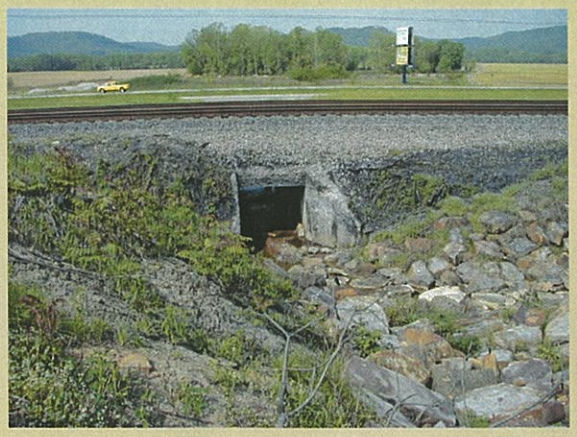
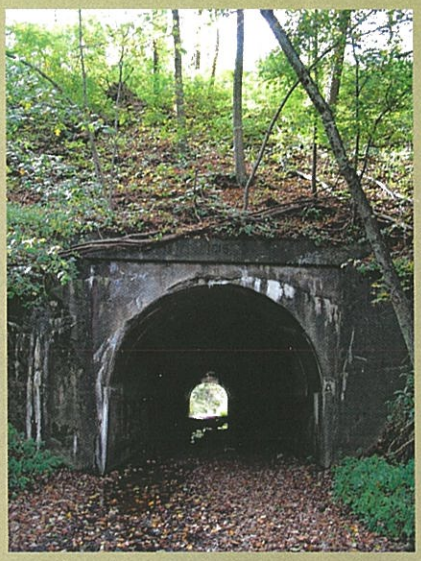
823 Portsmouth Bypass

An Appalachian Development Highway

Additional Studies

February 9, 2006





State of Ohio
Department of Transportation
SCI-823-0.00 PID 19415
City of Portsmouth, Scioto County

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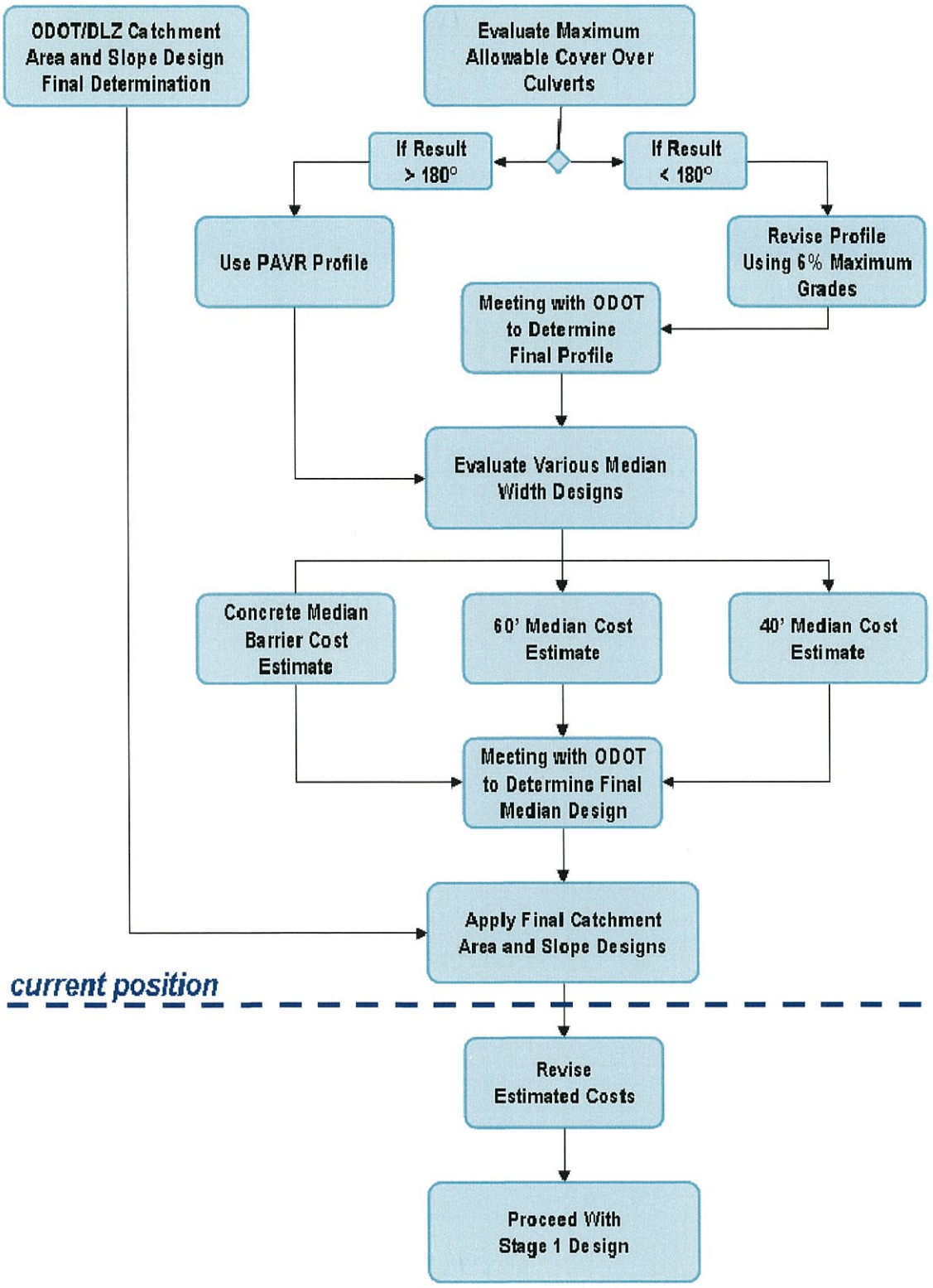
Additional Studies Flow Chart



Chronology of Meetings and Critical Decisions

JPP Workshop 8/26/05

- Investigate High fill culvert options
- Profile – investigate grades greater than 4%
- Median options – investigate 60', 40', concrete barrier section
- Investigate rock catchment ditch options

Profile Study Workshop 9/16/05

- Conceptual profile options discussed
- Investigate PAVR profile with special culvert designs and lightweight fill options
- Investigate using 5% grades (possibly 6% at select locations)
- Mainline grades to be investigated
- Evaluate earthwork volumes and costs for comparison

High Fill Culvert Meeting 12/8/05

- Five profile options were developed and evaluated
- Composite profile Option 6 to be investigated

High Fill Culvert Meeting #2 12/15/05

- Option 6 profile approved – five special design box culverts required

Profile Meeting at ORES 12/21/05

- The use of 5% grades in Option 6 approved

Median Options Meeting at ORES 1/17/06

- Options investigated were 60', 40' with cable barrier and narrow median with concrete barrier
- Preferred option is narrow median with concrete barrier

Rock Catchment Ditch Options Meeting 2/3/06

- Presented comparison of PAVR and OGE options A, B, and C
- Use 25' catchment width with 3:1 foreslope per Geotechnical Bulletin 3 Table C and verify CRSP for heights over 100'

RESULTANT PREFERRED OPTION

- Profile Option 6 with 5% grades
- 5 special box culvert designs
- Narrow median with concrete barrier
- 25' catchment design with 10' flat bottom
- Opportunities for further improvement

Additional Studies Overview

The Portsmouth Bypass project introduces challenges that are rarely, if ever, encountered in the State of Ohio. Some Ohio Department of Transportation (ODOT) design standards have been written specifically for this type of project and others have required 'project specific' consideration, all involving significant research. As these project conditions were discussed during the workshop on September 16, 2005, it was reported that the lowering of the profile to allow standard pipe culverts in lieu of special design high fill culverts would produce approximately 30 million cubic yards of waste material. This was due, in part, to the use of 4% maximum grades without the possibility of steeper grades in designing the vertical alignment. As such, TranSystems was asked to study the cost implications of certain critical design parameters including maximum allowable fill height above culverts, vertical alignment maximum grade, typical section, and rock fall catchment design before proceeding with the Stage I plans. A flow chart, shown on page 1, was established to reflect the order in which these parameters would be studied. Also, selected major cost items were applied to various design options and compared to the same Preferred Alternative Verification Review (PAVR) alignment cost items, which were used as the baseline for comparison. The optional vertical alignments and their comparative costs were studied for the mainline only; therefore, the resulting costs shown do not reflect the total project estimated cost.

The first subject to be studied was the high fill culverts. There were 16 high fill culverts ranging in sizes from 60" to 162" with fill heights from 94' to 183'. The goal was to research existing examples of culverts greater than 60" which are in high fill conditions ranging from 100' to 180', as well as their structural performance and maintenance history. A few examples were found in the States of West Virginia, North Carolina, and other states which used structural plate pipe. The Option 1 PAVR profile, using special design culverts in high fill conditions, is the design option which was questioned due to the use of special design culverts. Option 2 represents the lowering of the PAVR profile above each of the high fill culverts, using 5% maximum grades to enable the use of standard pipe culverts. While this option showed an improvement over 4% maximum grades, it was not chosen because the earthwork calculation of waste remained excessive. Option 3 is the same as Option 1 PAVR, with the exception of a lowered profile in one selected critical area to eliminate the need for three box culverts, while utilizing special design culverts for the other high fill areas. This option also generated an excess amount of waste. Option 4 reflects the PAVR profile using bridges in lieu of culverts. This option proved far too costly, but was included in order to provide all possible solutions in the analysis. Option 5 investigated the use of lightweight backfill over the high fill culverts in order to reduce the load on the pipes. This option was eliminated due to the high costs and excessive amounts of lightweight backfill needed. All of these options were presented at the December 8, 2005 workshop held at ODOT Central Office. The report and meeting minutes can be found in the Culvert Profile Section in the back of this report. In this meeting, a decision was made to investigate another option, described herein as Option 6.

Option 6 combined the Option 2 profile with the Option 1 PAVR profile between Stations 212+00 and 339+00, and was presented at the December 15, 2005 workshop. All but four culvert locations were able to accommodate standard ODOT culverts. It was agreed that these four sites, under high fills, would remain as box culverts. Also, the earthwork for this option generated a much lower amount of waste as compared to the other options. The revised report and meeting minutes from December 15, 2005, can be found in the Culvert Profile Section in the back of this report. In the process of implementing this profile adjustment, it was discovered that one additional culvert site did not meet the requirements for standard fill height. Upon review with the ODOT Hydraulic Section and District 9, a fifth box culvert site was approved.

A similar analysis was performed using a variation of the Option 6 profile using 6% maximum grades. At our meeting with the Office of Roadway Engineering Services (ORES) on December 21, 2005, it was not selected due to excessive maximum grade at the SR-140 interchange. The comparative earthwork calculations are shown in the graph on page 9. In addition, at this meeting, the Option 6 profile using 5% maximum grades was selected as the final profile.

Upon resolution of the high fill culverts issue and the selection of the final profile, we proceeded to study the impact of the median width. After the comparative cost analysis was compiled, a meeting was held on January 17, 2006, with ORES and District 9. The report and meeting minutes can be found in the Median Section in the back of this report. We compared a 60' grass median, a 40' grass median with cable barrier, and a 27' median with concrete barrier. The goal was to reduce the amount of earthwork and minimize cost on the project while maintaining a safe and efficient design. At first, the 40' median seemed to be the most cost efficient of the three options. However, it was decided at the meeting to revise the 40' median option to include a double run of cable barrier, a 2' width of pavement under each run of barrier, and an estimated 20-year maintenance cost. The 27' median design was revised to reflect a 15'-21.5' variable median. The median width is varied at each curve to maintain a stopping sight distance (SSD) design speed of 70 mph. There will, however, be a design exception for two curves which will have a SSD for a design speed of 65 mph. The revised comparison of these options can be found in the Median Section at the back of this report. The 15'-21.5' variable median option is preferred based upon safety and maintenance criteria. In addition, the earthwork calculation reflects significant improvement.

The rock fall catchment analysis represents the completion of the project typical section design. A summary of the cost impact for each catchment design, as well as a detail of each, can be found in the Catchment Section at the end of this report. A meeting was held on February 3, 2006 with the ODOT Office of Geotechnical Engineering (OGE), District 9, and DLZ. During the meeting, Option D was selected. The meeting minutes are included in the Catchment Section at the end of this report.

The most critical cost item associated with the Portsmouth Bypass Project is clearly the earthwork, which comprises 30-40% of the total project cost. The focus of these additional studies has been to carefully monitor the excavation, embankment, and waste for each of the

options considered. A table on page 7 shows all of the earthwork calculations for the options that were studied in each phase of this analysis. In addition, we have shown these quantities in a bar graph which reflects the critical changes and significant volumes associated with these items, as each option was analyzed, which can be found on page 8. These volumes apply to the mainline alignment only and include the most recent estimated swell factors, which range from 20% to 30%. The selected options are compared on a bar graph found on page 9. The final two columns compare the earthwork quantities resulting from revising the "Option 6" profile. The first revision was a result of extending a tangent between Station 230+00 and Station 250+00. This allowed us to increase the fill height resulting in a significant decrease in a waste. The second revision was a result of applying 6% maximum grades to the profile design which was previously discussed in this report.

