FINAL DRAINAGE REPORT

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TONTO VERDE UNIT 7

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December 1998

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INTRODUCTION

Tonto Verde is a master planned community development located in Northeast of Maricopa County, Arizona, south of Rio Verde Drive and west of Forest Road in Section 31 and 36, Township 5 North, Ranges 6 and 7 East of the Gila and Salt River Base and Meridian. The area is relatively flat, sloping from west to east and ranging from 1 percent to 3 percent. In a few locations the land slopes as steep as five percent. As with the previous phases, this phase will be developed in accordance with the Tonto Verde Development Master Plan.

Tonto Verde Unit Seven, with a total area of approximately 258 acres, consists of approximately one hundred fifty-six single-family homes and ninety-nine condominiums. Similar to Tonto Verde Unit One through Unit Six, Tonto Verde Unit Seven shall also include an eighteen-hole golf course as part of the development.

Firm Washes No. 10, 11 and 12 and Channel One that divert large quantities of flow from west to east and intersect the project in several locations have been designed and approved by the Flood Control District of the Maricopa County under a separate set of plans - Tonto Verde East Extension.

DISCUSSION

Existing Conditions

Tonto Verde Unit Seven is a new phase of residential development east of Forest Road in the Tonto Verde Master Planned Community. Existing Drainage Map 1 of 2 shows the drainage divides, watershed area delineation, concentration points and amount of flow that was depicted in the Rio Verde South Floodplain Delineation Study completed by the Flood Control District of Maricopa County. Existing drainage characteristics and features shall be maintained as much as possible. In location where the existing drainage pattern cannot be met, adequate provision shall be provided to alleviate the storm flow impact and divert it into new FIRM washes.

As with the previous phases, this phase will be developed in accordance with the Tonto Verde Master Plan. To maintain access to the site, all washes will cross the streets through either pipe culverts or box culverts that shall be sized for a 100-year storm recurrence interval. At the time of the preparation of this final report, two culverts and a golf cart tunnel are in their final stages of construction. A six cell 10' x 4' concrete box culvert is being constructed in Forest Road to convey the 10-year flow in Wash 10 and a four 10' x 4' reinforced concrete box culvert is being constructed in Forest Road to convey the 100-year flow in Wash 11. The golf cart tunnel is constructed of two 8' x 8' reinforced concrete box culverts to alleviate golf carts crossing under Forest Road. Existing offsite flows will be altered by constructing FIRM washes that intercept a large magnitude of offsite and, to some degree, onsite flows. These channels are roughly excavated and final construction which encompasses various drop structures and side slope improvements are underway. Due to maintaining the natural terrain and golf course improvements, all local drainage patterns will be regulated and rerouted through and around the golf courses by means of swales and drain to FIRM washes and other local channels. Certain modifications that have been made due to the flow regime and flow quantity resulting from Tonto Verde Units' improvements to the west of Forest Road have been incorporated as a part of Tonto Verde Unit Seven Drainage Studies. Those flows have been either re-routed to FIRM washes or modified to reflect accurate amount of flow passing through the project.

Proposed Conditions

One of the features in Tonto Verde Unit Seven will be the existence of golf courses and FIRM Washes 10, 11, and 12 and Channel One. These features have divided the land into several pieces and thus have created intercepting drainage ways within the project boundaries. The amount of storm flow, therefore, has been determined by Rational Methods. The proposed project is also comprised of open land, streets, single-family homes and condominiums which call for different rational runoff coefficients, "C". A weighted, rational runoff coefficient, "C", has been calculated and used to determine the quantity of storm runoff expected.

The majority of offsite flow impacts are concentrated toward the main channels such as Wash 10, Wash 11, Channels 1 and 2. Some offsite area drainage patterns cross Forest Road which has an impact on the proposed site. Portions of area A6 to the west of Forest Road, for example, seems to be the only area that directly crosses Forest Road before being drained to one of the major washes. A drainage easement (easement #8 with a 15-foot width) is provided to convey adequate onsite and offsite flow through swales into a channel.

Culverts within the project area are sized up to convey the 100-year storm. At this stage of design, all culverts are considered to be reinforced concrete box culverts. However, use of alternative culverts to convey the required flow safely throughout the project, which are considered economically feasible, cannot be ruled out.

The majority of areas is preserved in a natural state and thus facilitates the natural drainage pattern. Streets shall not carry storm flow to its full capacity. Lots adjacent to main washes shall drain into those washes and alleviate the flow magnitude on streets.

RESULTS

Development of Tonto Verde Unit Seven does not impact the post-development drainage pattern. Maintaining this unit in its natural state, the same as previous units, does not contribute to significant amounts of flow into the system in comparison to the amount of flow being carried by major channels within the reach.

The density of the proposed development on Unit Seven shall not have an impact on the drainage pattern that should require on-site retention. Golf course's irrigation system shall be regulated and controlled by the Rio Verde Services, Inc. golf course operating staff to eliminate excess flow, if any, generated by irrigating the golf courses. Rio Verde Services, Inc. has developed and completed Units 1 through 6 and the Maricopa County Flood Control District has approved the drainage plans. No retention has been provided for Tonto Verde Units 1 through 6 since adequate precautionary steps have been taken for irrigating the existing golf courses.

