

DESIGN REPORT  
REHABILITATION OF HARVARD GULCH  
CITY AND COUNTY OF DENVER, COLORADO  
PROJECT NO. 84-05.02

DECEMBER 1984

Prepared For:

Urban Drainage and Flood Control District  
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DEC Job No. 226

## INTRODUCTION

This report sets forth the conditions and criteria used in the design of the Rehabilitation of Harvard Gulch, City and County of Denver, Colorado, Project No. 84-05.02 along Harvard Avenue east of South Logan Street to the existing concrete spillway structure located just north of the intersection of South Clarkson Street and Harvard Avenue. The design section is a trapezoidal earth-lined trickle channel designed for 0.76 percent of the discharge for the 100-year storm event. The remaining portion of the channel section is to be lined with grass sod by others in the near future at slopes allowing free drainage and for ease in maintenance. Denver Engineering Corporation wishes to formally extend its appreciation to the many people and the Urban Drainage and Flood Control District in providing the necessary information and cooperation to complete this design report.

## HYDROLOGY

The design flows were those specified in the "Flood Hazard Area Delineation, Harvard Gulch, West Harvard Gulch and Dry Gulch, Urban Drainage and Flood Control District, City and County of Denver and Arapahoe County" prepared by Gingery Associates, Inc. and dated December 1979.

## DESCRIPTION

	<u>10-Year Flow (cfs)</u>	<u>100-Year Flow (cfs)</u>
Harvard Gulch above Dry Gulch confluence	2530	3600
Harvard Gulch at South Logan Street	3360	4860
Dry Gulch at Harvard Gulch confluence	900	1332

The earth-lined trickle channel along Harvard Gulch was sized for a capacity of 37 cfs which is 0.76 percent of the design (100-year) flow of Harvard Gulch at South Logan Street.

## ALIGNMENT AND GRADE

The channel alignment was chosen to best facilitate development of a straight channel as water flows from the existing concrete spillway parallel to Harvard Avenue to the 400 foot radius curve where the channel turns parallel to South Logan Street. The existing channel was designed as a meandering "S" curve in this section and at a very slight slope of 0.10 to 0.17 percent per the Record Drawings, "Harvard Gulch Flood Control Project, Project No. 9203-Phase II, City and County of Denver," Drawing No. 181-2 and dated November 26, 1965. Straightening the channel alignment had the following advantages:

1. The channel slope is increased producing higher velocities at low flow potentially minimizing sediment deposition and ponding which had occurred in the existing channel.
2. Large flood events should have less damage to the proposed earth-lined trickle channel side slopes for a straight channel rather than a meandering channel.
3. The flowline offset of the existing and proposed channel should assist the contractor during construction in controlling water along the construction site.

The remainder of the channel alignment follows the existing channel flowline and parallels South Logan Street leading into a 90 degree 50-foot radius curve to enter the existing South Logan Street Inlet Structure. All curves along the channel alignment were chosen to best follow the existing channel flowline. Tributary channels off South Pennsylvania Street and Dry Gulch were chosen to smoothly transition into the main Harvard Gulch channel.

The existing South Logan Street Inlet Structure is to be modified by cutting a 4 foot wide and approximately 2 foot deep rectangular concrete trickle channel into the existing concrete weir and approach apron. The concrete trickle channel was tied into the proposed

grouted riprap and earth-lined trickle channel located upstream. The purpose of constructing the concrete trickle channel was to lower the downstream elevation and obtain a steeper slope along the length of the project. The design slope is 0.524 percent which is just about the minimum slope that can be constructed using conventional earthwork equipment and methods of construction. In addition, water was ponding on the concrete apron and the installation of the concrete trickle channel should alleviate this problem.

### HYDRAULIC DESIGN

The hydraulic design conforms to applicable guidelines and criteria specified in "Urban Storm Drainage Criteria Manual" prepared for Urban Drainage and Flood Control District.