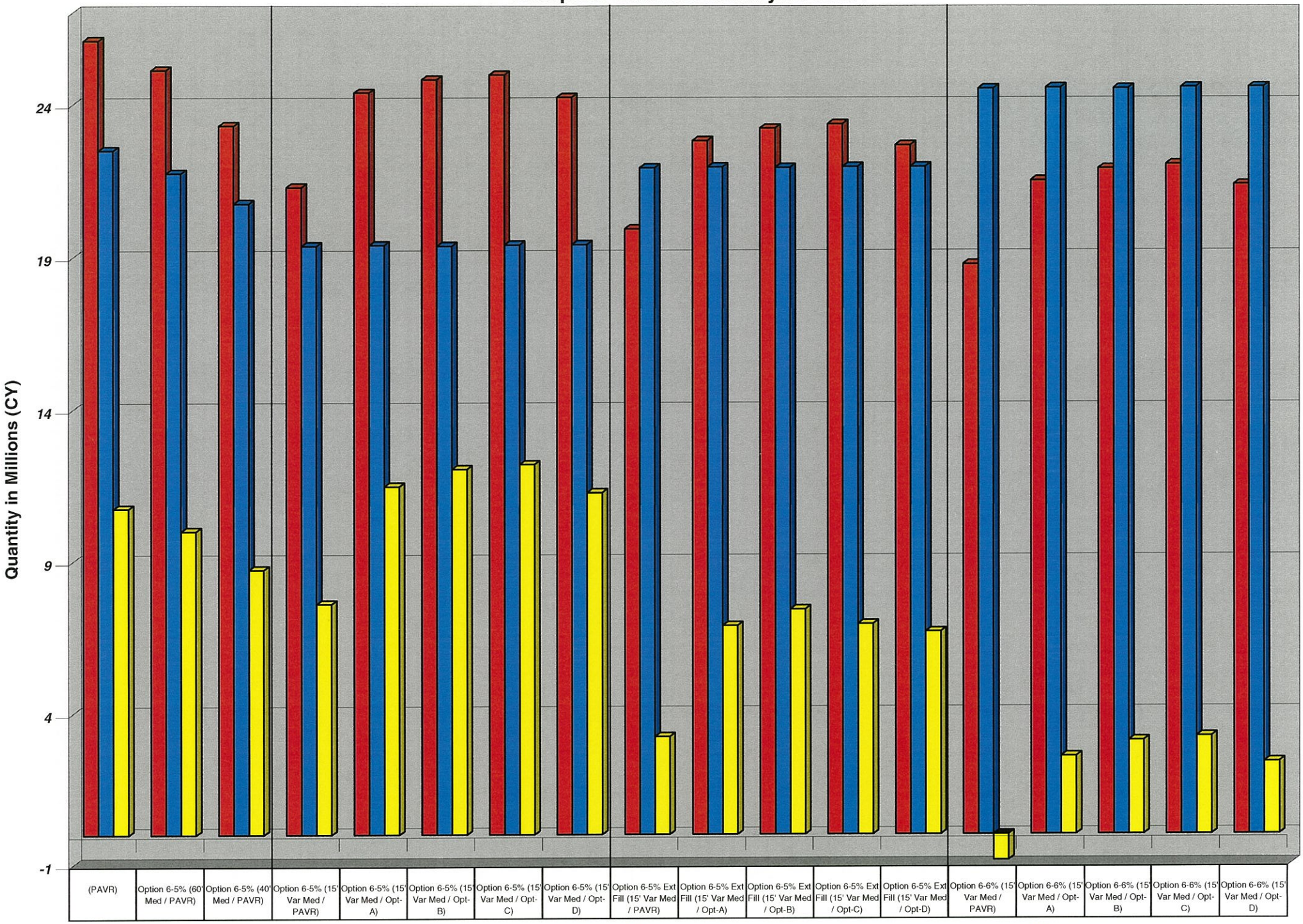
Earthwork Option Comparisons

Option	Excavation (CY)	Embankment (CY)	Waste (CY)*
(PAVR)	**26,074,861**	**22,505,243**	**10,755,644**
Option 6-5% Profile (60' Median / Catchment-PAVR)	**25,120,426**	**21,753,742**	**10,006,101**
Option 6-5% Profile (40' Median / Catchment-PAVR)	23,312,846	20,755,248	8,731,091
Option 6-5% Profile (15'-21.5' Variable Median / Catchment-PAVR)	**21,303,654**	**19,364,976**	**7,595,384**
Option 6-5% Profile (15'-21.5' Variable Median / Catchment-A)	24,384,747	19,391,248	11,473,016
Option 6-5% Profile (15'-21.5' Variable Median / Catchment-B)	24,812,521	19,367,277	12,039,029
Option 6-5% Profile (15'-21.5' Variable Median / Catchment-C)	24,960,281	19,400,995	12,192,640
Option 6-5% Profile (15'-21.5' Variable Median / Catchment-D)	**24,229,433**	**19,405,402**	**11,262,141**
Revised Option 6-5% Profile (15'-21.5' Variable Median / Catchment-PAVR)	19,918,516	21,924,762	3,234,918
Revised Option 6-5% Profile (15'-21.5' Variable Median / Catchment-A)	22,813,811	21,949,540	6,872,507
Revised Option 6-5% Profile (15'-21.5' Variable Median / Catchment-B)	23,223,795	21,929,948	7,411,014
Revised Option 6-5% Profile (15'-21.5' Variable Median / Catchment-C)	23,360,302	21,959,096	6,927,997
Revised Option 6-5% Profile (15'-21.5' Variable Median / Catchment-D)	**22,668,529**	**21,963,728**	**6,674,640**
Option 6-6% Profile (15'-21.5' Variable Median / Catchment-PAVR)	18,759,679	24,508,588	-855,672
Option 6-6% Profile (15'-21.5' Variable Median / Catchment-A)	21,509,375	24,541,422	2,584,551
Option 6-6% Profile (15'-21.5' Variable Median / Catchment-B)	21,898,194	24,514,096	3,103,283
Option 6-6% Profile (15'-21.5' Variable Median / Catchment-C)	22,032,755	24,550,616	3,236,926
Option 6-6% Profile (15'-21.5' Variable Median / Catchment-D)	**21,368,464**	**24,555,369**	**2,392,614**

Note: Color highlighted options were dismissed.

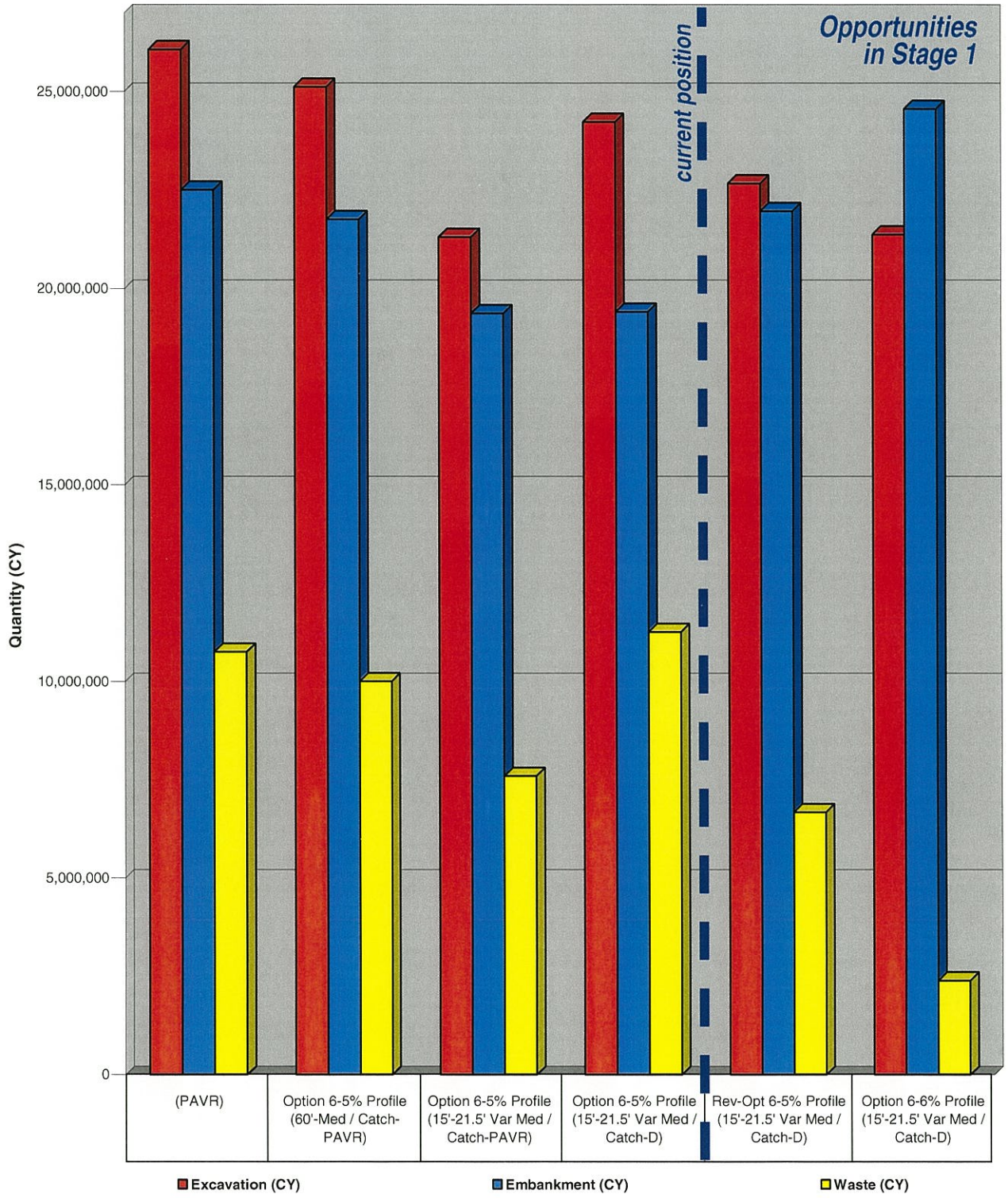
* ***Excavation + Swell - Embankment = Waste***

Complete Earthwork Analysis Chart



Note: Earthwork quantities include swell factor.

Selected Earthwork Analysis Chart



Note: Earthwork quantities include swell factor.

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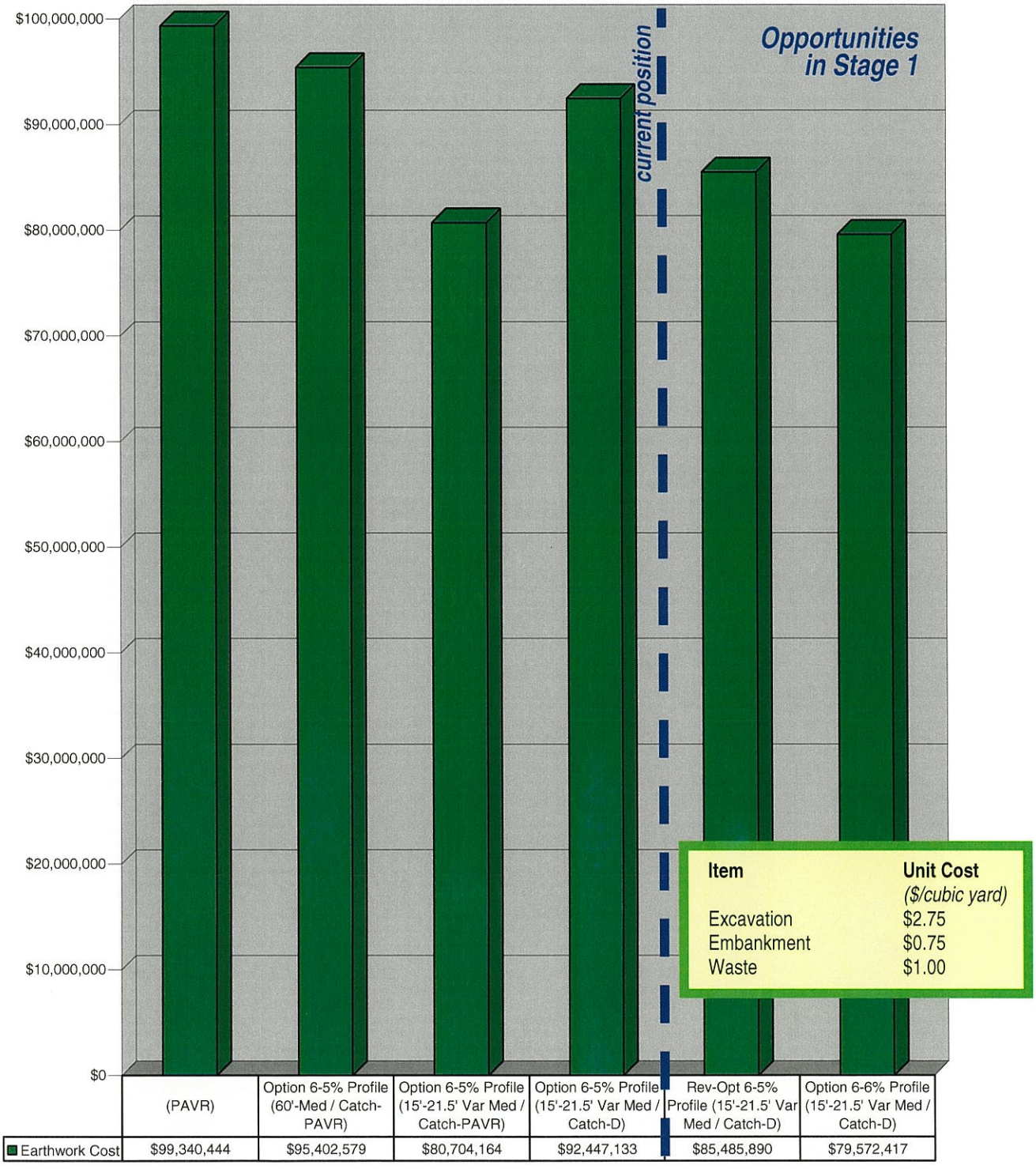
Earthwork Cost Comparison



	(PAVR)	Option 6-5% Profile (60'-Med / Catch-PAVR)	Option 6-5% Profile (15'-21.5' Var Med / Catch-PAVR)	Option 6-5% Profile (15'-21.5' Var Med / Catch-D)	Rev-Opt 6-5% Profile (15'-21.5' Var Med / Catch-D)	Option 6-6% Profile (15'-21.5' Var Med / Catch-D)
Earthwork Cost	$99,340,444	$95,402,579	$80,704,164	$92,447,133	$85,485,890	$79,572,417

Culvert Profile

SCI-823
PID 19415
Portsmouth Bypass

High Fill Option Report

December 8, 2005

TRANSYSTEMS CORPORATION
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Summary Report

Introduction:

It is the intent of this discussion to provide direction in the selection of the final mainline profile and the most appropriate recommendation for the culverts in high fill conditions. While studying the high fill culvert sites, five main options were formulated to be possible solutions to the problem. The accompanying spreadsheets reflect quantities and costs for options 1 thru 5. In order to facilitate the comparison of relative features pertaining to the high fill conditions on this project, we have compared options 2-5 to option 1, the improved PAVR profile. Only major cost items have been selected for this comparison, based upon their direct impact relative to the cost of the project. Only those proposed culverts which are subject to the most critical fill conditions are included. The costs associated with only those culverts are shown in the spreadsheets, and do not reflect the total drainage cost for the entire project. Similarly, the earthwork quantities and costs reflect only those associated with the mainline, and do not reflect the total earthwork costs for the entire project.