REFERENCES

Final Drainage Report - Tonto Verde Unit 3, Brooks, Hersey and Associates, Inc., September 20, 1994.

Addendum #1 to the Final Drainage Report of Tonto Verde Unit 3, Brooks, Hersey and Associates, Inc., October 27, 1994.

Final Drainage Report of Tonto Verde Unit 4, Brooks, Hersey and Associates, Inc., March 1996.

Drainage Design Manual for Maricopa County, Arizona, Vol. I, Hydrology, Revised, January 1, 1995, and Vol. II, Hydraulics, September 1, 1992.

Revised Master Drainage Plan for Tonto Verde, Brooks, Hersey and Associates, Inc., June 1993.

Rio Verde South Floodplain Delineation Study, MCFCD.

Final Drainage Report for Tonto Verde Unit 1, Brooks, Hersey and Associates, Inc., September 1993.

Final Drainage Report for Tonto Verde Unit 6, Brooks, Hersey and Associates, Inc., June 1998.

BROOKS HERSEY & ASSOCIATES, INC.
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JOB TONTO VERDE UNIT SEVEN
SHEET NO. 1 OF 1
CALCULATED BY LO DATE 8/20/98
CHECKED BY — DATE —
SCALE —

WEIGHTED RUN-OFF COEFFICIENT CALCULATIONS

FEATURES	AVERAGE "C" COEFFICIENT	AREA AC.	CA
SINGLE FAMILY	0.625	53.59	33.49
CONDOMINIUMS	0.690	8.18	5.64
GOLF COURSES	0.220	53.79	11.83
ROADWAYS	0.94	15.36	14.44
SUBURBAN	0.44	126.81	11.80
		257.73	77.20

$$C_W = \frac{77.20}{257.73} = 0.2995$$

$$\approx 0.30$$

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HYDROLOGIC SUMMARY TABLES

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A1

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	33.35	acres
Watercourse Length	1950.0	feet
Top Elevation	1589.0	feet
Bottom Elevation	1554.0	feet
Slope	.01795	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	20	28	36	49	64	77
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	25.9	22.7	20.7	19.0	17.9	16.9
i (in/hr)	2.0	2.8	3.6	4.5	5.3	6.2

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: AZ

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	17.46 acres
Watercourse Length	1970.0 feet
Top Elevation	1586.0 feet
Bottom Elevation	1547.0 feet
Slope	.01980 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	**2.30 inches**

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	11	15	19	26	34	41
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	25.1	21.9	20.1	18.4	17.3	16.3
i (in/hr)	2.0	2.9	3.6	4.6	5.4	6.3

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A3

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	12.92	acres
Watercourse Length	1740.0	feet
Top Elevation	1584.0	feet
Bottom Elevation	1547.0	feet
Slope	.02126	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	9	12	15	21	26	32
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	22.4	19.5	18.3	16.6	15.6	14.8
i (in/hr)	2.2	3.1	3.7	4.8	5.7	6.6

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A4

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	2.70	acres
Watercourse Length	550.0	feet
Top Elevation	1554.0	feet
Bottom Elevation	1547.0	feet
Slope	.01273	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	2	3	4	5	7	8
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	13.3	11.7	11.2	10.0	9.5	9.0
i (in/hr)	2.9	4.0	4.6	6.1	7.0	8.1

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A5

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	25.39 acres
Watercourse Length	1800.0 feet
Top Elevation	1578.0 feet
Bottom Elevation	1546.0 feet
Slope	.01778 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	16	22	28	39	50	60
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	24.7	21.6	19.9	18.2	17.1	16.1
i (in/hr)	2.1	2.9	3.6	4.6	5.4	6.3

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/24/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A6

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	18.00 acres
Watercourse Length	2400.0 feet
Top Elevation	1620.0 feet
Bottom Elevation	1572.0 feet
Slope	.02000 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	10	14	18	26	33	40
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	28.7	24.9	22.7	20.7	19.5	18.4
i (in/hr)	1.8	2.7	3.4	4.3	5.1	5.9

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A7

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	6.26	acres
Watercourse Length	900.0	feet
Top Elevation	1572.0	feet
Bottom Elevation	1534.0	feet
Slope	.04222	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	6	8	9	13	17	20
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	11.4	10.1	9.6	8.6	8.2	7.8
i (in/hr)	3.1	4.3	4.9	6.5	7.4	8.6

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A8

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	3.16	acres
Watercourse Length	650.0	feet
Top Elevation	1556.0	feet
Bottom Elevation	1555.0	feet
Slope	.00154	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	2	3	4	5	6
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	35.2	30.3	27.3	24.6	23.2	22.0
i (in/hr)	1.6	2.3	3.0	4.0	4.7	5.4