The following is a summary of the criteria used:

Roughness - The following Manning coefficients (n) were used :

Concrete Channel	0.013
Earth-lined Channel	0.025
Grouted Riprap Channel	0.028
Grass-lined Channel	0.035

### MAIN CHANNEL SECTION

Due to installation of a steeper slope along the channel, the bottom section of the channel must be excavated. The earth-lined trickle channel has an 8 foot wide bottom width, side slopes of 2 (horizontal) to 1 (vertical) and is one foot in depth. The channel side slope changes to 4 (horizontal) to 1 (vertical) extending to a 2.0 percent transitional slope which meets existing ground. These side slopes were chosen for safe and efficient use of mowing equipment on the side slope and also to bring the channel section up to existing ground at the "steepest" slope to minimize excavation and which should create good drainage for the areas on either side of the channel.

## TRIBUTARY CHANNEL SECTION

The two tributary channels, Dry Gulch and South Pennsylvania Street tributary, are to be lined in the near future with grass sod in a "V" section side sloped at 2.0 percent with a grade break increasing the side slope to 4 (horizontal) to 1 (vertical) and extending up to existing ground.

## CHANNEL VELOCITIES

The velocities for various design flows and channel sections are as follows:

<u>Description</u>	<u>Design (10-Year) Flow (cfs)</u>	<u>Design (10-Year) Velocity (fps)</u>	<u>Design (100-Year) Flow (cfs)</u>	<u>Design (100-Year) Velocity (fps)</u>
Harvard Gulch at South Logan Street	3360	7.0	4860	7.9
Harvard Gulch above Dry Gulch confluence	2530	6.2	3600	6.8
South Pennsylvania Street Tributary	14	2.1	—	—

The South Pennsylvania Street tributary flow was determined by calculating the flow in the 12-inch diameter reinforced concrete outlet pipe when full. The hydrology to determine the flow contributed at the South Pennsylvania Street tributary and Harvard Gulch confluence was not a part of the Scope of Work for this project and the investigation of existing reports did not provide any additional information.

Appendix A is a rating table comparing the depth of flow to flow rate as calculated using Manning's equation. Denver Engineering Corporation software program "Normal" was used to determine the design velocities for the new channel section flow for three representative channel cross-sections located at Stations 50+08, 55+00 and 60+00. Note that the design velocity of the design (100-year) flow is 7.9 feet per second for Harvard Gulch at South Logan Street. It is felt

that once the grass sod has established itself that this should not create a problem although minor repair of the grass sod may be required. In addition, the project minimum channel slope of 0.524 percent was chosen to facilitate construction and side slopes of 4 (horizontal) to 1 (vertical) were chosen to reduce the amount of excavation. The side slopes would have to be increased to well over 10 (horizontal) to 1 (vertical) to obtain velocities of less than or equal to 7.0 feet per second at the design (100-year) flow, but the haul removal would be significantly increased. Therefore, the design channel section is considered the "best" channel section.

The design flow for the earth-lined trickle channel flowing full is 37 cubic feet per second at a velocity of 3.7 feet per second.

Riprap - Riprap was designed utilizing the following references:

1. "Urban Storm Drainage Criteria Manual" November 15, 1982, Riprap Criteria Update, Urban Drainage and Flood Control District.
2. Design of Small Canal Structures, United States Department of the Interior, Bureau of Reclamation, 1978.
3. Open-Channel Hydraulics, Van Te Chow, 1959.

The existing grouted riprap located immediately downstream of the existing concrete spillway is to be removed and replaced. The grouted riprap area has been shaped to transition into the trickle channel over a length of just over 30 feet. The grouted riprap section is 2 feet in depth of Type M riprap placed on top of a two-layer bedding consisting of 6 inches of Type II over 6 inches of Type I granular bedding. Weep holes are to be installed at the toe of the trickle channel slope on 5 foot centers to reduce uplift forces on the grouted channel lining. A 4 foot grout cutoff wall is to be placed at the end of the grouted riprap structure to stabilize the grouted riprap to earth-lined channel interface.

An equivalent grouted riprap section is to be installed upstream of the South Logan Street Inlet. This section of grouted riprap is to protect a 50 foot radius 90 degree curve in the trickle channel from erosion and undercutting due to the excessive velocities along the channel banks. The limits of placement for the grouted riprap is 2 feet on either side and parallel to the trickle channel from the beginning of the South Logan Street Inlet Structure to 30 feet upstream of the 50 foot curve point of tangency.

Ordinary riprap is to be installed at the 30 inch corrugated metal pipe overflow drain for the existing detention dam. The riprap section consists of 2 feet of loose Type M riprap placed on top of a two-layer bedding consisting of 6-inches of Type II over 6-inches of Type I granular bedding. A smaller riprap designation than Type M could have been used, however, it is felt that Type M will provide less maintenance from vandalism due to the greater average weight of the riprap rock.