Option 1 (PAVR):

Option 1 is the improved PAVR profile using special design culverts for each high fill site. The profile was adjusted after the PAVR submission to provide an improved earthwork balance, and has slightly reduced the overall estimated cost of the project. The primary revision to the profile occurred at the relocated Shumway interchange, where we have taken the mainline over relocated Shumway Hollow Road (TR 234). While this introduces the additional cost of twin mainline bridges, it greatly reduces the length of the Shumway Bridge.
Most of the culverts are structural steel plate pipe at varying gages. These pipes were recommended by the manufacturer based on in-place culverts in similar fills. Three of the sites could not handle these pipes and a cast-in-place box culvert was used.

Option 2 (Lowered PAVR):

Option 2 is the improved PAVR profile lowered at each high fill culvert site in order to reduce the fills to fit the ODOT maximum fill height for each pipe size. This option uses 5% maximum grades, 4:1 fill slopes and 5 foot extended graded shoulders in fill areas to help reduce some of the excess waste material generated by lowering the profile.
All of the culverts used are standard ODOT culverts at each site.

Option 3 (PAVR lowered in one area):

Option 3 is the same as option 1, except the profile has been lowered over the 3 sites where box culverts had to be used. The profile was lowered in this area so that each pipe met the requirements for the ODOT maximum fill height.
All other culverts are special design culverts as described in option 1.

Option 4 (PAVR with bridges):

Option 4 is the same as option 1 except in lieu of special design culverts, bridges were placed.

Option 5 (PAVR with lightweight backfill):

Option 5 is the same as option 1 except lightweight backfill (such as geofoam, elastizell or flyash) is used at the high fill culvert locations to reduce the load on the pipes to make them compatible with the ODOT maximum fill height.
The culverts used are standard ODOT culverts.

Option Summary Spreadsheet

OPTION 1 IS THE IMPROVED PAVR PROFILE* WITH SPECIAL DESIGN CULVERTS.
* REVISIONS WERE MADE TO THE PAVR PROFILE AT THE SHUMWAY INTERCHANGE.

OPTION 2 IS THE IMPROVED PAVR PROFILE LOWERED AT EACH HIGH FILL CULVERT TO ALLOW STANDARD DESIGN CULVERTS. THIS REVISION USES 5% MAXIMUM GRADE, 4:1 FILL SLOPES AND 5' EXTENDED GRADED SHOULDERS IN FILL AREAS.

OPTION 3 IS THE IMPROVED PAVR PROFILE LOWERED FOR 3 SITES TO ELIMINATE CAST-IN-PLACE BOX CULVERTS, AND THEREBY UTILIZE SPECIAL DESIGN CULVERTS IN ALL LOCATIONS.

OPTION 4 IS THE IMPROVED PAVR PROFILE WITH BRIDGES IN LIEU OF SPECIAL DESIGN CULVERTS.

OPTION 5 IS THE IMPROVED PAVR PROFILE WITH LIGHTWEIGHT BACKFILL.

	OPTION 1: PAVR PROFILE W/ SPECIAL CULVERTS		OPTION 2: LOWERED PROFILE W/ STANDARD CULVERTS		OPTION 3: PAVR PROFILE LOWERED FOR 3 SITES W/ SPECIAL CULVERTS		OPTION 4: PAVR PROFILE W/ BRIDGES		OPTION 5: PAVR PROFILE W/ STANDARD CULVERTS AND LIGHTWEIGHT BACKFILL	
	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
CULVERT	LUMP SUM	$15,413,220	LUMP SUM	$8,258,086	LUMP SUM	$11,173,460	LUMP SUM***	$163,600,000	LUMP SUM	$8,593,150
CUT (CY)**	24,972,016	$68,673,044	28,473,650	$78,302,538	30,628,827	$84,229,274	26,066,684	$71,683,381	24,972,016	$68,673,044
FILL (CY)**	22,753,610	$17,065,208	17,256,595	$12,942,446	16,483,245	$12,362,434	12,646,249	$9,484,687	19,753,610	$14,815,208
GEOFOAM (CY)	0	$0	0	$0	0	$0	0	$0	3,000,000	$300,000,000
WASTE (CY)**	2,218,406	$2,218,406	11,217,055	$11,217,055	14,145,582	$14,145,582	13,420,435	$13,420,435	5,218,406	$5,218,406
GUARDRAIL (LF)	168,960	$1,689,600	110,318	$1,103,180	168,960	$1,689,600	151,008	$1,510,080	168,960	$1,689,600
PAVEMENT (SF)	7,038,009	$20,339,846	7,038,009	$20,339,846	7,038,009	$20,339,846	6,351,945	$18,357,121	7,038,009	$20,339,846
TOTAL		$125,399,324		$132,163,151		$143,940,196		$278,055,704		$419,329,253
DIFFERENCE		$0		$6,763,827		$18,540,873		$152,656,380		$293,929,929
PERCENT INCREASE		0.00%		5.39%		14.79%		121.74%		234.40%

** THE EARTHWORK QUANTITIES SHOWN ARE FOR THE MAINLINE ONLY AND DO NOT REFLECT ANY SHRINKAGE/SWELL FACTORS.

*** THE CULVERT PRICE FOR OPTION 4 IS ACTUALLY THE COST OF BRIDGES IN LIEU OF CULVERTS.

Option 1 Worksheet

OPTION 1
PAVR PROFILE WITH SPECIAL DESIGN CULVERTS

STANDARD PIPE							
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	STANDARD PIPE	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	114	NO	$279.45	625	$174,656.25
184+00	84	72	141	NO	$384.10	1,408	$540,812.80
209+00	72	90	105	NO	$284.05	607	$172,418.35
235+00	162	45	117	NO	$1,860.00	1,024	$1,904,640.00
239+50	156	45	135	NO	$1,860.00	743	$1,381,980.00
299+90	126	50	183	NO	$1,064.00	1,190	$1,266,160.00
312+50	78	79	151	NO	$331.20	850	$281,520.00
345+16	84	72	121	NO	$384.10	622	$238,910.20
623+30	78	79	100	NO	$331.20	657	$217,598.40
636+00	78	79	171	NO	$331.20	880	$291,456.00
659+00	60	100	166	NO	$276.00	810	$223,560.00
672+25	90	66	149	NO	$434.70	682	$296,465.40
771+00	78	79	115	NO	$331.20	740	$245,088.00
795+80	60	100	108	NO	$276.00	524	$144,624.00
815+00	72	90	128	NO	$284.05	976	$277,232.80
854+70	126	50	94	NO	$1,064.00	740	$787,360.00
857+55	66	100	82	YES	$279.45	532	$148,667.40

STANDARD DUAL PIPE							
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	STANDARD DUAL PIPE	UNIT PRICE	QUANTITY	TOTAL
175+00	54	100	114	NO	$279.45	1,250	$349,312.50
184+00	66	100	141	NO	$384.10	2,816	$1,081,625.60
209+00	54	100	105	NO	$284.05	1,214	$344,836.70
235+00	120	51	117	NO	$1,860.00	2,048	$3,809,280.00
239+50	114	53	135	NO	$1,860.00	1,486	$2,763,960.00
299+90	96	61	183	NO	$1,064.00	2,380	$2,532,320.00
312+50	60	100	151	NO	$331.20	1,700	$563,040.00
345+16	66	100	121	NO	$384.10	1,244	$477,820.40
623+30	60	100	100	YES	$331.20	1,314	$435,196.80
636+00	60	100	171	NO	$331.20	1,760	$582,912.00
659+00	48	100	166	NO	$276.00	1,620	$447,120.00
672+25	66	100	149	NO	$434.70	1,364	$592,930.80
771+00	60	100	115	NO	$331.20	1,480	$490,176.00
795+80	48	100	108	NO	$276.00	1,048	$289,248.00
815+00	54	100	128	NO	$284.05	1,952	$554,465.60
854+70	96	61	94	NO	$1,064.00	1,480	$1,574,720.00

SPECIAL PIPE								
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	TYPE OF PIPE	EXAMPLE	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	114	3 GAGE	YES	$532.00	625	$332,500.00
184+00	84	72	141	5/16"	NO	$930.00	1,408	$1,309,440.00
209+00	72	90	105	3 GAGE	YES	$555.00	607	$336,885.00
235+00	162	45	117	NONE	NO	N/A	1,024	N/A
239+50	156	45	135	NONE	NO	N/A	743	N/A
299+90	126	50	183	NONE	NO	N/A	1,190	N/A
312+50	78	79	151	5/16"	NO	$580.00	850	$493,000.00
345+16	84	72	121	5/16"	NO	$930.00	622	$578,460.00
623+30	78	79	100	3 GAGE	YES	$580.00	657	$381,060.00
636+00	78	79	171	5/16"	YES	$580.00	880	$510,400.00
659+00	60	100	166	5/16"	YES	$485.00	810	$392,850.00
672+25	90	66	149	5/16"	NO	$1,089.00	682	$742,698.00
771+00	78	79	115	5/16"	YES	$532.00	740	$393,680.00
795+80	60	100	108	5 GAGE	YES	$485.00	524	$254,140.00
815+00	72	90	128	1 GAGE	YES	$555.00	976	$541,680.00
854+70	126	50	94	5/16"	NO	$1,064.00	740	$787,360.00

SPECIAL DUAL PIPE								
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	TYPE OF PIPE	EXAMPLE	UNIT PRICE	QUANTITY	TOTAL
235+00	120	51	117	NONE	NO	N/A	2,048	N/A
239+50	114	53	135	NONE	NO	N/A	1,486	N/A
299+90	96	61	183	NONE	NO	N/A	2,380	N/A

BOX CULVERT						
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	UNIT PRICE	QUANTITY	TOTAL
235+00	162	45	117	$2,500.00	1,024	$2,560,000.00
239+50	156	45	135	$2,800.00	743	$2,080,400.00
299+90	126	50	183	$3,000.00	1,190	$3,570,000.00

SUMMARY				
STATION	TYPE OF PIPE	QUANTITY	UNIT PRICE	TOTAL
175+00	SPECIAL	625	$532.00	$332,500
184+00	SPECIAL	1,408	$930.00	$1,309,440
209+00	SPECIAL	607	$555.00	$336,885
235+00	BOX CULVERT	1,024	$2,500.00	$2,560,000
239+50	BOX CULVERT	743	$2,800.00	$2,080,400
299+90	BOX CULVERT	1,190	$3,000.00	$3,570,000
312+50	SPECIAL	850	$580.00	$493,000
345+16	SPECIAL	622	$930.00	$578,460
623+30	SPECIAL	657	$580.00	$381,060
636+00	SPECIAL	880	$580.00	$510,400
659+00	SPECIAL	810	$485.00	$392,850
672+25	SPECIAL	682	$1,089.00	$742,698
771+00	SPECIAL	740	$532.00	$393,680
795+80	SPECIAL	524	$485.00	$254,140
815+00	SPECIAL	976	$555.00	$541,680
854+70	SPECIAL	740	$1,064.00	$787,360
857+55	STANDARD	532	$279.45	$148,667
DRAINAGE				$15,413,220
CUT (CY)		24,972,016	$2.75	$68,673,044
FILL (CY)		22,753,610	$0.75	$17,065,208
WASTE (CY)		2,218,406	$1.00	$2,218,406
GUARDRAIL (LF)		168,960	$10.00	$1,689,600
PAVEMENT (SF)		7,038,009	$2.89	$20,339,846
TOTAL				$125,399,324

West Virginia Division of Highways
Partial List of Structural Plate Pipe Under High Fills

Location	Diameter	Thickness	Total Length	Max. Fill Height
Hardy County	66"	10 gage	474'	64'
Hardy County	72"	1 gage 6 bolt/ft	991'	141'
Hardy County	twin 72"	1 gage 6 bolt/ft	854'	157'
Hardy County	96"	1 gage 6 bolt/ft	866'	105'
Hardy County	twin 120"	1 gage 6 bolt/ft	954'	85'
McDowell County	60"	5/16"	1821'	215'
McDowell County	72"	3/8"	2767'	213'
Mercer County	twin 60"	1 gage	2024'	146'

A Key Hole Slot Multi-Plate structure was built at Benedum Airport in Clarksburg WV. It is described below. that can also be included on this list.