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A 9

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	5.12 acres
Watercourse Length	1100.0 feet
Top Elevation	1553.0 feet
Bottom Elevation	1547.0 feet
Slope	.00545 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	3	4	5	7	9	11
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	29.2	25.4	23.0	21.0	19.8	18.7
i (in/hr)	1.8	2.6	3.4	4.3	5.0	5.9

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A10

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	19.14 acres
Watercourse Length	760.0 feet
Top Elevation	1548.0 feet
Bottom Elevation	1547.0 feet
Slope	.00132 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	8	12	16	23	29	35
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	42.6	36.1	32.3	29.0	27.3	25.8

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A11

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	31.67 acres
Watercourse Length	1500.0 feet
Top Elevation	1585.0 feet
Bottom Elevation	1559.0 feet
Slope	.01733 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	21	30	36	51	65	78
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	22.0	19.3	18.0	16.4	15.4	14.6
i (in/hr)	2.2	3.2	3.8	4.9	5.7	6.6

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A/2

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	20.00	acres
Watercourse Length	2200.0	feet
Top Elevation	1595.0	feet
Bottom Elevation	1568.0	feet
Slope	.01227	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	10	14	19	27	34	41
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	33.5	28.9	26.1	23.6	22.2	21.1
i (in/hr)	1.6	2.4	3.1	4.1	4.8	5.5

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A13

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	12.56 acres
Watercourse Length	1200.0 feet
Top Elevation	1584.0 feet
Bottom Elevation	1553.0 feet
Slope	.02583 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	10	14	16	23	29	35
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	16.4	14.4	13.7	12.3	11.6	11.0
i (in/hr)	2.6	3.6	4.2	5.6	6.4	7.5

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A14

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	1.42	acres
Watercourse Length	350.0	feet
Top Elevation	1553.0	feet
Bottom Elevation	1548.0	feet
Slope	.01429	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	2	2	3	4	5
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	9.7	8.6	8.2	7.4	7.0	6.6
i (in/hr)	3.3	4.6	5.2	6.9	7.9	9.1

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A15

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	19.06 acres
Watercourse Length	1400.0 feet
Top Elevation	1559.0 feet
Bottom Elevation	1546.0 feet
Slope	.00929 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	11	16	20	28	36	43
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	27.4	23.9	21.8	20.0	18.7	17.7
i (in/hr)	1.9	2.7	3.5	4.4	5.2	6.0

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A16

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	6.47	acres
Watercourse Length	1600.0	feet
Top Elevation	1576.0	feet
Bottom Elevation	1553.0	feet
Slope	.01438	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	4	6	7	10	13	15
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	24.9	21.8	20.0	18.3	17.2	16.3
i (in/hr)	2.0	2.9	3.6	4.6	5.4	6.3

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A17

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	11.28 acres
Watercourse Length	1200.0 feet
Top Elevation	1587.0 feet
Bottom Elevation	1563.0 feet
Slope	.02000 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	8	12	14	20	25	30
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	18.1	15.9	15.0	13.5	12.8	12.1
i (in/hr)	2.5	3.5	4.0	5.4	6.2	7.2

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A18

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	8.58 acres
Watercourse Length	600.0 feet
Top Elevation	1587.0 feet
Bottom Elevation	1583.0 feet
Slope	.00667 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	6	9	10	15	19	23
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	17.9	15.8	14.9	13.4	12.7	12.0
i (in/hr)	2.5	3.5	4.0	5.4	6.2	7.2

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A19

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	14.92 acres
Watercourse Length	1800.0 feet
Top Elevation	1581.0 feet
Bottom Elevation	1549.0 feet
Slope	.01778 feet/feet
Roughness Coefficient (Kb)	.12000
10-Year, 6-Hour Rainfall	2.30 inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	9	13	16	23	29	35
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	24.7	21.6	19.9	18.2	17.1	16.1
i (in/hr)	2.1	2.9	3.6	4.6	5.4	6.3

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A20

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	4.04	acres
Watercourse Length	800.0	feet
Top Elevation	1564.0	feet
Bottom Elevation	1555.0	feet
Slope	.01125	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
0 0	0					
Q (cfs)	3	4	5	7	9	11
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	17.5	15.4	14.6	13.1	12.4	11.7
i (in/hr)	2.5	3.5	4.1	5.4	6.3	7.3

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A21

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	1.00	acres
Watercourse Length	440.0	feet
Top Elevation	1596.0	feet
Bottom Elevation	1594.0	feet
Slope	.00455	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	1	1	1	2	2	3
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	17.1	15.1	14.3	12.8	12.1	11.5
i (in/hr)	2.6	3.6	4.1	5.5	6.3	7.3

Flood Control District of Maricopa County
Hydrologic Design Manual Rational Method

