESTIMATE
PROJECT MANAGEMENT & ADMINISTRATION					\$155,000
Project Management (Pre Construction)	5% of Design & Environmental	78,200			78,200
Administrative Engineering	5% of Design	66,200			66,200
Contract Preparation / Legal Counsel				10,000	10,000
Other	Car Mileage			1,000	1,000
DESIGN SURVEY					\$150,000
Preliminary Survey					
Field Survey		75,000			75,000
Aerial Survey					
Design Survey		75,000			75,000
Other					
DESIGN ENGINEERING					\$1,174,000
Project Study Report / Alternative Concepts		7,500	150,000		157,500
Permits / Agreements					
Technical Studies	Included in Consultant contract				
Traffic Study	Included in Consultant contract	2,000	20,000		22,000
Materials Report	Included in Consultant contract	2,000	20,000		22,000
Hydrology Analysis and / or Drainage Report	Included in Consultant contract	2,000	20,000		22,000
Utility Relocation Plans	by Utility Company				
Design Exception			5,000		5,000
Project Report / Preliminary Engineering	Included in Environmental	10,000	100,000		110,000
Final Plans	PS&E from Consultant contract		650,000		650,000
Contract Documents (Specs & Estimates)		2,500			2,500
Plan Checking	2% of Final Plans	15,000			15,000
Award Processing		10,000	8,000		18,000
Other	Con Support & Contingency		150,000		150,000
ENVIRONMENTAL					\$240,000
ENVIRONMENTAL ASSESSMENT	ND/IS/EA & PROJECT REPORT				
Documentation		20,000	200,000		220,000
Processing Fee					
Other					
SPECIAL STUDIES					
Air Quality Analysis					
Historical Evaluation					
Archaeological Survey					
Hazardous Waste Survey					
Biological Survey(s)					
Paleontological Survey					
Mitigation Plan					
Land Use/Noise/Relocation/Etc...					
MITIGATIONS	To be determined by Studies				
Habitat Replacement/Protection					
Fossil Recovery					
Noise Abatement					
Air Quality					
Landscaping					
PERMITS / AGREEMENTS					
Fish & Game 1601 Permit					
Corp. of Engineers 404 Permit					
Stevens Kangaroo Rat Take					
Section 10a / Section 7					
NPDES		2,000	18,000		20,000
Other					
Other					

PRELIMINARY PROJECT COST ESTIMATE

PRINTED: 12/29/98

PROJECT: <sample project>

PROJECT NO.: <A0-0000>

ROADWAY CONSTRUCTION < put note here as required > **\$5,803,000**

ITEM	NOTE	UNITS	QUANTITIES	UNIT COSTS	COST
EARTHWORK					\$1,443,000
Roadway Excavation		M3	10,000	2.00	20,000
Imported Borrow		M3	440,000	3.00	1,320,000
Clearing & Grubbing		LS	1	100,000.00	100,000
Develop Water Supply		LS	1	3,000.00	3,000

STRUCTURAL SECTION **\$1,695,000**

PCC Pavement					
Asphalt Concrete	Type A	TONN	53,345	23.00	1,226,935
AC Base					
Aggregate Base	Class 2	M3	31,186	15.00	467,790
Aggregate Subbase					
Pavement Reinforcing Fabric					
Curb & Gutter					
AC Dike					
Sidewalk					

DRAINAGE **\$250,000**

Large Drainage Facilities / Pumping Plants					
Storm Drains		LS	1	250,000.00	250,000
Project Drainage (X-Drains, Overside, Slotted Pipes)					
Rock Slope Protection					
Headwalls					
Concrete Channel Lining					

TRAFFIC ITEMS **\$617,000**

Lighting		LS	1	87,000.00	87,000
Traffic Signals		LS	1	400,000.00	400,000
Permanent Signing		LS	1	100,000.00	100,000
Traffic Controls		LS	1	30,000.00	30,000
Traffic Management Plan					