Harrison County	72"	variable 3 gage max.	2000'+	186'

Option 2 Worksheet

OPTION 2
LOWERED PROFILE WITH STANDARD CULVERTS

STANDARD PIPE STATION	MAINTENANCE SIZE	ODOT MAX FILL	LOWERED FILL	STANDARD PIPE	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	79	Y	$279.45	885	$247,313.25
184+00	84	72	72	Y	$384.10	1474	$566,163.40
209+00	72	90	80	Y	$284.05	834	$236,897.70
235+00	162	45	45	Y	$1,860.00	975	$1,813,500.00
239+50	156	45	45	Y	$1,860.00	725	$1,348,500.00
299+90	126	50	50	Y	$1,064.00	760	$808,640.00
312+50	78	79	57	Y	$331.20	670	$221,904.00
345+16	84	72	72	Y	$384.10	612	$235,069.20
623+30	78	79	72	Y	$331.20	805	$266,616.00
636+00	78	79	79	Y	$331.20	850	$281,520.00
659+00	60	100	100	Y	$276.00	978	$269,928.00
672+25	90	66	66	Y	$434.70	826	$359,062.20
771+00	78	79	78	Y	$331.20	740	$245,088.00
795+80	60	100	100	Y	$276.00	524	$144,624.00
815+00	72	90	89	Y	$284.05	976	$277,232.80
854+70	126	50	44	Y	$1,064.00	740	$787,360.00
857+55	66	100	45	Y	$279.45	532	$148,667.40

SUMMARY STATION	QUANTITY	UNIT PRICE	TOTAL
175+00	885	$279.45	$247,313
184+00	1474	$384.10	$566,163
209+00	834	$284.05	$236,898
235+00	975	$1,860.00	$1,813,500
239+50	725	$1,860.00	$1,348,500
299+90	760	$1,064.00	$808,640
312+50	670	$331.20	$221,904
345+16	612	$384.10	$235,069
623+30	805	$331.20	$266,616
636+00	850	$331.20	$281,520
659+00	978	$276.00	$269,928
672+25	826	$434.70	$359,062
771+00	740	$331.20	$245,088
795+80	524	$276.00	$144,624
815+00	976	$284.05	$277,233
854+70	740	$1,064.00	$787,360
857+55	532	$279.45	$148,667
DRAINAGE			$8,258,086
CUT (CY)	28,473,650	$2.75	$78,302,538
FILL (CY)	17,256,595	$0.75	$12,942,446
WASTE (CY)	11,217,055	$1.00	$11,217,055
GUARDRAIL (LF)	110,318	$10.00	$1,103,180
PAVEMENT (SF)	7,038,009	$2.89	$20,339,846
TOTAL			$132,163,151

Option 3 Worksheet

OPTION 3
PAVR PROFILE LOWERED IN ONE PLACE WITH SPECIAL DESIGN CULVERTS

SUMMARY			
STATION	**QUANTITY**	**UNIT PRICE**	**TOTAL**
175+00	625	$532.00	$332,500
184+00	1,408	$930.00	$1,309,440
209+00	607	$555.00	$336,885
235+00	975	$1,860.00	$1,813,500
239+50	725	$1,860.00	$1,348,500
299+90	760	$1,064.00	$808,640
312+50	850	$580.00	$493,000
345+16	622	$930.00	$578,460
623+30	657	$580.00	$381,060
636+00	880	$580.00	$510,400
659+00	810	$485.00	$392,850
672+25	682	$1,089.00	$742,698
771+00	740	$532.00	$393,680
795+80	524	$485.00	$254,140
815+00	976	$555.00	$541,680
854+70	740	$1,064.00	$787,360
857+55	532	$279.45	$148,667
DRAINAGE			$11,173,460
CUT (CY)	30,628,827	$2.75	$84,229,274
FILL (CY)	16,483,245	$0.75	$12,362,434
WASTE (CY)	14,145,582	$1.00	$14,145,582
GUARDRAIL (LF)	168,960	$10.00	$1,689,600
PAVEMENT (SF)	7,038,009	$2.89	$20,339,846
TOTAL			$143,940,196

Option 4 Worksheet

OPTION 4
PAVR PROFILE WITH BRIDGES

SUMMARY			
STATION	**QUANTITY**	**UNIT PRICE**	**TOTAL**
175+00	45,000	$200.00	$9,000,000
184+00	55,000	$200.00	$11,000,000
209+00	40,000	$200.00	$8,000,000
235+00 & 239+50	81,000	$200.00	$16,200,000
299+90	72,000	$200.00	$14,400,000
312+50	58,000	$200.00	$11,600,000
345+16	43,000	$200.00	$8,600,000
623+30	40,000	$200.00	$8,000,000
636+00	64,000	$200.00	$12,800,000
659+00	62,000	$200.00	$12,400,000
672+25	54,000	$200.00	$10,800,000
771+00	46,000	$200.00	$9,200,000
795+80	44,000	$200.00	$8,800,000
815+00	51,000	$200.00	$10,200,000
854+70 & 857+55	63,000	$200.00	$12,600,000
BRIDGES			$163,600,000
CUT (CY)	26,066,684	$2.75	$71,683,381
FILL (CY)	12,646,249	$0.75	$9,484,687
WASTE (CY)	13,420,435	$1.00	$13,420,435
GUARDRAIL (LF)	151,008	$10.00	$1,510,080
PAVEMENT (SF)	6,351,945	$2.89	$18,357,121
TOTAL			$278,055,704

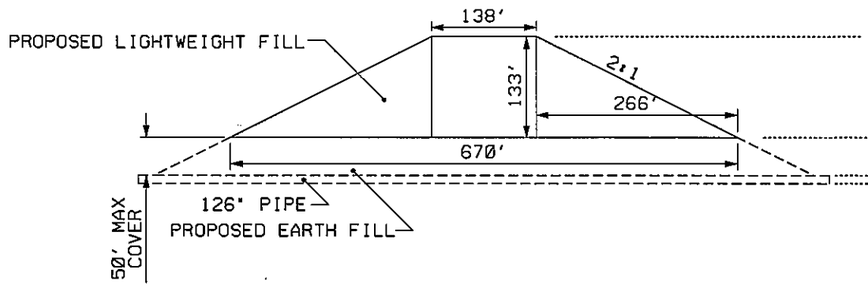
Option 5 Worksheet

OPTION 5
PAVR PROFILE WITH LIGHTWEIGHT BACKFILL AND STANDARD CULVERTS

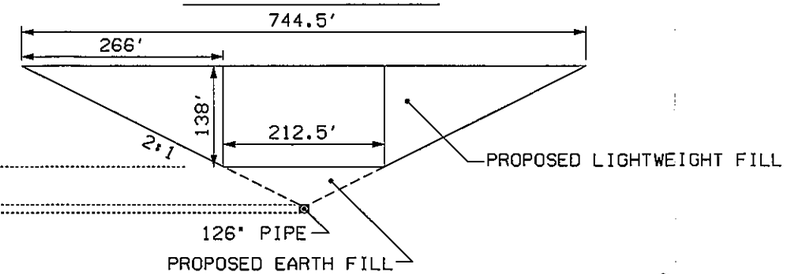
SUMMARY			
STATION	QUANTITY	UNIT PRICE	TOTAL
175+00	885	$279.45	$247,313
184+00	1474	$384.10	$566,163
209+00	834	$284.05	$236,898
235+00	975	$1,860.00	$1,813,500
239+50	725	$1,860.00	$1,348,500
299+90	760	$1,064.00	$808,640
312+50	670	$331.20	$221,904
345+16	612	$384.10	$235,069
623+30	805	$331.20	$266,616
636+00	850	$331.20	$281,520
659+00	978	$276.00	$269,928
672+25	826	$434.70	$359,062
771+00	740	$331.20	$245,088
795+80	524	$276.00	$144,624
815+00	976	$284.05	$277,233
854+70	740	$1,064.00	$787,360
857+55	532	$279.45	$148,667
DRAINAGE			$8,258,086
CUT (CY)	24,972,016	$2.75	$68,673,044
FILL (CY)	19,753,610	$0.75	$14,815,208
GEOFOAM (CY)	3,000,000	$100.00	$300,000,000
WASTE (CY)	5,218,406	$1.00	$5,218,406
GUARDRAIL (LF)	168,960	$10.00	$1,689,600
PAVEMENT (SF)	7,038,009	$2.89	$20,339,846
TOTAL			$418,994,189

SAMPLE STATION: 299+90

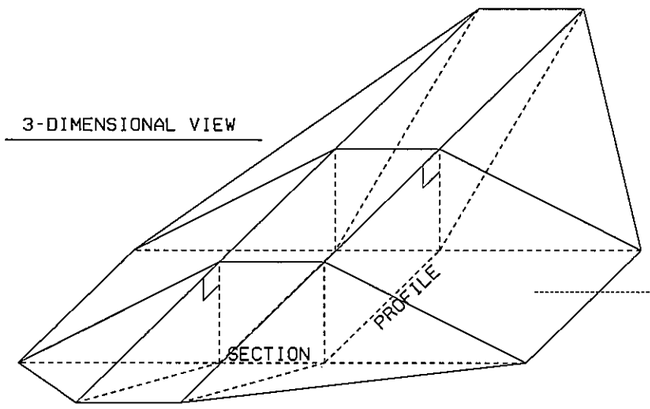
CROSS SECTION VIEW

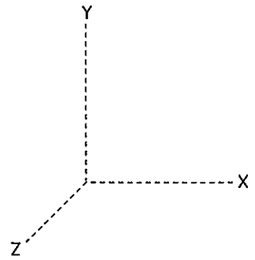


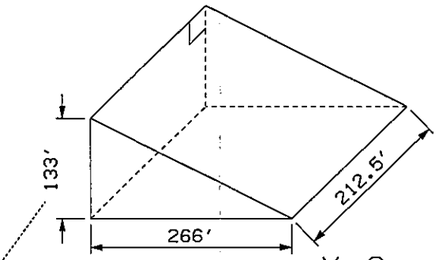
PROFILE VIEW



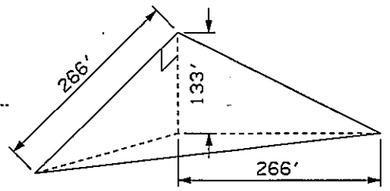
3-DIMENSIONAL VIEW

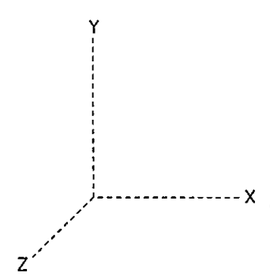






X 2
V=B(H)(W)/2





X 4
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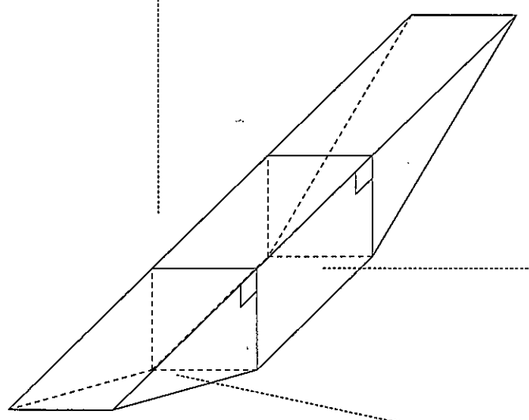

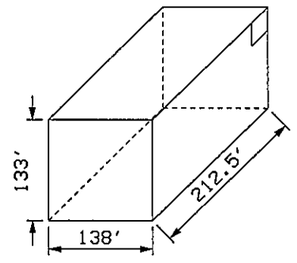

X 1
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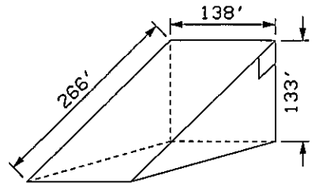
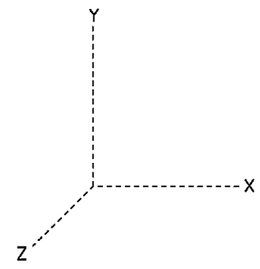




X 2
V=B(H)(W)/2

TOTAL VOLUME CALCULATION

V= (2)(266')(133')(212.5')/2
\+ (4)(266')(133')(266')/6
\+ (1)(138')(133')(212.5')
\+ (2)(266')(138')(133')/2

= 22,573,913 CFT /27
= 836,071 CYS

SCI-823-0.00 (PID 19415)
Portsmouth Bypass NEPA/Stage 1 Design Phase

TRANSYSTEMS CORPORATION

Minutes of High Fill Culvert Options Meeting December 8, 2005

Attendees

Tom Barnitz	ODOT District 9
David Norris	ODOT District 9
David Riley	ODOT Hydraulics
Gene Geiger	ODOT OGE
Steve Taliaferro	ODOT OGE
Greg Brown	TranSystems
Hans Streuber	TranSystems
Ram Nunna	TranSystems
Michelle Terrell	TranSystems
Bob Campbell	TranSystems (via teleconference)
Jon Cox	TranSystems (via teleconference)
Mike Weeks	TranSystems
Pete Nix	DLZ

Minutes

The purpose of this meeting was to review the High Fill Culvert Options Report prepared by TranSystems. Please notify Mike Weeks if there are comments regarding these minutes.

The High Fill Culvert Options Report was distributed among the attendees and the summary report outlining the various options considered during the investigation was reviewed.

Greg Brown presented the options and referred to the profile roll plot that was displayed on the wall. The determination was made that Options 1 and 2 were the only viable alternatives.

Option 1 represents the PAVR profile with minor refinements and utilizes special culvert designs for 16 high fill locations (3 are concrete box structures). TranSystems has accumulated design and cost information from Contech as well as Lane for the structural steel plate culverts. Examples of similar in-place culvert installations were obtained for some of the conditions and are shown in the report worksheet. Dave Riley expressed concern with the construction of these special culverts and possible settlement deflections. It might be possible to follow up on the example installations to see how long they have been in place and obtain monitoring data if available. High velocities are a concern - the culverts would need to be lined for protection. The concrete box culverts would need dissipators cast in the bottoms. The box culvert should be sized to permit the insertion of an adequate sized circular pipe in the future. Tom Barnitz asked if the culverts could be flattened and outlet onto the fill slopes, thus reducing the fill height, length and outlet velocity. This may not be permitted if the streams have been assigned a high quality designation. This possibility will be addressed.

Option 2 represents the PAVR profile lowered to allow the use of standard culvert designs meeting the ODOT maximum fill height criteria. This option results in a 5.4% increase in cost compared to the PAVR design. Pete Nix indicated that approximatey 50% of the borings would have to be re-drilled ands may take 20 weeks to perform the field work only.

The profile exhibit was utilized in assessing the potential of another feasible option. It was determined that an additional Option 6 should be investigated using the PAVR profile south of the airport interchange, utilizing the 3 concrete box culverts sized for future maintenance, and lowering the profile north of the

interchange as needed to provide standard height culvert installations for the remainder of the project length.

Option 6 will be developed ASAP and reported on next week. Gene Geiger will try to reserve a meeting time for Thursday 12/15.