Computed by: Lute Obaidi Date: 11/23/98

LOCATION DATA

Location: Tonto Verde

Project Name: TV7 Subarea id: A22

Drainage Area Cover: Suburban/Alluvial

DESIGN DATA

Drainage Area	4.00	acres
Watercourse Length	730.0	feet
Top Elevation	1600.0	feet
Bottom Elevation	1588.0	feet
Slope	.01644	feet/feet
Roughness Coefficient (Kb)	.12000	
10-Year, 6-Hour Rainfall	2.30	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	3	5	5	8	10	12
C	0.300	0.300	0.300	0.330	0.360	0.375
Tc (min)	14.3	12.7	12.0	10.8	10.2	9.7
i (in/hr)	2.8	3.9	4.4	5.9	6.8	7.9

CULVERTS

Culvert Calculator Report
TV 7, W10RCBC on Javalina Trail Q=2010

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	1,578.20	ft	Headwater Depth/ Height	1.14	
Computed Headwater Elevation	1,578.20	ft	Discharge	2,026.64	cfs
Inlet Control HW Elev	1,578.11	ft	Tailwater Elevation	1,576.11	ft
Outlet Control HW Elev	1,578.20	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	1,572.51	ft	Downstream Invert	1,572.21	ft
Length	30.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	3.90	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.29	ft
Velocity Downstream	8.66	ft/s	Critical Slope	0.023546	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.035	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 5 ft		Rise	5.00	ft
Number Sections	6				

Outlet Control Properties					
Outlet Control HW Elev	1,578.20	ft	Upstream Velocity Head	1.04	ft
Ke	0.50		Entrance Loss	0.52	ft

Inlet Control Properties					
Inlet Control HW Elev	1,578.11	ft	Flow Control	N/A	
Inlet Type	90 and 15 ° wingwall flares		Area Full	300.0	ft²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	2	
C	0.04000		Equation Form	1	
Y	0.80000				

Culvert Calculator Report
TV 7,W11RCBC on Javalina Trail Q=950cfs 2

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	1,575.40	ft	Headwater Depth/ Height	1.19	
Computed Headwater Elevation	1,575.40	ft	Discharge	997.86	cfs
Inlet Control HW Elev	1,574.90	ft	Tailwater Elevation	1,574.11	ft
Outlet Control HW Elev	1,575.40	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	1,570.65	ft	Downstream Invert	1,570.35	ft
Length	30.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	3.76	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.68	ft
Velocity Downstream	6.63	ft/s	Critical Slope	0.022780	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.035	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 4 ft		Rise	4.00	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev	1,575.40	ft	Upstream Velocity Head	0.66	ft
Ke	0.40		Entrance Loss	0.26	ft

Inlet Control Properties					
Inlet Control HW Elev	1,574.90	ft	Flow Control	N/A	
Inlet Type45 ° bevels; 10 - 45 ° skewed headwall			Area Full	160.0	ft²
K	0.49800		HDS 5 Chart	11	
M	0.66700		HDS 5 Scale	4	
C	0.03270		Equation Form	2	
Y	0.75000				

Culvert Calculator Report
TV 7 CSP,Q=52cfs, Granite Mountain Rd 3

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,580.50	ft	Headwater Depth/ Height	1.69	
Computed Headwater Elevation	1,580.88	ft	Discharge	52.00	cfs
Inlet Control HW Elev	1,580.20	ft	Tailwater Elevation	1,580.20	ft
Outlet Control HW Elev	1,580.88	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	1,576.65	ft	Downstream Invert	1,576.35	ft
Length	30.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	Pressure		Depth, Downstream	3.85	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	1.41	ft
Velocity Downstream	3.53	ft/s	Critical Slope	0.034904	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.035	
Section Material	CMP		Span	2.50	ft
Section Size	30 inch		Rise	2.50	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev	1,580.88	ft	Upstream Velocity Head	0.19	ft
Ke	0.50		Entrance Loss	0.10	ft

Inlet Control Properties					
Inlet Control HW Elev	1,580.20	ft	Flow Control	N/A	
Inlet Type	Headwall		Area Full	14.7	ft^2
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Culvert Calculator Report
TV 7, RCBC, Channel one,@ RanchoVistaDr. 4

Solve For: Headwater Elevation

Culvert Summary				
Allowable HW Elevation	1,555.19 ft		Headwater Depth/ Height	0.94
Computed Headwater Elevation	1,555.41 ft		Discharge	1,136.00 cfs
Inlet Control HW Elev	1,554.89 ft		Tailwater Elevation	1,554.89 ft
Outlet Control HW Elev	1,555.41 ft		Control Type	Outlet Control

Grades				
Upstream Invert	1,550.69 ft		Downstream Invert	1,550.39 ft
Length	30.00 ft		Constructed Slope	0.010000 ft/ft

Hydraulic Profile				
Profile	M1		Depth, Downstream	4.50 ft
Slope Type	Mild		Normal Depth	2.87 ft
Flow Regime	Subcritical		Critical Depth	2.23 ft
Velocity Downstream	4.21 ft/s		Critical Slope	0.020824 ft/ft

Section				
Section Shape	Box		Mannings Coefficient	0.035
Section Material	Concrete		Span	12.00 ft
Section Size	12 x 5 ft		Rise	5.00 ft
Number Sections	5			