#### UTILITIES

An existing 24-inch diameter reinforced concrete drain pipe and five drop inlets are located along the existing channel flowline which drains to a side connection in the South Logan Street Inlet Structure. This existing drain system consists of the following:

1. A drop inlet is located west of Inlet No. 1 along the east curb and gutter of South Logan Street. Water flows from this inlet to Inlet No. 1.
2. Inlet No. 6 is located adjacent to a drop inlet and 12 inch reinforced concrete pipe outlet along the north curb of Harvard Avenue at the intersection with South Pennsylvania Street. Inlet No. 6 is connected to the 24 inch drain system at Inlet No. 2 with a 12 inch reinforced concrete drain pipe.

3. The Dry Gulch Outlet Structure consists of a concrete energy dissipator apron that has a 15 inch reinforced concrete drain pipe. The Dry Gulch Outlet drain pipe connects to Inlet No. 3.

The drain system will be cleaned as part of this project. Inlets Nos. 1, 2, 3 and 6 will be modified by installation of a concrete lid to convert the drain system into a storm sewer system. The Harvard Avenue and South Pennsylvania Street drop inlet will be connected to the drain system drop inlet with a 12 inch reinforced concrete pipe to eliminate surface flow in the tributary for small storm events. The existing tributary channel will be graded to accommodate large storm events should the flow overtop the 6 inch vertical curb to be installed behind the street drop inlet. Therefore, silting which is occurring along the South Pennsylvania Street tributary should be alleviated by routing street runoff into the drainage system.

In addition, it appears from the underdrain Record Drawings that the 12 inch reinforced concrete pipe between Inlet Nos. 2 and 6 must be lowered to accommodate the new channel grades and reduction of the overall Inlet No. 2 structure height as modified with the concrete lid. These inlets could not be found during the field survey due to siltation and standing water and therefore, prior to removing and replacing the 12 inch reinforced concrete pipe, the contractor is to verify (pothole) the drop inlets. Should the actual invert elevation of the 12 inch reinforced concrete pipe at Inlet No. 2 be lower than what is shown on the Record Drawings, this item will become a credit from the contractor.

The Dry Gulch Outlet Structure drain will continue to drain the structure apron into Inlet No. 3. Inlet Nos. 4 and 5 will be abandoned as the design intent is to convey the Harvard Gulch flows in the channel.

An existing 30-inch diameter corrugated metal pipe is an overflow drain for the existing dam located immediately northeast of the concrete spillway structure. The invert elevation of the drain outlet was determined during the topographic survey to be 5298.01 feet. In order for the pipe to drain to the new channel section at a minimum slope of 0.50 percent, the drain outlet must be relocated to elevation 5298.40 feet. This requires cutting the pipe 20 feet up from the current outlet location. The outlet is to be reconstructed per its current configuration.

An existing 36 inch diameter reinforced concrete sanitary sewer pipe crosses the channel at approximate Station 50+30. The channel bottom elevation has been lowered due to the increase in the channel slope, however six foot of cover will be maintained over the sewer pipe.

#### EXCAVATION AND EMBANKMENT

Excavation and embankment quantities and cross sections were calculated and plotted utilizing Denver Engineering Corporation's "Earthwork Volume Computations" software program on a Hewlett-Packard 86B personal computer and 7885B plotter. Quantities are calculated using the average end area method. Appendix B is the computer output providing earthwork quantities and survey slope stake data for each cross section along Harvard Gulch.

The estimated total excavation volume is 3350 cubic yards. 3221 cubic yards are from the Harvard Gulch section and 129 cubic yards are from other areas of the project. The volume of excavation that can be used as embankment is 2250 cubic yards. The embankment volume has been adjusted to include a 10 percent compaction factor as determined from the geotechnical investigation. Therefore, the estimated volume of haul material is 1100 cubic yards.

#### SURVEYING

All surveying for the project was performed by Denver Engineering

Corporation (Field Book No. 39). A baseline was established along the length of the project. Three "x" were chisled in concrete to provide permanent horizontal and vertical survey control during construction of the project. Two "x" are located at South Logan Street and provide the basis of bearing. One "x" is located in the concrete spillway abutment. All survey control points are shown on the construction drawings.