SCI-823
PID 19415
Portsmouth Bypass

High Fill Option Report

December 15, 2005

TRANSYSTEMS CORPORATION
5747 Perimeter Drive, Suite 240, Dublin, Ohio 43017

TABLE OF CONTENTS

Summary Report

Introduction:

It is the intent of this discussion to provide direction in the selection of the final mainline profile and the most appropriate recommendation for the culverts in high fill conditions. While studying the high fill culvert sites, six main options were formulated to be possible solutions to the problem. The accompanying spreadsheets reflect quantities and costs for options 1 thru 6. In order to facilitate the comparison of relative features pertaining to the high fill conditions on this project, we have compared options 2-6 to option 1, the improved PAVR profile. Only major cost items have been selected for this comparison, based upon their direct impact relative to the cost of the project. Only those proposed culverts which are subject to the most critical fill conditions are included. The costs associated with only those culverts are shown in the spreadsheets, and do not reflect the total drainage cost for the entire project. Similarly, the earthwork quantities and costs reflect only those associated with the mainline, and do not reflect the total earthwork costs for the entire project.

Option 1 (PAVR):

Option 1 is the improved PAVR profile using special design culverts for each high fill site. The profile was adjusted after the PAVR submission to provide an improved earthwork balance, and has slightly reduced the overall estimated cost of the project. The primary revision to the profile occurred at the relocated Shumway interchange, where we have taken the mainline over relocated Shumway Hollow Road (TR 234). While this introduces the additional cost of twin mainline bridges, it greatly reduces the length of the Shumway Bridge.
Most of the culverts are structural steel plate pipe at varying gages. These pipes were recommended by the manufacturer based on in-place culverts in similar fills. Three of the sites could not handle these pipes and a cast-in-place box culvert was used.

Option 2 (Lowered PAVR):

Option 2 is the improved PAVR profile lowered at each high fill culvert site in order to reduce the fills to fit the ODOT maximum fill height for each pipe size. This option uses 5% maximum grades, 4:1 fill slopes and 5 foot extended graded shoulders in fill areas to help reduce some of the excess waste material generated by lowering the profile.
All of the culverts used are standard ODOT culverts at each site.

Option 3 (PAVR lowered in one area):

Option 3 is the same as option 1, except the profile has been lowered over the 3 sites where box culverts had to be used. The profile was lowered in this area so that each pipe met the requirements for the ODOT maximum fill height.
All other culverts are special design culverts as described in option 1.

Option 4 (PAVR with bridges):

Option 4 is the same as option 1 except in lieu of special design culverts, bridges were placed.

Option 5 (PAVR with lightweight backfill):

Option 5 is the same as option 1 except lightweight backfill (such as geofoam, elastizell or flyash) is used at the high fill culvert locations to reduce the load on the pipes to make them compatible with the ODOT maximum fill height.
The culverts used are standard ODOT culverts.

Option 6 (Lowered PAVR raised in one area):

Option 6 is the same as option 2, except the profile has been raised to the same height as option 1 between station 212+00 and station 339+00 where box culverts are to be used at 4 sites.
All other culverts used are standard ODOT culverts.

Option Summary Spreadsheet

OPTION 1 IS THE IMPROVED PAVR PROFILE* WITH SPECIAL DESIGN CULVERTS.
* REVISIONS WERE MADE TO THE PAVR PROFILE AT THE SHUMWAY INTERCHANGE.

OPTION 2 IS THE IMPROVED PAVR PROFILE LOWERED AT EACH HIGH FILL CULVERT TO ALLOW STANDARD DESIGN CULVERTS. THIS REVISION USES 5% MAXIMUM GRADE, 4:1 FILL SLOPES AND 5' EXTENDED GRADED SHOULDERS IN FILL AREAS.

OPTION 3 IS THE IMPROVED PAVR PROFILE LOWERED FOR 3 SITES TO ELIMINATE CAST-IN-PLACE BOX CULVERTS, AND THEREBY UTILIZE SPECIAL DESIGN CULVERTS IN ALL LOCATIONS.

OPTION 4 IS THE IMPROVED PAVR PROFILE WITH BRIDGES IN LIEU OF SPECIAL DESIGN CULVERTS.

OPTION 5 IS THE IMPROVED PAVR PROFILE WITH LIGHTWEIGHT BACKFILL.

OPTION 6 IS THE IMPROVED PAVR PROFILE LOWERED AT EACH HIGH FILL CULVERT TO ALLOW STANDARD DESIGN CULVERTS, EXCEPT IN ONE AREA WHERE 4 CAST-IN-PLACE BOX CULVERTS ARE USED. THIS REVISION USES 5% MAXIMUM GRADE, 4:1 FILL SLOPES AND 5' EXTENDED GRADED SHOULDERS IN FILL AREAS.

	OPTION 1: PAVR PROFILE W/ SPECIAL CULVERTS		OPTION 2: LOWERED PROFILE W/ STANDARD CULVERTS		OPTION 3: PAVR PROFILE LOWERED FOR 3 SITES W/ SPECIAL CULVERTS		OPTION 4: PAVR PROFILE W/ BRIDGES		OPTION 5: PAVR PROFILE W/ STANDARD CULVERTS AND LIGHTWEIGHT BACKFILL		OPTION 6: LOWERED PROFILE W/ STANDARD CULVERTS & 4 BOX CULVERTS	
	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
CULVERT	LUMP SUM	$15,413,220	LUMP SUM	$8,258,086	LUMP SUM	$11,173,460	LUMP SUM***	$163,600,000	LUMP SUM	$8,593,150	LUMP SUM	$14,825,942
CUT (CY)**	24,972,016	$68,673,044	28,473,650	$78,302,538	30,628,827	$84,229,274	26,066,684	$71,683,381	24,972,016	$68,673,044	25,119,374	$69,078,279
FILL (CY)**	22,753,610	$17,065,208	17,256,595	$12,942,446	16,483,245	$12,362,434	12,646,249	$9,484,687	19,753,610	$14,815,208	22,160,155	$16,620,116
GEOFOAM (CY)	0	$0	0	$0	0	$0	0	$0	3,000,000	$300,000,000	0	$0
WASTE (CY)**	2,218,406	$2,218,406	11,217,055	$11,217,055	14,145,582	$14,145,582	13,420,435	$13,420,435	5,218,406	$5,218,406	2,959,219	$2,959,219
GUARDRAIL (LF)	168,960	$1,689,600	110,318	$1,103,180	168,960	$1,689,600	151,008	$1,510,080	168,960	$1,689,600	133,614	$1,336,140
PAVEMENT (SF)	7,038,009	$20,339,846	7,038,009	$20,339,846	7,038,009	$20,339,846	6,351,945	$18,357,121	7,038,009	$20,339,846	7,038,009	$20,339,846
TOTAL		$125,399,324		$132,163,151		$143,940,196		$278,055,704		$419,329,253		$125,159,542
DIFFERENCE		$0		$6,763,827		$18,540,873		$152,656,380		$293,929,929		-$239,782
PERCENT INCREASE		0.00%		5.39%		14.79%		121.74%		234.40%		-0.19%

** THE EARTHWORK QUANTITIES SHOWN ARE FOR THE MAINLINE ONLY AND DO NOT REFLECT ANY SHRINKAGE/SWELL FACTORS.

*** THE CULVERT PRICE FOR OPTION 4 IS ACTUALLY THE COST OF BRIDGES IN LIEU OF CULVERTS.

Option 1 Worksheet

OPTION 1
PAVR PROFILE WITH SPECIAL DESIGN CULVERTS

STANDARD PIPE							
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	STANDARD PIPE	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	114	NO	$279.45	625	$174,656.25
184+00	84	72	141	NO	$384.10	1,408	$540,812.80
209+00	72	90	105	NO	$284.05	607	$172,418.35
235+00	162	45	117	NO	$1,860.00	1,024	$1,904,640.00
239+50	156	45	135	NO	$1,860.00	743	$1,381,980.00
299+90	126	50	183	NO	$1,064.00	1,190	$1,266,160.00
312+50	78	79	151	NO	$331.20	850	$281,520.00
345+16	84	72	121	NO	$384.10	622	$238,910.20
623+30	78	79	100	NO	$331.20	657	$217,598.40
636+00	78	79	171	NO	$331.20	880	$291,456.00
659+00	60	100	166	NO	$276.00	810	$223,560.00
672+25	90	66	149	NO	$434.70	682	$296,465.40
771+00	78	79	115	NO	$331.20	740	$245,088.00
795+80	60	100	108	NO	$276.00	524	$144,624.00
815+00	72	90	128	NO	$284.05	976	$277,232.80
854+70	126	50	94	NO	$1,064.00	740	$787,360.00
857+55	66	100	82	YES	$279.45	532	$148,667.40

STANDARD DUAL PIPE							
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	STANDARD DUAL PIPE	UNIT PRICE	QUANTITY	TOTAL
175+00	54	100	114	NO	$279.45	1,250	$349,312.50
184+00	66	100	141	NO	$384.10	2,816	$1,081,625.60
209+00	54	100	105	NO	$284.05	1,214	$344,836.70
235+00	120	51	117	NO	$1,860.00	2,048	$3,809,280.00
239+50	114	53	135	NO	$1,860.00	1,486	$2,763,960.00
299+90	96	61	183	NO	$1,064.00	2,380	$2,532,320.00
312+50	60	100	151	NO	$331.20	1,700	$563,040.00
345+16	66	100	121	NO	$384.10	1,244	$477,820.40
623+30	60	100	100	YES	$331.20	1,314	$435,196.80
636+00	60	100	171	NO	$331.20	1,760	$582,912.00
659+00	48	100	166	NO	$276.00	1,620	$447,120.00
672+25	66	100	149	NO	$434.70	1,364	$592,930.80
771+00	60	100	115	NO	$331.20	1,480	$490,176.00
795+80	48	100	108	NO	$276.00	1,048	$289,248.00
815+00	54	100	128	NO	$284.05	1,952	$554,465.60
854+70	96	61	94	NO	$1,064.00	1,480	$1,574,720.00

SPECIAL PIPE								
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	TYPE OF PIPE	EXAMPLE	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	114	3 GAGE	YES	$532.00	625	$332,500.00
184+00	84	72	141	5/16"	NO	$930.00	1,408	$1,309,440.00
209+00	72	90	105	3 GAGE	YES	$555.00	607	$336,885.00
235+00	162	45	117	NONE	NO	N/A	1,024	N/A
239+50	156	45	135	NONE	NO	N/A	743	N/A
299+90	126	50	183	NONE	NO	N/A	1,190	N/A
312+50	78	79	151	5/16"	NO	$580.00	850	$493,000.00
345+16	84	72	121	5/16"	NO	$930.00	622	$578,460.00
623+30	78	79	100	3 GAGE	YES	$580.00	657	$381,060.00
636+00	78	79	171	5/16"	YES	$580.00	880	$510,400.00
659+00	60	100	166	5/16"	YES	$485.00	810	$392,850.00
672+25	90	66	149	5/16"	NO	$1,089.00	682	$742,698.00
771+00	78	79	115	5/16"	YES	$532.00	740	$393,680.00
795+80	60	100	108	5 GAGE	YES	$485.00	524	$254,140.00
815+00	72	90	128	1 GAGE	YES	$555.00	976	$541,680.00
854+70	126	50	94	5/16"	NO	$1,064.00	740	$787,360.00

SPECIAL DUAL PIPE								
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	TYPE OF PIPE	EXAMPLE	UNIT PRICE	QUANTITY	TOTAL
235+00	120	51	117	NONE	NO	N/A	2,048	N/A
239+50	114	53	135	NONE	NO	N/A	1,486	N/A
299+90	96	61	183	NONE	NO	N/A	2,380	N/A

BOX CULVERT						
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	UNIT PRICE	QUANTITY	TOTAL
235+00	162	45	117	$2,500.00	1,024	$2,560,000.00
239+50	156	45	135	$2,800.00	743	$2,080,400.00
299+90	126	50	183	$3,000.00	1,190	$3,570,000.00

SUMMARY				
STATION	TYPE OF PIPE	QUANTITY	UNIT PRICE	TOTAL
175+00	SPECIAL	625	$532.00	$332,500
184+00	SPECIAL	1,408	$930.00	$1,309,440
209+00	SPECIAL	607	$555.00	$336,885
235+00	BOX CULVERT	1,024	$2,500.00	$2,560,000
239+50	BOX CULVERT	743	$2,800.00	$2,080,400
299+90	BOX CULVERT	1,190	$3,000.00	$3,570,000
312+50	SPECIAL	850	$580.00	$493,000
345+16	SPECIAL	622	$930.00	$578,460
623+30	SPECIAL	657	$580.00	$381,060
636+00	SPECIAL	880	$580.00	$510,400
659+00	SPECIAL	810	$485.00	$392,850
672+25	SPECIAL	682	$1,089.00	$742,698
771+00	SPECIAL	740	$532.00	$393,680
795+80	SPECIAL	524	$485.00	$254,140
815+00	SPECIAL	976	$555.00	$541,680
854+70	SPECIAL	740	$1,064.00	$787,360
857+55	STANDARD	532	$279.45	$148,667
DRAINAGE				$15,413,220
CUT (CY)		24,972,016	$2.75	$68,673,044
FILL (CY)		22,753,610	$0.75	$17,065,208
WASTE (CY)		2,218,406	$1.00	$2,218,406
GUARDRAIL (LF)		168,960	$10.00	$1,689,600
PAVEMENT (SF)		7,038,009	$2.89	$20,339,846
TOTAL				$125,399,324

High Fill Culvert Examples

West Virginia Division of Highways
Partial List of Structural Plate Pipe Under High Fills

Location	Diameter	Thickness	Total Length	Max. Fill Height
Hardy County	66"	10 gage	474'	64'
Hardy County	72"	1 gage 6 bolt/ft	991'	141'
Hardy County	twin 72"	1 gage 6 bolt/ft	854'	157'
Hardy County	96"	1 gage 6 bolt/ft	866'	105'
Hardy County	twin 120"	1 gage 6 bolt/ft	954'	85'
McDowell County	60"	5/16"	1821'	215'
McDowell County	72"	3/8"	2767'	213'
Mercer County	twin 60"	1 gage	2024'	146'

A Key Hole Slot Multi-Plate structure was built at Benedum Airport in Clarksburg WV. It is described below. that can also be included on this list.