Outlet Control Properties				
Outlet Control HW Elev	1,555.41 ft		Upstream Velocity Head	0.31 ft
Ke	0.50		Entrance Loss	0.15 ft

Inlet Control Properties				
Inlet Control HW Elev	1,554.89 ft		Flow Control	N/A
Inlet Type	90 and 15 ° wingwall flares		Area Full	300.0 ft²
K	0.06100		HDS 5 Chart	8
M	0.75000		HDS 5 Scale	2
C	0.04000		Equation Form	1
Y	0.80000			

Culvert Calculator Report
TV7 RCBC, Granite Mntn. Rd.Q=750cfs 5

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	1,575.26	ft	Headwater Depth/ Height	1.04	
Computed Headwater Elevation	1,575.43	ft	Discharge	750.00	cfs
Inlet Control HW Elev	1,575.31	ft	Tailwater Elevation	1,573.77	ft
Outlet Control HW Elev	1,575.43	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	1,571.26	ft	Downstream Invert	1,570.96	ft
Length	30.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	2.81	ft
Slope Type	Steep		Normal Depth	1.57	ft
Flow Regime	N/A		Critical Depth	2.38	ft
Velocity Downstream	7.41	ft/s	Critical Slope	0.002880	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	12.00	ft
Section Size	12 x 4 ft		Rise	4.00	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev	1,575.43	ft	Upstream Velocity Head	1.19	ft
Ke	0.50		Entrance Loss	0.60	ft

Inlet Control Properties					
Inlet Control HW Elev	1,575.31	ft	Flow Control	N/A	
Inlet Type	90 and 15 ° wingwall flares		Area Full	144.0	ft²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	2	
C	0.04000		Equation Form	1	
Y	0.80000				

EASEMENTS

Easement 1&2 - Worksheet for Trianglular Channel
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement 1 & :
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

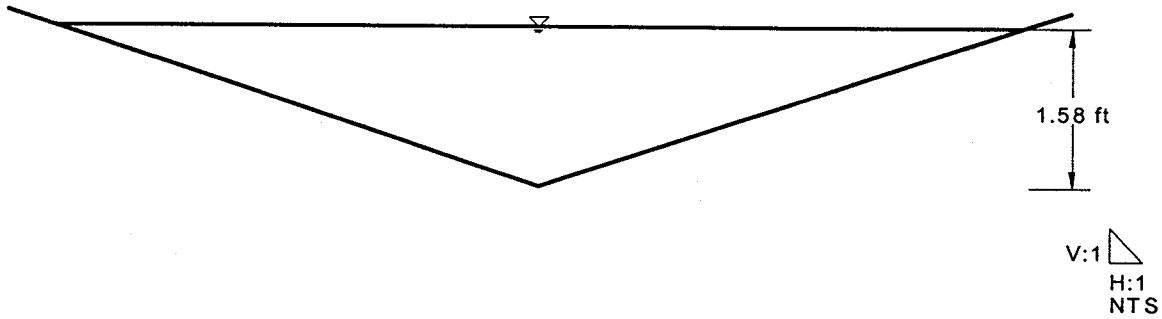
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Discharge	31.00	cfs

Results		
Depth	1.58	ft
Flow Area	7.6	ft²
Wetted Perimeter	10.09	ft
Top Width	9.58	ft
Critical Depth	1.45	ft
Critical Slope	0.015625	ft/ft
Velocity	4.09	ft/s
Velocity Head	0.26	ft
Specific Energy	1.84	ft
Froude Number	0.81	
Flow Type	Subcritical	

Cross Section for Easements 1 & 2
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement 1 & :
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	1.58	ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Discharge	31.00	cfs



Easement 3 - Worksheet for Trianglular Channel
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement :
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

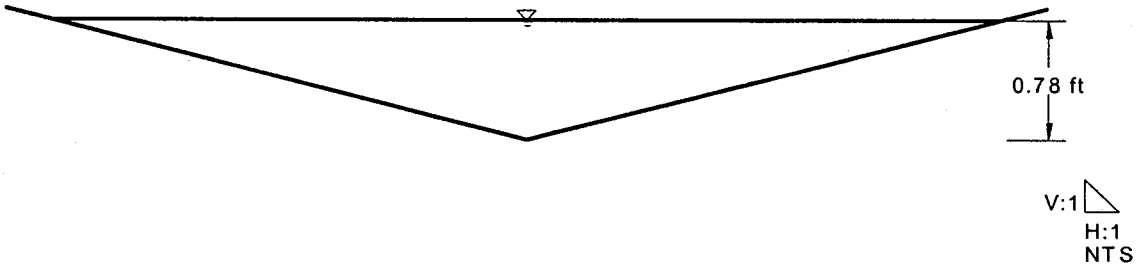
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	6.20	cfs

Results		
Depth	0.78	ft
Flow Area	2.4	ft²
Wetted Perimeter	6.39	ft
Top Width	6.20	ft
Critical Depth	0.68	ft
Critical Slope	0.019530	ft/ft
Velocity	2.58	ft/s
Velocity Head	0.10	ft
Specific Energy	0.88	ft
Froude Number	0.73	
Flow Type	Subcritical	