#### SOILS

The geotechnical investigation for the project was performed by Dames and Moore of Golden, Colorado. The report is entitled "Subsurface Exploration Proposed Harvard Gulch Rehabilitative Channel Maintenance, City and County of Denver, UDFCD Project No. 84-05.02" and is dated October 1984.

#### STRUCTURAL

The structural design for the South Logan Street Inlet Structure modification was performed by SDG Inc. of Lakewood, Colorado. The structural design calls for State of Colorado Division of Highways Class "AX" concrete and Grade 60 reinforcing steel. A one inch sawcut joint in the existing concrete at the joint with the new construction will provide a clean and aesthetically pleasing joint. The existing concrete below the sawcut joint is to be chipped away to permit the extension of the existing rebars into the new construction providing structural continuity across the construction joint. Where called for, existing rebars are to be bent at the standard radius for 90 degree bar bends. The two #8 rebars in the bottom of the existing weir are to be maintained to provide structural continuity in this area.

## RIGHT-OF-WAY

All work is to be performed within the existing Harvard Gulch drainage easement. The limits of construction have been defined on the construction drawings to confine the contractor's construction operation and minimize the destruction of existing landscaping.

## COST ESTIMATE

The engineer's cost estimate is provided in Appendix C. Unit prices were determined from review of the following cost information.

1. "1983 Cost Data", Department of Highways, State of Colorado
2. Recent bid tabulations published by the Colorado Contractors Association.
3. Solicitation of estimates from various contractors for the various items of work.

The construction cost estimate for the Rehabilitation of Harvard Gulch, City and County of Denver, Project No. 84-05.02 is \$89,700.00

A 15 percent contingency was used in computing the total construction cost estimate for the project. Drop Inlet Nos. 1 through 3 and 6 could not be located during the field survey due to siltation and standing water. Therefore, the inverts were determined from Record Drawings. A note has been placed on the plans requiring the contractor to field verify (pothole) these drop inlets prior to existing underdrain cleaning and prior to beginning channel earthwork. In addition, the Contractor is to notify the engineer a minimum of 2 working days prior to construction for review of the existing underdrain grades as shown on the plans. Should the actual elevation found in the field differ from the Record Drawings, then provisions for adjusting the grades of the existing underdrain pipe can be made and paid from the contingency funds.

The estimated costs of construction are intended to provide an indication of the costs involved and are considered to be an estimate only. We, as engineers, have no control over the cost of materials, equipment and labor, or competitive bidding, and cannot guarantee the accuracy of the construction costs. The unit prices used in the estimate reflect estimated current costs and do not provide for inflation.

#### CONSTRUCTION DRAWINGS

The construction plans for the major drainage facility are comprised of the following drawings:

- Title and Index Sheet
- Plan and Profile
- Miscellaneous Details
- Cross Sections

The plan and profile drawings have a horizontal scale of 1"=40' and a vertical scale of 1"=5'.

#### SPECIFICATIONS

The Urban Drainage and Flood Control District standard "boiler plate" contract documents were used for the General Contract Conditions, Contract Forms, Bond Forms, Proposal Forms, Notice for Proposals and Instruction to Bidders. The State of Colorado Department of Highways "Standard Specifications for Road and Bridge Construction," Sections 200 through 700, were made a part of the specifications except as modified by the Special Contract Conditions and the Detail and Technical Specifications.

APPENDIX A

REHABILITATION OF HARVARD GULCH

CROSS SECTION RATING TABLES

CROSS SECTION RATING INFORMATION  
HARVARD GULCH - STATION 50+08

Channel Flowline Elevation - 5213.24 Feet

Average "N" Value

0.034

Slope (Ft/Ft)