Harrison County	72"	variable 3 gage max.	2000'+	186'

Option 2 Worksheet

OPTION 2
LOWERED PROFILE WITH STANDARD CULVERTS

STANDARD PIPE							
STATION	MAINTENANCE SIZE	ODOT MAX FILL	LOWERED FILL	STANDARD PIPE	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	79	YES	$279.45	885	$247,313.25
184+00	84	72	72	YES	$384.10	1474	$566,163.40
209+00	72	90	80	YES	$284.05	834	$236,897.70
235+00	162	45	45	YES	$1,860.00	975	$1,813,500.00
239+50	156	45	45	YES	$1,860.00	725	$1,348,500.00
299+90	126	50	50	YES	$1,064.00	760	$808,640.00
312+50	78	79	57	YES	$331.20	670	$221,904.00
345+16	84	72	72	YES	$384.10	612	$235,069.20
623+30	78	79	72	YES	$331.20	805	$266,616.00
636+00	78	79	79	YES	$331.20	850	$281,520.00
659+00	60	100	100	YES	$276.00	978	$269,928.00
672+25	90	66	66	YES	$434.70	826	$359,062.20
771+00	78	79	78	YES	$331.20	740	$245,088.00
795+80	60	100	100	YES	$276.00	524	$144,624.00
815+00	72	90	89	YES	$284.05	976	$277,232.80
854+70	126	50	44	YES	$1,064.00	740	$787,360.00
857+55	66	100	45	YES	$279.45	532	$148,667.40

SUMMARY			
STATION	QUANTITY	UNIT PRICE	TOTAL
175+00	885	$279.45	$247,313
184+00	1474	$384.10	$566,163
209+00	834	$284.05	$236,898
235+00	975	$1,860.00	$1,813,500
239+50	725	$1,860.00	$1,348,500
299+90	760	$1,064.00	$808,640
312+50	670	$331.20	$221,904
345+16	612	$384.10	$235,069
623+30	805	$331.20	$266,616
636+00	850	$331.20	$281,520
659+00	978	$276.00	$269,928
672+25	826	$434.70	$359,062
771+00	740	$331.20	$245,088
795+80	524	$276.00	$144,624
815+00	976	$284.05	$277,233
854+70	740	$1,064.00	$787,360
857+55	532	$279.45	$148,667
DRAINAGE			$8,258,086
CUT (CY)	28,473,650	$2.75	$78,302,538
FILL (CY)	17,256,595	$0.75	$12,942,446
WASTE (CY)	11,217,055	$1.00	$11,217,055
GUARDRAIL (LF)	110,318	$10.00	$1,103,180
PAVEMENT (SF)	7,038,009	$2.89	$20,339,846
TOTAL			$132,163,151

Option 3 Worksheet

OPTION 3
PAVR PROFILE LOWERED IN ONE PLACE WITH SPECIAL DESIGN CULVERTS

SPECIAL PIPE						
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	114	$532.00	625	$332,500.00
184+00	84	72	141	$930.00	1,408	$1,309,440.00
209+00	72	90	105	$555.00	607	$336,885.00
312+50	78	79	151	$580.00	850	$493,000.00
345+16	84	72	121	$930.00	622	$578,460.00
623+30	78	79	100	$580.00	657	$381,060.00
636+00	78	79	171	$580.00	880	$510,400.00
659+00	60	100	166	$485.00	810	$392,850.00
672+25	90	66	149	$1,089.00	682	$742,698.00
771+00	78	79	115	$532.00	740	$393,680.00
795+80	60	100	108	$485.00	524	$254,140.00
815+00	72	90	128	$555.00	976	$541,680.00
854+70	126	50	94	$1,064.00	740	$787,360.00

STANDARD PIPE						
STATION	MAINTENANCE SIZE	ODOT MAX FILL	LOWERED FILL	UNIT PRICE	QUANTITY	TOTAL
235+00	162	45	45	$1,860.00	975	$1,813,500.00
239+50	156	45	45	$1,860.00	725	$1,348,500.00
299+90	126	50	50	$1,064.00	760	$808,640.00
857+55	66	100	82	$279.45	532	$148,667.40

SUMMARY			
STATION	QUANTITY	UNIT PRICE	TOTAL
175+00	625	$532.00	$332,500
184+00	1,408	$930.00	$1,309,440
209+00	607	$555.00	$336,885
235+00	975	$1,860.00	$1,813,500
239+50	725	$1,860.00	$1,348,500
299+90	760	$1,064.00	$808,640
312+50	850	$580.00	$493,000
345+16	622	$930.00	$578,460
623+30	657	$580.00	$381,060
636+00	880	$580.00	$510,400
659+00	810	$485.00	$392,850
672+25	682	$1,089.00	$742,698
771+00	740	$532.00	$393,680
795+80	524	$485.00	$254,140
815+00	976	$555.00	$541,680
854+70	740	$1,064.00	$787,360
857+55	532	$279.45	$148,667
DRAINAGE			$11,173,460
CUT (CY)	30,628,827	$2.75	$84,229,274
FILL (CY)	16,483,245	$0.75	$12,362,434
WASTE (CY)	14,145,582	$1.00	$14,145,582
GUARDRAIL (LF)	168,960	$10.00	$1,689,600
PAVEMENT (SF)	7,038,009	$2.89	$20,339,846
TOTAL			$143,940,196

Option 4 Worksheet

OPTION 4
PAVR PROFILE WITH BRIDGES

SUMMARY			
STATION	**QUANTITY**	**UNIT PRICE**	**TOTAL**
175+00	45,000	$200.00	$9,000,000
184+00	55,000	$200.00	$11,000,000
209+00	40,000	$200.00	$8,000,000
235+00 & 239+50	81,000	$200.00	$16,200,000
299+90	72,000	$200.00	$14,400,000
312+50	58,000	$200.00	$11,600,000
345+16	43,000	$200.00	$8,600,000
623+30	40,000	$200.00	$8,000,000
636+00	64,000	$200.00	$12,800,000
659+00	62,000	$200.00	$12,400,000
672+25	54,000	$200.00	$10,800,000
771+00	46,000	$200.00	$9,200,000
795+80	44,000	$200.00	$8,800,000
815+00	51,000	$200.00	$10,200,000
854+70 & 857+55	63,000	$200.00	$12,600,000
BRIDGES			$163,600,000
CUT (CY)	26,066,684	$2.75	$71,683,381
FILL (CY)	12,646,249	$0.75	$9,484,687
WASTE (CY)	13,420,435	$1.00	$13,420,435
GUARDRAIL (LF)	151,008	$10.00	$1,510,080
PAVEMENT (SF)	6,351,945	$2.89	$18,357,121
TOTAL			$278,055,704

Option 5 Worksheet

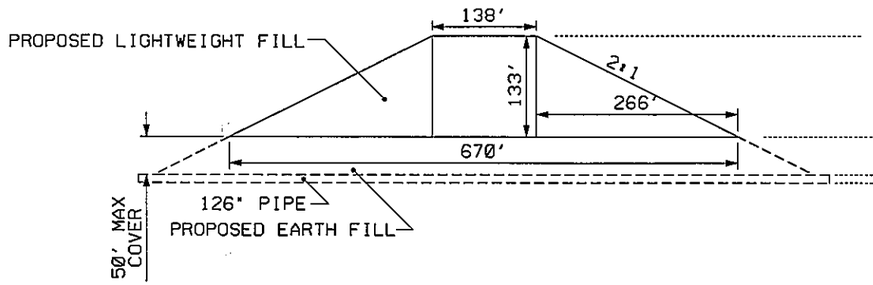
OPTION 5
PAVR PROFILE WITH LIGHTWEIGHT BACKFILL AND STANDARD CULVERTS

STANDARD PIPE STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	AMOUNT OF GEOFOAM	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	114	14	$279.45	625	$174,656.25
184+00	84	72	141	69	$384.10	1,408	$540,812.80
209+00	72	90	105	15	$284.05	607	$172,418.35
235+00	162	45	117	72	$1,860.00	1,024	$1,904,640.00
239+50	156	45	135	90	$1,860.00	743	$1,381,980.00
299+90	126	50	183	133	$1,064.00	1,190	$1,266,160.00
312+50	78	79	151	72	$331.20	850	$281,520.00
345+16	84	72	121	49	$384.10	622	$238,910.20
623+30	78	79	100	21	$331.20	657	$217,598.40
636+00	78	79	171	92	$331.20	880	$291,456.00
659+00	60	100	166	66	$276.00	810	$223,560.00
672+25	90	66	149	83	$434.70	682	$296,465.40
771+00	78	79	115	36	$331.20	740	$245,088.00
795+80	60	100	108	8	$276.00	524	$144,624.00
815+00	72	90	128	38	$284.05	976	$277,232.80
854+70	126	50	94	44	$1,064.00	740	$787,360.00
857+55	66	100	82	-18	$279.45	532	$148,667.40

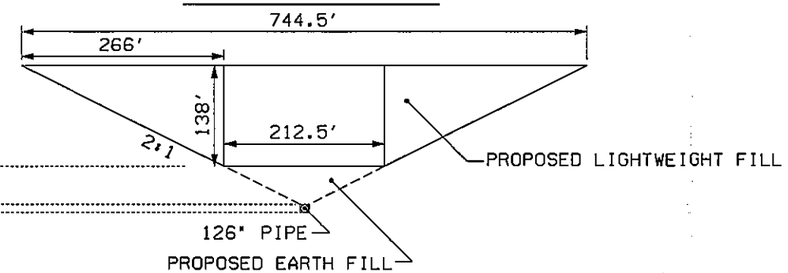
SUMMARY STATION	QUANTITY	UNIT PRICE	TOTAL
175+00	625	$279.45	$174,656
184+00	1,408	$384.10	$540,813
209+00	607	$284.05	$172,418
235+00	1,024	$1,860.00	$1,904,640
239+50	743	$1,860.00	$1,381,980
299+90	1,190	$1,064.00	$1,266,160
312+50	850	$331.20	$281,520
345+16	622	$384.10	$238,910
623+30	657	$331.20	$217,598
636+00	880	$331.20	$291,456
659+00	810	$276.00	$223,560
672+25	682	$434.70	$296,465
771+00	740	$331.20	$245,088
795+80	524	$276.00	$144,624
815+00	976	$284.05	$277,233
854+70	740	$1,064.00	$787,360
857+55	532	$279.45	$148,667
DRAINAGE			$8,593,150
CUT (CY)	24,972,016	$2.75	$68,673,044
FILL (CY)	19,753,610	$0.75	$14,815,208
GEOFOAM (CY)	3,000,000	$100.00	$300,000,000
WASTE (CY)	5,218,406	$1.00	$5,218,406
GUARDRAIL (LF)	168,960	$10.00	$1,689,600
PAVEMENT (SF)	7,038,009	$2.89	$20,339,846
TOTAL			$419,329,253

SAMPLE STATION: 299+90

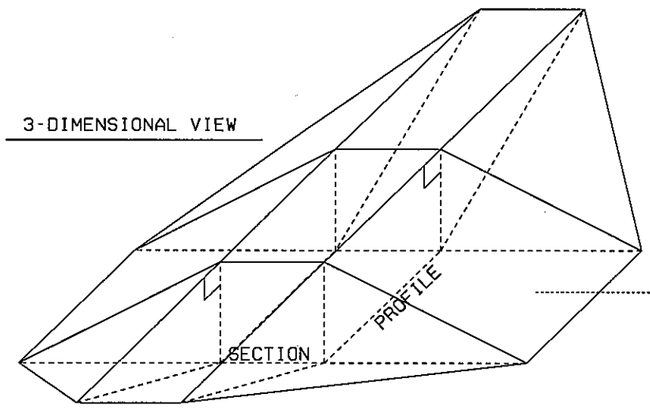
CROSS SECTION VIEW

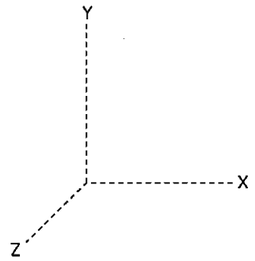


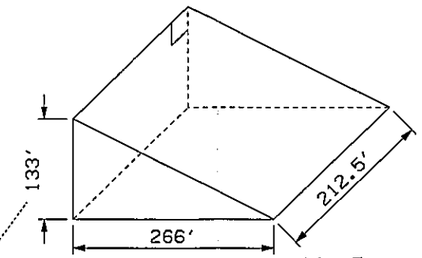
PROFILE VIEW



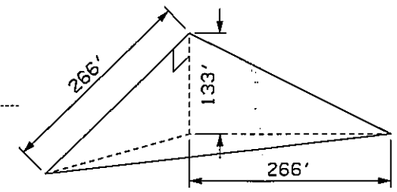
3-DIMENSIONAL VIEW

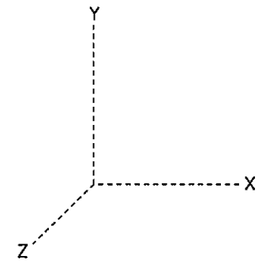






X 2
V=B(H)(W)/2





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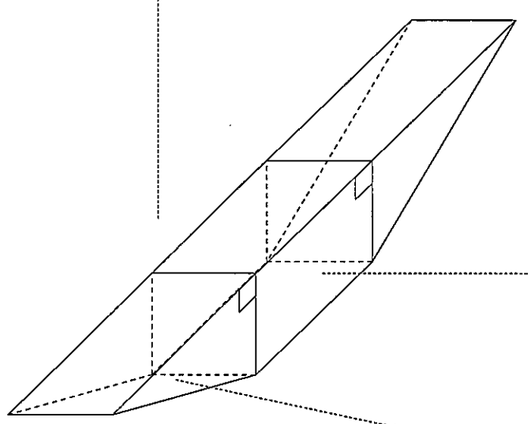