Cross Section for Easement 3
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement :
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

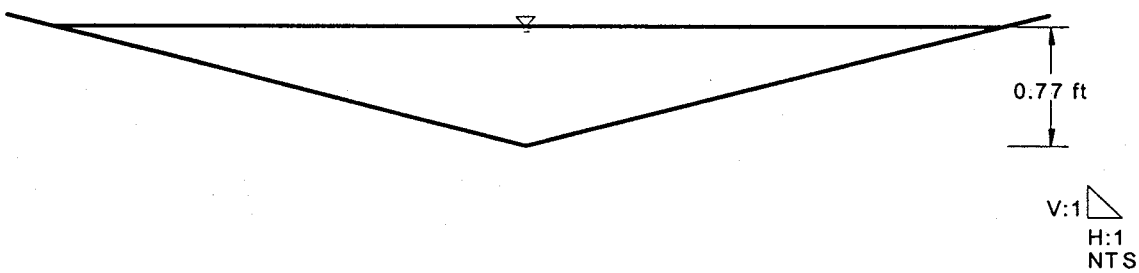
Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.78	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	6.20	cfs



Cross Section for Easement 4
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

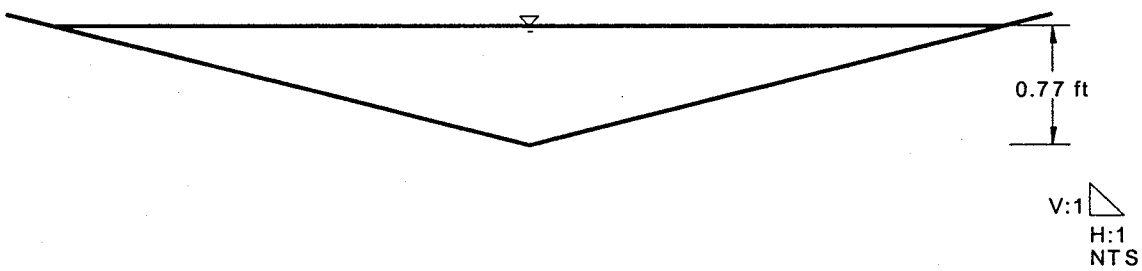
Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.77	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	6.00	cfs



Cross Section for Easement 4
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

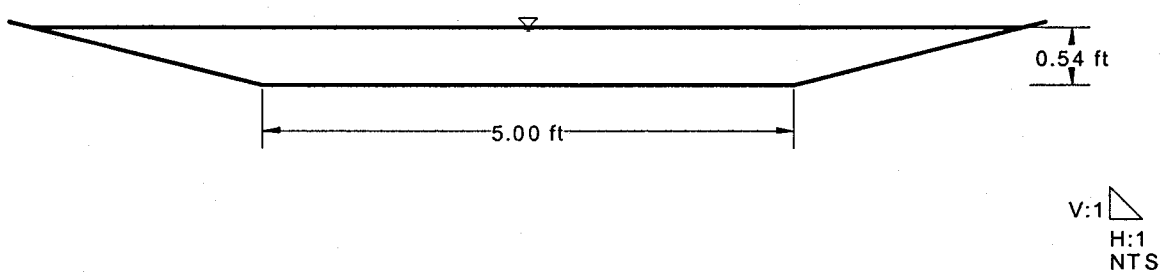
Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.77	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	6.00	cfs



Cross Section for Easement 5
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

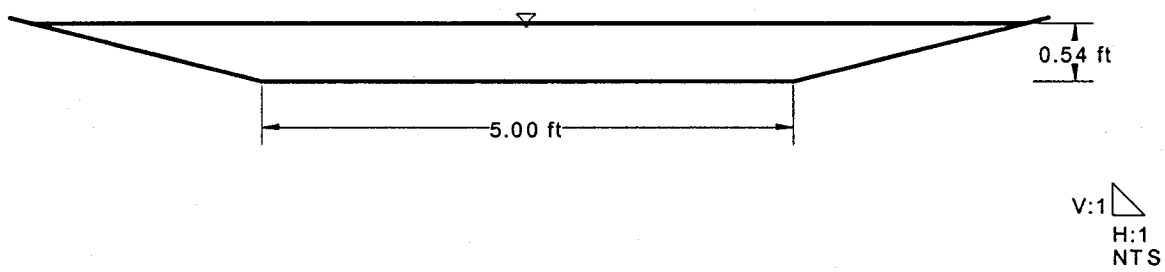
Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.54	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	5.00	ft
Discharge	10.70	cfs



Cross Section for Easement 5
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.54	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	5.00	ft
Discharge	10.70	cfs