SPECIALTY ITEMS **\$246,000**

Retaining Walls		LS	1	36,000.00	36,000
Soundwalls					
Remove / Relocate Existing Facilities					
Landscaping / Irrigation / Establishment		LS	1	100,000.00	100,000
Erosion Control		LS	1	30,000.00	30,000
Slope Paving					
Barriers & GuardRails		M	1,600	50.00	80,000
Hazardous Waste					
Fencing					

SUBTOTAL (A): **\$4,251,000**

MINOR ITEMS 10% of SUBTOTAL (A) **5%** **\$213,000**

SUBTOTAL (B): **\$4,464,000**

ROADWAY MOBILIZATION 10% of SUBTOTAL (B) **10%** **\$446,000**

ROADWAY ADDITIONS 5 - 10% of SUBTOTAL (B) **5%** **\$223,000**

CONTINGENCIES 10 - 50% of SUBTOTAL (B) **15%** **\$670,000**

PRELIMINARY PROJECT COST ESTIMATE

PRINTED: 12/29/98

PROJECT: <sample project>

PROJECT NO.: <A0-0000>

STRUCTURES CONSTRUCTION

< put note here as needed >

\$1,810,000

ITEM	NOTE	UNITS	QUANTITIES	UNIT COSTS	COST				
<name of structure>					\$1,810,000				
Structure Construction	(Includes 10% Mobil. & 20% Contin.)	M2	1,800	949.83	1,709,694				
Structure Type	CIP/PS Box Concrete Gutter								
Footing Type	Pile / Spread								
Width	M					30			
Span Length	M					60			
Structure Depth	M								
Total Area	M2					1,800			
Remove Existing Bridge						LS	1	100,000.00	100,000
Railroad Related Costs									
Other									

<name of structure>

Structure Construction									
Structure Type									
Footing Type									
Width									
Span Length									
Structure Depth									
Total Area									
Remove Existing Bridge									
Railroad Related Costs									
Other									

Structure Construction									
Structure Type									
Footing Type									
Width									
Span Length									
Structure Depth									
Total Area									
Remove Existing Bridge									
Railroad Related Costs									
Other									

Structure Construction									
Structure Type									
Footing Type									
Width									
Span Length									
Structure Depth									
Total Area									
Remove Existing Bridge									
Railroad Related Costs									
Other									