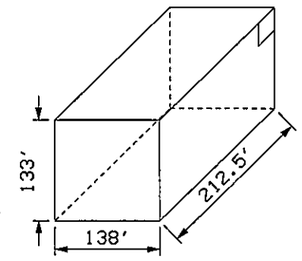

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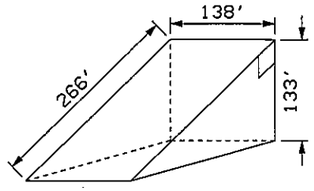

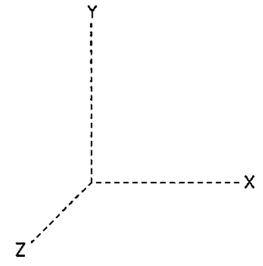

X 2
V=B(H)(W)/2

TOTAL VOLUME CALCULATION

V= (2)(266')(133')(212.5')/2
\+ (4)(266')(133')(266')/6
\+ (1)(138')(133')(212.5')
\+ (2)(266')(138')(133')/2

= 22,573,913 CFT /27
= 836,071 CYS

Option 6 Worksheet

OPTION 6
PAVR PROFILE LOWERED EXCEPT IN ONE AREA WITH STANDARD CULVERTS AND 4 BOX CULVERTS

STANDARD PIPE						
STATION	MAINTENANCE SIZE	ODOT MAX FILL	LOWERED FILL	UNIT PRICE	QUANTITY	TOTAL
175+00	66	100	79	$279.45	885	$247,313.25
184+00	84	72	72	$384.10	1474	$566,163.40
209+00	72	90	80	$284.05	834	$236,897.70
345+16	84	72	72	$384.10	612	$235,069.20
623+30	78	79	72	$331.20	805	$266,616.00
636+00	78	79	79	$331.20	850	$281,520.00
659+00	60	100	100	$276.00	978	$269,928.00
672+25	90	66	66	$434.70	826	$359,062.20
771+00	78	79	78	$331.20	740	$245,088.00
795+80	60	100	100	$276.00	524	$144,624.00
815+00	72	90	89	$284.05	976	$277,232.80
854+70	126	50	44	$1,064.00	740	$787,360.00
857+55	66	100	45	$279.45	532	$148,667.40

BOX CULVERT						
STATION	MAINTENANCE SIZE	ODOT MAX FILL	PAVR FILL	UNIT PRICE	QUANTITY	TOTAL
235+00	162	45	117	$2,500.00	1,024	$2,560,000.00
239+50	156	45	135	$2,800.00	743	$2,080,400.00
299+90	126	50	183	$3,000.00	1,190	$3,570,000.00
312+50	78	79	151	$3,000.00	850	$2,550,000.00

SUMMARY			
STATION	QUANTITY	UNIT PRICE	TOTAL
175+00	885	$279.45	$247,313
184+00	1474	$384.10	$566,163
209+00	834	$284.05	$236,898
235+00	1,024	$2,500.00	$2,560,000
239+50	743	$2,800.00	$2,080,400
299+90	1,190	$3,000.00	$3,570,000
312+50	850	$3,000.00	$2,550,000
345+16	612	$384.10	$235,069
623+30	805	$331.20	$266,616
636+00	850	$331.20	$281,520
659+00	978	$276.00	$269,928
672+25	826	$434.70	$359,062
771+00	740	$331.20	$245,088
795+80	524	$276.00	$144,624
815+00	976	$284.05	$277,233
854+70	740	$1,064.00	$787,360
857+55	532	$279.45	$148,667
DRAINAGE			$14,825,942
CUT (CY)	25,119,374	$2.75	$69,078,279
FILL (CY)	22,160,155	$0.75	$16,620,116
WASTE (CY)	2,959,219	$1.00	$2,959,219
GUARDRAIL (LF)	133,614	$10.00	$1,336,140
PAVEMENT (SF)	7,038,009	$2.89	$20,339,846
TOTAL			$125,159,542

TRANSYSTEMS CORPORATION

SCI-823 High Fill Culvert Meeting
Thursday, December 15, 2005
Room 3A ODOT Central Office from 1:00pm to 2:30pm

Attendees

David Norris - ODOT District 9
Tom Barnitz - ODOT District 9
David Riley - ODOT Hydraulics
Gene Geiger - ODOT OGE
Steve Taliaferro - ODOT OGE
Noel Alcala - ODOT OES
Bill Cody - ODOT OES
Mike Pettigrew - ODOT OES
Jerry Workman - ODOT CO Planning
Bob Campbell - TranSystems
Mike Weeks - TranSystems
Greg Brown - TranSystems
Ram Nunna - TranSystems
Chadwick Collins - TranSystems
Jon Cox - TranSystems
Hans Streuber - TranSystems

Review of the Thursday December 8, 2005 meeting tasks.

- Presentation of the modified profile as per the December 8, 2005 meeting.
- Description of the factors that resulted in an additional box culvert added to the drainage structures, raising the box culvert count in the high fills from three to four.

Review of Profile and Discussion.

- The mainline profile was accepted by Tom Barnitz and Davis Norris.
- The use of four box culverts was accepted by Dave Riley.
- Dave Riley indicated bankfull stream calculations are not to be used for this project.
- Discussed the use of flattening steeply profiled culverts and outletting the culverts to the embankment slope. Bill Cody indicated that there is no stream restrictions to the culvert flattening based on either class of stream or animal issues. The reasoning is that stream is essentially disrupted therefore it does not matter if the stream slope is continuous through the pipe. An example of culvert slope flattening was discussed where the effect on the stream was that it deposited its sediment load at the mouth of the culvert thereby effectively reducing the culvert opening. It was suggested that the flattening be used only in the upper reaches of the streams, where the sediment load would not be significant.

Tasks

- At the new Lucasville-Minford Road interchange Stream 17a is a Class III stream that initially crossed the mainline bridge at approximately Sta. 539+50. Concerns were raised as to the issues that may surround the relocation of this stream as per the new interchange configuration. Mike Weeks is to contact OES concerning any issues that mat need to be addressed.
- Gene Geiger of ODOT OGE requested a copy of the new profile delivered as a dgn file and a hard copy as presented during this meeting.
- Flattening of the culvert slopes is to be included in the culvert design where applicable and as per discussions at this meeting.
- Within the box culverts the energy dissipaters maybe utilized where necessary.
- Drill costs are to be calculated.
- The houses appear to be turned off in the Lucasville-Minford Road interchange area. Check the topo in the plan.dgn to see if the level the houses are on is turned off.

Median

SCI-823
PID 19415
Portsmouth Bypass

Median Option Report

January 17, 2006

Median Option Report

TRANSYSTEMS CORPORATION
5747 Perimeter Drive, Suite 240, Dublin, Ohio 43017

Table of Contents

Summary Report

Introduction:

It is the intent of this discussion to provide direction in the selection of the final median design for the mainline. While studying the median design, three main options were considered. The accompanying spreadsheets reflect quantities and costs for the three options. Options 2 and 3 are compared to option 1. All three options use the profile that was chosen in the previous high fill culvert meeting, known as the "option 6" profile. This profile uses 5% maximum grades, 4:1 fill slopes when allowable and a 5 foot extended graded shoulder. Only major cost items have been selected for this comparison, based upon their direct impact relative to the cost of the project. The earthwork quantities and costs reflect only those associated with the mainline, and do not reflect the total earthwork costs for the entire project. The earthwork quantities also do not reflect any shrinkage/swell factors. The drainage quantities and costs reflect only those associated with the mainline median, and do not reflect the total drainage costs for the entire project. The pavement quantities and costs reflect only those associated with extra pavement needed on option 3 in lieu of a grass median for options 1 and 2, and do not reflect the total pavement costs for the entire project.

Option 1 (60ft median with no barrier):

Option 1 uses a median width of 60ft. This design does not use any type of median barrier. There is however concrete median barrier at the beginning and ending of the job before the median becomes the full 60ft width.

Option 2 (40ft median with cable barrier):

Option 2 uses a median width of 40ft. This design requires cable barrier. There is concrete median barrier at the beginning and ending of the job before the median becomes the full 40ft width.

Option 3 (27ft median with concrete barrier):

Option 3 uses a median width of 27ft. This design requires concrete barrier throughout the entire length of the mainline. The width of the median is 27ft based on a sight distance study done along the median, and is shown on sheet 4 of this report. The drainage costs are based on the difference in price by substituting an I-3A inlet for all the CB4 catch basins previously located in the grass median. The pavement quantity is based on the amount of extra pavement that would be required in the median in lieu of grass.

Median Sight Distance Summary

SR 823 DESIGN SPEED = 70 MPH
STOPPING SIGHT DISTANCE = 730 FEET

CURVE#	D_C DEGREES	RADIUS FEET	MIDDLE ORDINATE FEET	REQUIRED SHLD WIDTH FEET	AVAILABLE SHLD WIDTH FEET	LENGTH OF CURVE FEET	MINIMUM CONC. MEDIAN WIDTH FEET
1	1^0 RT	5729.578	11.6	5.6	6.3	4094.19	15
2	$1^0$30' LT	3819.718	17.4	11.4	6.3	1842.14	21
3	$1^0$30' LT	3819.718	17.4	11.4	6.3	1842.14	21
4	$0^0$30' LT	11459.16	5.8	-0.2	6.3	4058.07	15
5	$1^0$15' RT	4583.662	14.5	8.5	6.3	2989.56	18
6	$0^0$45' LT	7639.437	8.7	2.7	6.3	5946.84	15
7	2^0 LT	2864.789	23.2	17.2	6.3	3245.33	27
8	1^0 RT	5729.578	11.6	5.6	6.3	2395.7	15
9	2^0 LT	2864.789	23.2	17.2	6.3	2465.01	27
10	$0^0$45' RT	7639.437	8.7	2.7	6.3	9437.48	15
11	$1^0$15' LT	4583.662	14.5	8.5	6.3	7884.31	18
12	$1^0$15' RT	4583.662	14.5	8.5	6.3	2611.08	18

Median Option Summary Spreadsheet

OPTION 1 IS A 60' MEDIAN WITH NO BARRIER.

OPTION 2 IS A 40' MEDIAN WITH CABLE BARRIER.

OPTION 3 IS A 27' MEDIAN WITH CONCRETE BARRIER.

	OPTION 1: 60' MEDIAN W/ NO BARRIER		OPTION 2: 40' MEDIAN W/ CABLE BARRIER		OPTION 3: 27' MEDIAN W/ CONCRETE BARRIER	
	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
CUT (CY)*	25,120,426	$69,081,172	23,312,846	$64,110,327	22,231,175	$61,135,731
FILL (CY)*	21,753,742	$16,315,307	20,755,249	$15,566,437	19,924,374	$14,943,281
WASTE (CY)*	3,366,684	$3,366,684	2,557,597	$2,557,597	2,306,801	$2,306,801
CABLE BARRIER (LF)	0	$0	67,489	$978,597	0	$0
ANCHOR TERMINAL (EACH)	0	$0	26	$65,000	0	$0
CONCRETE BARRIER (LF)	14,447	$1,155,769	14,447	$1,155,769	81,937	$6,554,923
DRAINAGE (EACH)**	0	$0	0	$0	112	$168,000
PAVEMENT (SY)***	0	$0	0	$0	142,478	$3,704,420
TOTAL		$89,918,931		$84,433,726		$88,813,156
DIFFERENCE		$0		-$5,485,205		-$1,105,775
PERCENT INCREASE		0.00%		-6.10%		-1.23%

*ALL EARTHWORK QUANTITIES ARE BASED ON USING THE FINAL PROFILE (ALSO KNOWN AS THE OPTION 6 PROFILE). THE EARTHWORK QUANTITIES SHOWN ARE FOR THE MAINLINE ONLY AND DO NOT REFLECT ANY SHRINKAGE/SWELL FACTORS.

**DRAINAGE QUANTITY/COST IS BASED ON SUBSTITUTING AN I-3A INLET ($4000 EACH) FOR ALL CB4 CATCH BASINS ($2500 EACH) LOCATED IN THE MEDIAN WHEN CONCRETE BARRIER IS USED.

***PAVEMENT QUANTITY/COST IS BASED ON THE EXTRA PAVEMENT WIDTH NEEDED WITH OPTION 3 IN LIEU OF A GRASS MEDIAN FOR OPTIONS 1 AND 2.

Option Worksheet

OPTION 1
60' MEDIAN WITH NO BARRIER

SUMMARY			
ITEM	**QUANTITY**	**UNIT PRICE**	**TOTAL**
CUT (CY)	25,120,426	$2.75	$69,081,172
FILL (CY)	21,753,742	$0.75	$16,315,307
WASTE (CY)	3,366,684	$1.00	$3,366,684
CABLE BARRIER (LF)	0	$14.50	$0
ANCHOR TERMINAL (EACH)	0	$2,500.00	$0
CONCRETE BARRIER (LF)	14,447	$80.00	$1,155,769
DRAINAGE (EACH)	0	$1,500.00	$0
PAVEMENT (SY)	0	$26.00	$0
TOTAL			$89,918,931

OPTION 2
40' MEDIAN WITH CABLE BARRIER

SUMMARY			
ITEM	**QUANTITY**	**UNIT PRICE**	**TOTAL**
CUT (CY)	23,312,846	$2.75	$64,110,327
FILL (CY)	20,755,249	$0.75	$15,566,437
WASTE (CY)	2,557,597	$1.00	$2,557,597
CABLE BARRIER (LF)	67,489	$14.50	$978,597
ANCHOR TERMINAL (EACH)	26	$2,500.00	$65,000
CONCRETE BARRIER (LF)	14,447	$80.00	$1,155,769
DRAINAGE (EACH)	0	$1,500.00	$0
PAVEMENT (SY)	0	$26.00	$0
TOTAL			$84,433,726

OPTION 3
27' MEDIAN WITH CONCRETE BARRIER

SUMMARY			
ITEM	**QUANTITY**	**UNIT PRICE**	**TOTAL**
CUT (CY)	22,231,175	$2.75	$61,135,731
FILL (CY)	19,924,374	$0.75	$14,943,281
WASTE (CY)	2,306,801	$1.00	$2,306,801
CABLE BARRIER (LF)	0	$14.50	$0
ANCHOR TERMINAL (EACH)	0	$2,500.00	$0
CONCRETE BARRIER (LF)	81,937	$80.00	$6,554,923
DRAINAGE (EACH)	112	$1,500.00	$168,000
PAVEMENT (SY)	142,478	$26.00	$3,704,420
TOTAL			$88,813,156

SCI-823-0.00 (PID 19415)
Portsmouth Bypass

Minutes of Median Options Meeting January 17, 2006

Attendees

David Norris	ODOT District 9
Dirk Gross	ODOT ORES
Rick Bruce	ODOT ORES
Bob Campbell	TranSystems
Greg Brown	TranSystems
Ram Nunna	TranSystems
Michelle Terrell	TranSystems
Mike Weeks	TranSystems

Minutes

A meeting was held at ODOT Central Office Room 2B to review the median options that have been studied to determine the most feasible alternative that will minimize excavation costs and meet safety and maintenance requirements.