Worksheet for Easement 6
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

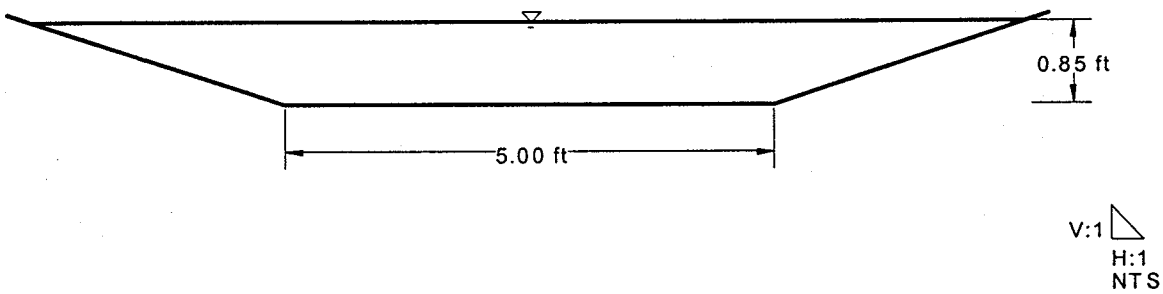
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	22.90	cfs

Results		
Depth	0.85	ft
Flow Area	6.4	ft²
Wetted Perimeter	10.40	ft
Top Width	10.12	ft
Critical Depth	0.74	ft
Critical Slope	0.016391	ft/ft
Velocity	3.58	ft/s
Velocity Head	0.20	ft
Specific Energy	1.04	ft
Froude Number	0.79	
Flow Type	Subcritical	

Cross Section for Easement 6
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.85	ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	22.90	cfs



Worksheet for Easement 7
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

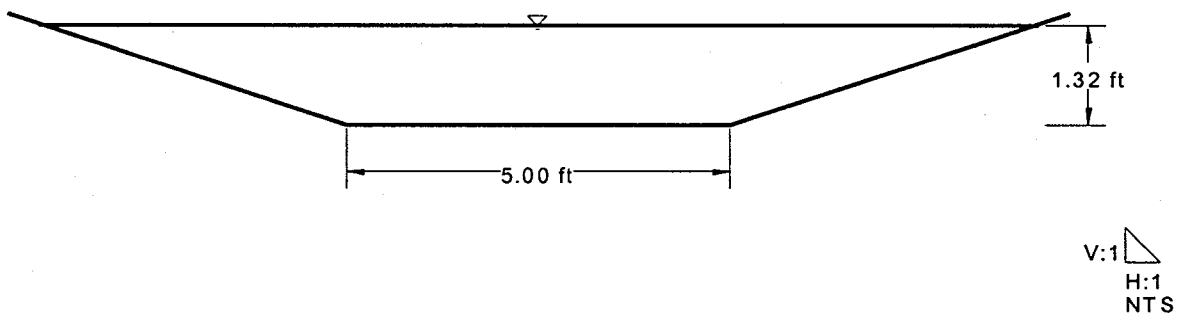
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	54.40	cfs

Results		
Depth	1.32	ft
Flow Area	11.9	ft²
Wetted Perimeter	13.44	ft
Top Width	13.01	ft
Critical Depth	1.20	ft
Critical Slope	0.014445	ft/ft
Velocity	4.57	ft/s
Velocity Head	0.32	ft
Specific Energy	1.65	ft
Froude Number	0.84	
Flow Type	Subcritical	

Cross Section for Easement 7
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	1.32	ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	54.40	cfs



Worksheet for Easement 8
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

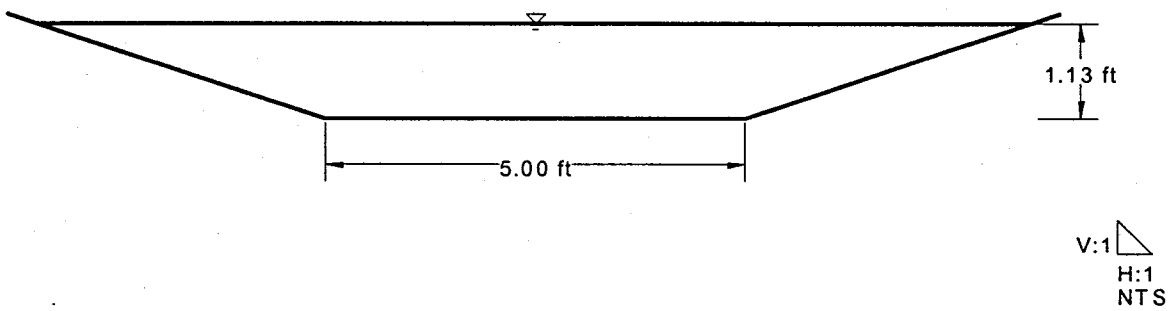
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	40.00	cfs

Results		
Depth	1.13	ft
Flow Area	9.5	ft²
Wetted Perimeter	12.22	ft
Top Width	11.85	ft
Critical Depth	1.02	ft
Critical Slope	0.015094	ft/ft
Velocity	4.20	ft/s
Velocity Head	0.27	ft
Specific Energy	1.40	ft
Froude Number	0.83	
Flow Type	Subcritical	