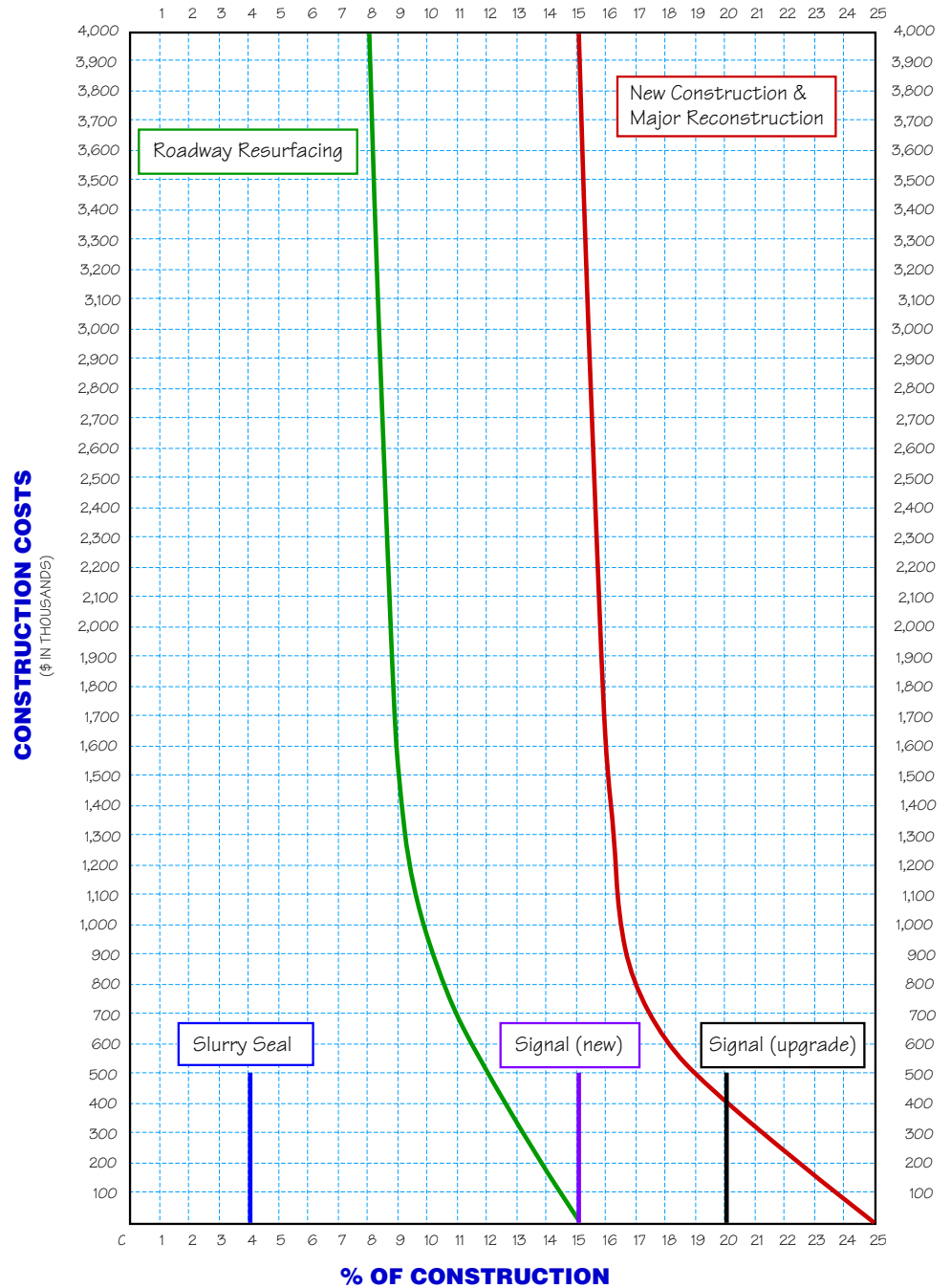
Cost/Mile Calculation Guide (New Construction for FY 1991)

T.I.	ROADTYPE	STANDARD NUMBER	COST PER MILE	STRUCTURAL SECTION
5.0	32' Access Road, and Restricted Local	106	\$320,500	.21' A.C. on .51' A.B.
5.5	32' Residential Frontage Road	107	\$336,500	.21' A.C. on .60' A.B.
5.5	36' Short Local	105	\$370,000	.21' A.C. on .60' A.B.
6.0	40' General Local	104	\$426,500	.23' A.C. on .65' A.B.
6.5	44' Collector	103	\$492,000	.26' A.C. on .69' A.B.
7.0	56' Industrial Cul-de-sac		\$647,000	.30' A.C. on .71' A.B.
7.5	56' Industrial Collector	111	\$684,500	.34' A.C. on .72' A.B.
7.5	58' Secondary Frontage Road	108	\$706,000	.34' A.C. on .72' A.B.
7.5	64' Secondary	102	\$772,500	.34' A.C. on .72' A.B.
8.0	Dump Road		\$818,500	.38' A.C. on .74' A.B.
*8.0	70' Major Frontage Road	109	\$1,158,500	.38' A.C. on .74' A.B.
*8.0	76' Major	101	\$1,228,500	.38' A.C. on .74' A.B.
*8.5	110' Arterial	100	\$1,335,500	.42' A.C. on .76' A.B.
8.5	40' Mountain Arterial	100C	\$639,000	.42' A.C. on .76' A.B.
8.5	52' Mountain Arterial	100C	\$788,000	.42' A.C. on .76' A.B.
8.5	64' Mountain Arterial	100C	\$937,500	.42' A.C. on .76' A.B.
9.0	110' Urban Arterial	100A	\$1,878,500	.45' A.C. on .80' A.B.