The Median Option Report dated January 17, 2005 was reviewed.

Option 1 is the 60 ft. depressed median as shown in the PAVR and is the baseline for the cost comparison.

Option 2 is a 40 ft. depressed median with cable barrier

- Dirk indicated the 40 ft. median will require 2 lines of cable barrier
- Option 2 will need maintenance costs included; Dirk will provide some assessment of costs. He will also check with Dean Focke to see if he has any concerns. Likely the shoulder under the cable will need some nominal thickness of asphalt paving to eliminate the erosion seen at some installations.

Option 3 is a 27 ft. paved median with concrete barrier

- Rick stated they do not want paved shoulders greater than 12'
- Ram discussed the SSD analysis summarized on sheet 4. 27' was the width required for 2° curves (#7 and #9) and was used throughout the length.
- TranSystems will investigate reducing the required median width by adjusting the degree of curve for the EOP for curves 7 and 9 to obtain a SSD good for 65 mph (this will effectively provide for curve widening in these locations). A design exception for SSD can be justified for these two locations and a narrower median will further reduce earthwork costs.
- Dave expressed a preference for concrete median barrier for maintenance considerations as well as truck traffic safety.
- Rick stated they would typically require 57" barrier for this type of facility. Fig. 604-1E does not show that glare screening is required for the traffic volumes projected for this project (2010 ADT = 21,200 and 2030 ADT = 31,200).
- Pavement drainage – the two travel lanes will be sloped to the outside and the median shoulder sloped to the inside (consistent with Fig. 301-6E).

There was some discussion on the need for guardrail protection for the high fill slopes. Will GR be required for slopes 3:1 or flatter since the fill height will be in excess of 60'? Rick indicated that this type of facility

would typically use safety grading where obtainable. TSC will investigate the use of 6:1 (8:1 preferable) or flatter slopes within the clear zone and 3:1 or flatter on the foreslopes. The impacts to the footprint will dictate the usage.

The rock catchment designs were discussed. Dirk's main concern is with accumulation of rock within the clear zone and liability with timely removal. He indicated Option A in OGE's IOC dated 8/8/05 could be considered if the foreslope is flattened to 6:1 (safety grading), thus likely increasing the required width of the ditch. The analysis needs to be verified. Option B and C are ok since there is guardrail protection.

Action items:

1. TSC will update the cost for the 40' median option to include 2 lines of cable barrier and maintenance costs.
2. Another concrete median option will be developed to provide 65 mph SSD at the two curve locations.
3. Assess the rock catchment option A with 6:1 foreslopes.
4. Confirm the percent of rock captured by Options A,B and C as well as the PAVR design.

Revised Median Option Summary Spreadsheet

OPTION 1 IS A 60' MEDIAN WITH NO BARRIER.

OPTION 2 IS A 40' MEDIAN WITH CABLE BARRIER.

OPTION 3 IS A 15' VARIED MEDIAN WITH CONCRETE BARRIER.

	OPTION 1: 60' MEDIAN W/ NO BARRIER		OPTION 2: 40' MEDIAN W/ CABLE BARRIER		OPTION 3: 15' VARIED MEDIAN W/ CONCRETE BARRIER	
	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
CUT (CY)*	25,120,426	$69,081,172	23,312,846	$64,110,327	21,303,654	$58,585,049
FILL (CY)*	21,753,742	$16,315,307	20,755,249	$15,566,437	19,364,976	$14,523,732
WASTE (CY)*	3,366,684	$3,366,684	2,557,597	$2,557,597	1,938,678	$1,938,678
CABLE BARRIER (LF)	0	$0	134,979	$1,957,193	0	$0
ANCHOR TERMINAL (EACH)	0	$0	52	$130,000	0	$0
20YR MAINTENACE (MILE)	0	$0	26	$2,267,172	0	$0
CONCRETE BARRIER (LF)	14,447	$1,155,769	14,447	$1,155,769	81,937	$6,554,923
DRAINAGE (EACH)**	0	$0	0	$0	112	$168,000
PAVEMENT (SY)***	0	$0	29,995	$779,878	61,610	$1,601,860
TOTAL		$89,918,931		$88,524,372		$83,372,242
DIFFERENCE		$0		-$1,394,559		-$6,546,689
PERCENT INCREASE		0.00%		-1.55%		-7.28%

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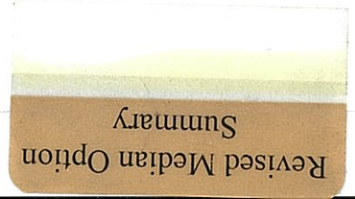
**DRAINAGE QUANTITY/COST IS BASED ON SUBSTITUTING AN I-3A INLET ($4000 EACH) FOR ALL CB4 CATCH BASINS ($2500 EACH) LOCATED IN THE MEDIAN WHEN CONCRETE BARRIER IS USED.

***PAVEMENT QUANTITY/COST IS BASED ON THE EXTRA PAVEMENT WIDTH NEEDED WITH OPTION 3 IN LIEU OF A GRASS MEDIAN FOR OPTIONS 1 AND 2.



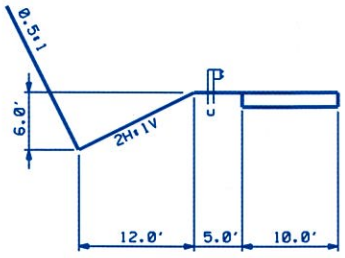
Catchment

Catchment Option Summary Spreadsheet

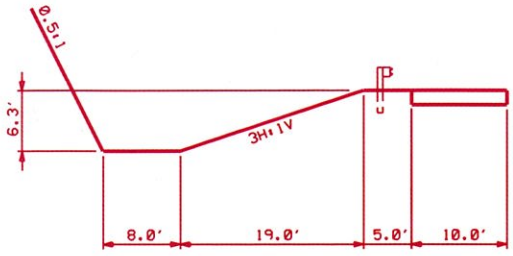
	PAVR		OPTION A		OPTION B		OPTION C		OPTION D	
	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
CUT (CY)*	21,303,654	$58,585,049	24,384,748	$67,058,057	24,812,521	$68,234,433	24,960,281	$68,640,773	24,229,433	$66,630,941
FILL (CY)*	19,364,976	$14,523,732	19,391,248	$14,543,436	19,367,277	$14,525,458	19,400,995	$14,550,746	19,405,402	$14,554,052
WASTE (CY)*	1,938,678	$1,938,678	4,993,500	$4,993,500	5,445,244	$5,445,244	5,559,286	$5,559,286	4,824,031	$4,824,031
GUARDRAIL (LF)	86,004	$860,040	0	$0	86,004	$860,040	86,004	$860,040	86,004	$860,040
TOTAL		$75,907,499		$86,594,993		$89,065,175		$89,610,845		$86,869,063
DIFFERENCE		$0		$10,687,495		$13,157,676		$13,703,347		$10,961,565
PERCENT INCREASE		0.00%		14.08%		17.33%		18.05%		14.44%

Catchment Option Summary

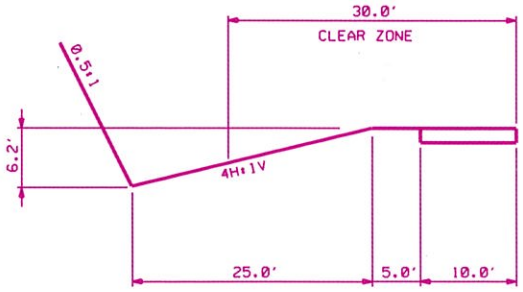
CATCHMENT OPTION DETAILS



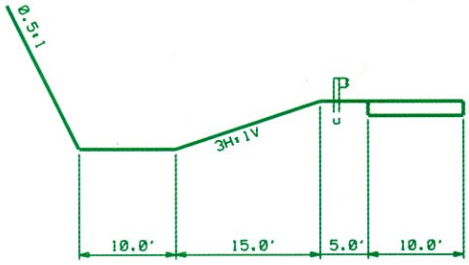
TYPICAL DITCH SECTION - PAVR SUBMITTAL WITH BARRIER



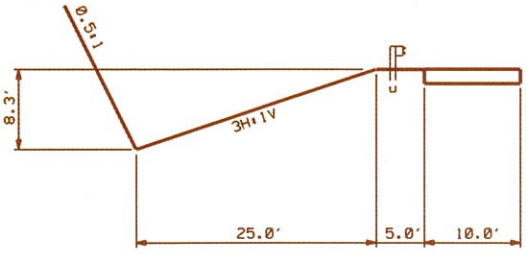
TYPICAL DITCH SECTION - OPTION C (OGE)
WITH BARRIER



TYPICAL DITCH SECTION - OPTION A (OGE)
CLEAR ZONE USED FOR CATCHMENT. W/O BARRIER



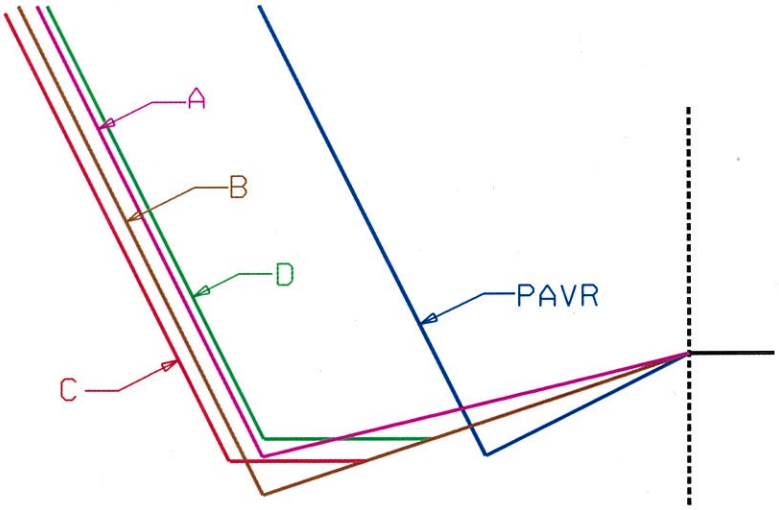
TYPICAL DITCH SECTION - OPTION D
WITH BARRIER



TYPICAL DITCH SECTION - OPTION B (OGE)
WITH BARRIER

CATCHMENT OPTIONS

- PAVR CATCHMENT OPTION
- OPTION A CATCHMENT
- OPTION B CATCHMENT
- OPTION C CATCHMENT
- OPTION D CATCHMENT



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Catchment Option Details

SCI-823-0.00 (PID 19415)
Portsmouth Bypass

TRANSYSTEMS CORPORATION

Minutes of Rock Catchment Meeting February 3, 2006

Attendees

David Norris	ODOT District 9
Chad Mitten	ODOT District 9
Gene Geiger	ODOT OGE
Chris Merklin	ODOT OGE
Steve Taliaferro	ODOT OGE
Bob Campbell	TranSystems
Greg Brown	TranSystems
Ram Nunna	TranSystems
Mike Weeks	TranSystems
Pete Nix	DLZ
Andrew Jalbrzikowski	DLZ
Brian Mott	DLZ

Minutes

A meeting was held at ODOT OGE 2nd Floor Conference Room to discuss the rock catchment ditch design options.

DLZ presented the results from the CRSP analysis for two cut locations (136' and 157' heights). The results were discussed and how they relate to the GB-3 requirements. OGE agreed that the CRSP underestimates the catchment width as indicated in the Oregon study. The values presented in GB-3 Table C are conservative and the designer should run CSRP to verify these values.

GB-3 requires that 95% rock fall retention be obtained at the edge of paved shoulder (later clarified to mean the PI of the shoulder and foreslope). 5' construction benches are to be used at 30' intervals – these should not be considered in the analysis since they may not be constructed or will be filled with rock fall in the future. Geotechnical and overburden benches are to be a minimum of 10'. The catchment ditch width values in GB-3 Table C should be used and the adequacy of these values should be verified using CRSP for cuts greater than 100'.

District 9 prefers a flat bottom section since it can accommodate a front end loader and dump truck access for maintenance. After discussing various section options, it was agreed that a section using a 5' berm from edge of paved shoulder, 15' 3:1 foreslope and 10' bottom (total of 30' from edge of paved shoulder) should be checked with CRSP. DLZ will run the program and advise TranSystems before the February 9 JPP update meeting.

General discussion items:

- DLZ will investigate using various rock sizes to evaluate the impact on the CRSP results. 18" rock size was used on present analysis – effects of smaller sizes will be assessed.
- There was some discussion on the limits of the rock cut in the subgrade and potential drainage problems. D-9 has some recent drainage problems in rock cuts on ROS-35 project. C&MS Section 204.05 specifies an undercut below subgrade of 2' minus the thickness of the aggregate base. It might be best to cut to entire roadbed to the ditch elevation to ensure there are not pockets of trapped drainage. This issue will be assessed.

Dave indicated he estimated that there is approximately $350K cost increase on each side for each 1 foot of width of cut for the length of the project.

TRANSYSTEMS CORPORATION