0.00524

<u>Elevation (ft)</u>	<u>Area (sq. ft)</u>	<u>Velocity (fps)</u>	<u>Discharge (cfs)</u>
5293.2	0.0	0.0	0.0
5295.2	26.0	3.7	95.9
5295.7	37.0	4.1	153.0
5296.2	50.0	4.6	228.2
5296.7	65.0	5.0	323.3
5297.2	82.0	5.4	440.3
5297.7	101.9	5.1	515.7
5298.2	133.3	4.6	608.1
5298.7	176.2	4.7	824.8
5299.2	229.3	5.1	1158.6
5299.7	286.7	5.7	1634.9
5300.1	346.5	6.3	2182.4
5300.7	408.8	6.8	2796.5
5301.2	473.6	7.3	3480.3
5301.7	541.0	7.8	4234.5
5302.2	610.9	8.3	5059.7
5302.7	683.4	8.7	5956.5
5303.2	758.5	9.1	6925.8
5303.7	836.1	9.5	7968.6

CROSS SECTION RATING INFORMATION  
 HARVARD GULCH - STATION 55+00

Channel Flowline Elevation - 5295.83 Feet

Average "N" Value

0.034

Slope (Ft/Ft)

0.00524

<u>Elevation (ft)</u>	<u>Area (sq. ft)</u>	<u>Velocity (fps)</u>	<u>Discharge (cfs)</u>
5295.8	0.0	0.0	0.0
5297.3	17.0	3.2	54.8
5297.8	26.0	3.7	95.9
5298.3	37.0	4.1	153.0
5298.8	50.0	4.6	228.2
5299.3	65.0	5.0	323.3
5299.8	83.4	4.5	379.1
5300.3	117.6	3.7	432.8
5300.8	171.4	4.0	678.8
5301.3	234.2	4.7	1099.3
5301.8	300.2	5.4	1609.9
5302.3	369.3	6.0	2205.6
5302.8	441.6	6.5	2885.3
5303.3	517.0	7.1	3648.8
5303.8	595.5	7.5	4496.1
5304.3	677.2	8.0	5428.4
5304.8	762.1	8.5	6446.3
5305.3	850.1	8.9	7550.9
5305.8	941.3	9.3	8743.5

CROSS SECTION RATING INFORMATION  
HARVARD GULCH - STATION 60+00

Channel Flowline Elevation - 5298.49 Feet

Average "N" Value

0.034

Slope (Ft/Ft)

0.00524

<u>Elevation (ft)</u>	<u>Area (sq. ft)</u>	<u>Velocity (fps)</u>	<u>Discharge (cfs)</u>
5298.4	0.0	0.0	0.0
5300.4	26.0	3.7	95.9
5300.9	37.0	4.1	153.0
5301.4	50.0	4.6	228.2
5301.9	67.6	3.8	253.4
5302.4	102.8	3.5	362.6
5302.9	148.5	4.2	628.8
5303.4	198.2	4.8	956.9
5303.9	253.2	5.3	1343.5
5304.4	314.4	5.7	1788.5
5304.9	382.7	6.1	2317.5
5305.4	458.1	6.4	2938.5
5305.9	540.5	6.8	3657.5
5306.4	629.9	7.1	4480.3

**APPENDIX B**

**EARTHWORK QUANTITIES AND  
SURVEY SLOPE STAKE DATA**

DENVER ENGINEERING CORPORATION  
 OCTOBER 24 1984  
 EARTHWORK VOLUMES - MAIN CHANNEL HARVARD GULCH  
 DEC JOB NUMBER 226.001  
 SHEET 1  
 \*\*\*\*\* DESIGN VOLUMES \*\*\*\*\*

TEMPLATE FILE:TMPL13

X-SECTION FILE:exist  
 HARVARD GULCH

-----  
 HORIZ. SCALE= 10

VERT. SCALE= 10

\*\*\*\*\*  
 SECTION ( 1 ) = 48+25.00

PT	OFFSET	ELEV
1	-80.00	5303.63
2	-36.00	5295.50
3	-25.00	5295.00
4	-23.00	5295.30
5	0.00	5295.90
6	37.00	5296.10
7	39.00	5295.50
8	58.00	5296.60
REF	-6.00	5292.28

TEMPLATE POINTS

PT	OFFSET	ELEV
1	-22.01	5295.78
2	-22.00	5295.78
3	-12.00	5293.28
4	-10.00	5292.28
5	-6.00	5292.28
6	-2.00	5292.28
7	0.00	5293.28
8	16.00	5297.28
9	16.01	5297.28

CATCH POINTS

PT	OFFSET	ELEV
1*	-39.40	5296.13
2	-20.36	5295.37
3	10.71	5295.96

	AREA	VOLUME	TOTAL
CUT	63	0	0
FILL	11	0	0

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SHEET 2  
TEMPLATE FILE:TEMPL0