Notes: *curb and sidewalk cost included
 Add \$9.00 for each linear ft. of A-6 curb
 Add \$10.00 for each linear ft. of A-8 curb
 Add \$2.75 for each linear ft. of A.C. dike
 Add \$2.5 for each square ft. of concrete sidewalk
 Add \$3.00 for each square ft. of concrete driveway approach
 Add \$3.25 for each square ft. of concrete cross gutter

Project Development as % of Construction Chart

Includes Design, Environmental, and Preconstruction Administration.



Note: This chart is not for use in determining consultant fees. This chart includes County reviews, oversight, and administration.

14-SG-11
1.9/2.2
14204 123321

ESTIMATE BACKUP DATA

I. Roadway Items

Section 1 Earthwork

Roadway Excavation

Length: Sta. 100 0° section

Sta. 102 20' Cut

Sta. 106 20' Cut

Sta. 108 0° section

Average Length = 600 ft.

Width: 50+5+24+10 = 89 ft.

Height: = 20 ft.

$\frac{600 \times 89 \times 20}{27} = 40,000 \text{ c.y.}$

Embankment

Length: Sta. 108 0° section

Sta. 110 20' fill

Sta. 118 20' fill

Average Length = 900 ft.

Width: 50+5+24+10+3 = 92 ft.

Height: = 20 ft.

$\frac{900 \times 92 \times 20}{27} = 61,000 \text{ c.y.}$

Earthwork Balance

40,000 c.y. roadway excavation

0.90 grading factor

40,000 x 0.90 = 36,000 c.y. available for embankment

61,000-36,000 = 25,000 c.y. imported borrow

Clearing and Grubbing

Length: 1800 ft.

Width: 147 ft.

$$\frac{1800 \times 147}{43,560} = \underline{6 \text{ acres}}$$

Develop Water Supply

Use 10% of combined price of roadway excavation
and imported borrow

Section 2 Structural Section

Asphalt Concrete

Mainline

Length: 1800 ft.

Width: 24 ft. Note: Ignore transition tapers.

Depth: 0.5 ft.

$$\frac{1800 \times 24 \times 0.50 \times 2}{27} = 1600 \text{ Tons}$$

Shoulders

Length: 1800 ft.

Width: 15 ft. = Ignore Transition Tapers

Depth: 0.25 ft.

$$\frac{1800 \times 15 \times 0.25 \times 2}{27} = 500 \text{ Tons}$$

Total Asphalt Concrete = 2100 Tons

Aggregate Base

Main Line (same limits as above)

$$\frac{1800 \times 24 \times 0.50}{27} = 800 \text{ c.y.}$$

Shoulders (same limits as before, except width increased to 19 ft. -- use fill width)

$$\frac{1800 \times 19 \times 0.50}{27} = 650 \text{ c.y.}$$

Total Aggregate Base = 1,450 c.y.

Aggregate Subbase

Main Line (same limits as above)

$$\frac{1800 \times 24 \times 0.5}{27} = 800 \text{ c.y.}$$

Shoulders (same limits as before except outside shoulder only with width of 14 ft. -- use fill width)

$$\frac{1800 \times 14 \times 0.5}{27} = 500 \text{ c.y.}$$

Total Aggregate Subbase = 1,300 c.y.

Section 3 Drainage

Use 15% of combined price of roadway excavation and imported borrow.

Section 4 Specialty Items

Soundwall

Length: 600 l.f. (Sta. 101 to Sta. 107)

Height: 8 ft. (assumed)

$$600 \times 8 = \underline{4800 \text{ sq. ft.}}$$

Section 5 Traffic Items

From Traffic Department

Permanent Signing and Lighting	\$10,000
Traffic Control System	35,000
Traffic Management Plan	<u>10,000</u>
	\$55,000

II. Structure Items

See estimate form

III. Right of Way

From R/W Department

4 houses @ \$150,000	= \$600,000
4 acres @ \$ 15,500	= 62,000
Utilities	= 20,000
Clean up (Demolition, etc.)	= 10,000
RAP	= 10,000
Title & Escrow Fees	= 4,000
Construction	
Contract Work	= <u>0</u>
Total R/W	= \$706,000