X-SECTION FILE:exist  
HARVARD GULCH

SECTION ( 2 ) = 48+68.00

PT	OFFSET	ELEV
1	-84.10	5305.40
2	0.00	5299.44
3	51.76	5296.10
4	53.12	5295.50
5	80.86	5298.80
REF	17.00	5292.50

TEMPLATE POINTS

PT	OFFSET	ELEV
1	-19.01	5301.00
2	-19.00	5301.00
3	11.00	5293.50
4	13.00	5292.50
5	17.00	5292.50
6	21.00	5292.50
7	23.00	5293.50
8	36.20	5296.80
9	36.21	5296.80

CATCH POINTS

PT	OFFSET	ELEV
1*	-23.20	5301.08
2	-17.81	5300.70
3*	39.80	5296.87
4*	69.68	5297.47

	AREA	VOLUME	TOTAL
CUT	175	190	190
FILL	22	26	26

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SHEET 3  
TEMPLATE FILE:TEMPL1

X-SECTION FILE:exist  
HARVARD GULCH

SECTION ( 3 ) = 49+12.00

PT	OFFSET	ELEV
1	-34.00	5304.30
2	0.00	5299.20
3	18.00	5296.80
4	57.00	5295.90
5	115.00	5298.80
6	132.00	5301.20
REF	60.00	5292.73

TEMPLATE POINTS

PT	OFFSET	ELEV
1	43.99	5296.23
2	44.00	5296.23
3	54.00	5293.73
4	56.00	5292.73
5	60.00	5292.73
6	64.00	5292.73
7	66.00	5293.73
8	79.20	5297.03
9	79.21	5297.03

CATCH POINTS

PT	OFFSET	ELEV
1*	34.25	5296.43
2	44.13	5296.20
3	79.10	5297.01
4*	79.87	5297.04

	AREA	VOLUME	TOTAL
CUT	66	197	386
FILL	0	18	44

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SHEET 4  
 TEMPLATE FILE:TEMPL2

X-SECTION FILE:exist  
 HARVARD GULCH

SECTION ( 4 ) = 49+62.00

PT	OFFSET	ELEV
1	-33.00	5304.90
2	0.00	5300.00
3	10.00	5298.70
4	78.00	5297.20
5	80.00	5295.20
6	85.00	5295.30
7	87.00	5297.30
8	112.00	5297.70
9	130.00	5301.50
REF	61.00	5293.00

TEMPLATE POINTS

PT	OFFSET	ELEV
1	38.71	5298.07
2	38.72	5298.07
3	55.00	5294.00
4	57.00	5293.00
5	61.00	5293.00
6	65.00	5293.00
7	67.00	5294.00
8	80.20	5297.30
9	80.21	5297.30

CATCH POINTS

PT	OFFSET	ELEV
1*	37.01	5298.10
2	38.74	5298.07
3	78.36	5296.84
4*	113.23	5297.96

	AREA	VOLUME	TOTAL
CUT	105	158	544
FILL	19	18	62

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SHEET 5  
 TEMPLATE FILE:TEMPL2

X-SECTION FILE:exist  
 HARVARD GULCH

SECTION ( 5) = 50+08.00

PT	OFFSET	ELEV
1	-34.00	5305.50
2	0.00	5300.30
3	7.00	5299.10
4	57.00	5297.70
5	61.00	5296.00
6	65.00	5295.30
7	66.00	5297.50
8	80.00	5297.00
9	114.00	5297.99
10	137.00	5304.20
REF	61.00	5293.24

TEMPLATE POINTS

PT	OFFSET	ELEV
1	38.71	5298.31
2	38.72	5298.31
3	55.00	5294.24
4	57.00	5293.24
5	61.00	5293.24
6	65.00	5293.24
7	67.00	5294.24
8	80.20	5297.54
9	80.21	5297.54

CATCH POINTS

PT	OFFSET	ELEV
1*	26.45	5298.56
2	39.16	5298.20
3	78.28	5297.06
4*	114.90	5298.23

	AREA	VOLUME	TOTAL
CUT	84	161	705
FILL	14	28	90

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SHEET 6  
 TEMPLATE FILE:TEMPL3

X-SECTION FILE:exist  
 HARVARD GULCH

SECTION ( 6 ) = 50+58.00

PT	OFFSET	ELEV
1	-44.00	5306.40
2	0.00	5299.80
3	5.00	5299.10
4	31.00	5298.00
5	60.00	5297.50
6	62.00	5296.30
7	64.00	5296.30
8	65.00	5297.70
9	110.00	5298.00
10	141.00	5302.70
REF	57.50	5293.50

TEMPLATE POINTS

PT	OFFSET	ELEV
1	37.89	5297.90
2	37.90	5297.90
3	51.50	5294.50
4	53.50	5293.50
5	57.50	5293.50
6	61.50	5293.50
7	63.50	5294.50
8	76.70	5297.80
9	76.71	5297.80

CATCH POINTS

PT	OFFSET	ELEV
1*	29.30	5298.07
2	37.98	5297.88
3	76.61	5297.78
4*	113.54	5298.54

	AREA	VOLUME	TOTAL
CUT	84	156	862
FILL	9	22	112

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SHEET 7  
 TEMPLATE FILE:TEMPL3\

X-SECTION FILE:exist  
 HARVARD GULCH

SECTION ( 7 ) = 50+83.00

PT	OFFSET	ELEV
1	-46.00	5306.50
2	0.00	5299.44
3	22.00	5298.10
4	54.00	5297.70
5	55.00	5296.80
6	58.00	5296.50
7	59.00	5298.00
8	108.00	5298.30
9	140.00	5302.80
REF	53.00	5293.63

TEMPLATE POINTS

PT	OFFSET	ELEV
1	33.39	5298.03
2	33.40	5298.03
3	47.00	5294.63
4	49.00	5293.63
5	53.00	5293.63
6	57.00	5293.63
7	59.00	5294.63
8	72.20	5297.93
9	72.21	5297.93

CATCH POINTS

PT	OFFSET	ELEV
1*	18.14	5298.34
2	33.71	5297.95
3*	83.07	5298.15
4*	110.87	5298.70

	AREA	VOLUME	TOTAL
CUT	88	80	942
FILL	6	7	119

\*\*\*\*\*

SHEET 8  
TEMPLATE FILE:TEMPL4

X-SECTION FILE:exist  
HARVARD GULCH

SECTION ( 8) = 51+13.00

PT	OFFSET	ELEV
1	-54.00	5306.30
2	0.00	5299.44
3	23.00	5298.30
4	38.00	5297.70
5	57.00	5297.90
6	62.00	5295.99
7	67.00	5297.90
8	117.00	5298.80
9	146.00	5303.60
REF	55.00	5293.79

TEMPLATE POINTS

PT	OFFSET	ELEV
1	36.99	5297.79
2	37.00	5297.79
3	49.00	5294.79
4	51.00	5293.79
5	55.00	5293.79
6	59.00	5293.79
7	61.00	5294.79
8	74.20	5298.09
9	74.21	5298.09

CATCH POINTS

PT	OFFSET	ELEV
1*	34.50	5297.84
2	37.24	5297.73
3	73.94	5298.02
4*	118.00	5298.97

	AREA	VOLUME	TOTAL
CUT	75	91	1032
FILL	5	6	125

\*\*\*\*\*

SHEET 9  
 TEMPLATE FILE:TEMPL5

X-SECTION FILE:exist  
 HARVARD GULCH

SECTION ( 10) = 51+89.00

PT	OFFSET	ELEV
1	-35.00	5307.10
2	0.00	5302.00
3	14.00	5299.30
4	26.00	5298.70
5	46.00	5298.10
6	64.00	5297.99
7	80.00	5297.50
8	125.00	5298.40
9	160.00	5305.00
REF	68.00	5294.19

TEMPLATE POINTS

PT	OFFSET	ELEV
1	49.99	5298.19
2	50.00	5298.19
3	62.00	5295.19
4	64.00	5294.19
5	68.00	5294.19
6	72.00	5294.19
7	74.00	5295.19
8	85.20	5297.99
9	85.21	5297.99

CATCH POINTS

PT	OFFSET	ELEV
1*	29.00	5298.61
2	50.47	5298.07
3	83.52	5297.57
4*	127.29	5298.83

	AREA	VOLUME	TOTAL
CUT	70	203	1235
FILL	18	32	157

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