Cross Section for Easement 8
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	1.13	ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	40.00	cfs



Worksheet for Easement 9
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

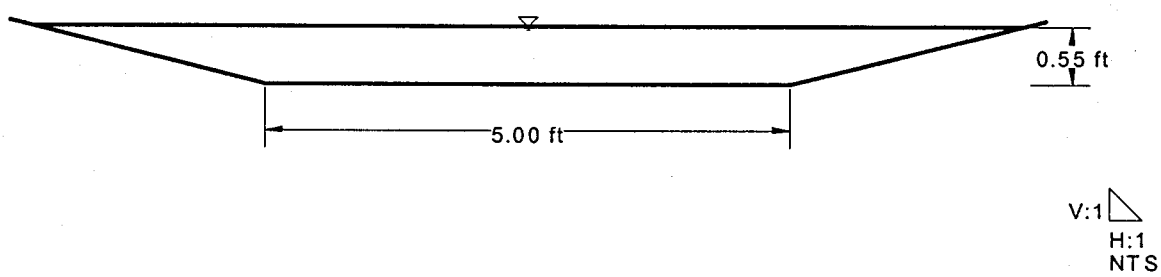
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	5.00	ft
Discharge	10.90	cfs

Results		
Depth	0.55	ft
Flow Area	4.0	ft²
Wetted Perimeter	9.53	ft
Top Width	9.40	ft
Critical Depth	0.46	ft
Critical Slope	0.018671	ft/ft
Velocity	2.76	ft/s
Velocity Head	0.12	ft
Specific Energy	0.67	ft
Froude Number	0.75	
Flow Type	Subcritical	

Cross Section for Easement 9
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.55	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	5.00	ft
Discharge	10.90	cfs



Worksheet for Easement 10
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement 1
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

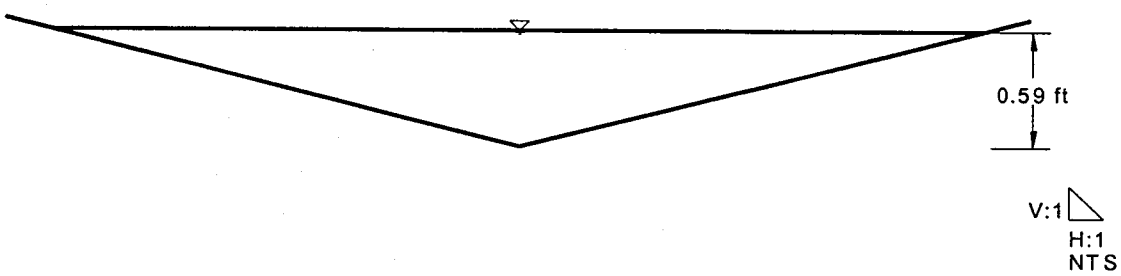
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	3.00	cfs

Results		
Depth	0.59	ft
Flow Area	1.4	ft²
Wetted Perimeter	4.87	ft
Top Width	4.72	ft
Critical Depth	0.51	ft
Critical Slope	0.021515	ft/ft
Velocity	2.15	ft/s
Velocity Head	0.07	ft
Specific Energy	0.66	ft
Froude Number	0.70	
Flow Type	Subcritical	

Cross Section for Easement 10
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement 1
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.59	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	3.00	cfs



Worksheet for Easement 11
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

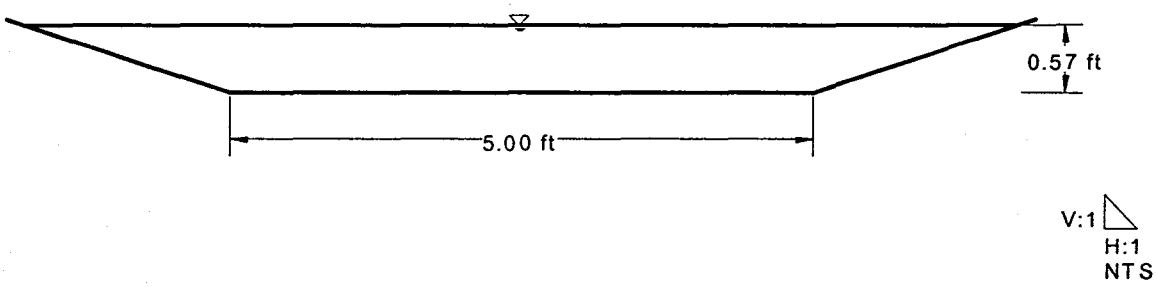
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	11.00	cfs

Results		
Depth	0.57	ft
Flow Area	3.8	ft²
Wetted Perimeter	8.63	ft
Top Width	8.45	ft
Critical Depth	0.48	ft
Critical Slope	0.018391	ft/ft
Velocity	2.88	ft/s
Velocity Head	0.13	ft
Specific Energy	0.70	ft
Froude Number	0.75	
Flow Type	Subcritical	

Cross Section for Easement 11
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.57	ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	11.00	cfs



Worksheet for Easement 12
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

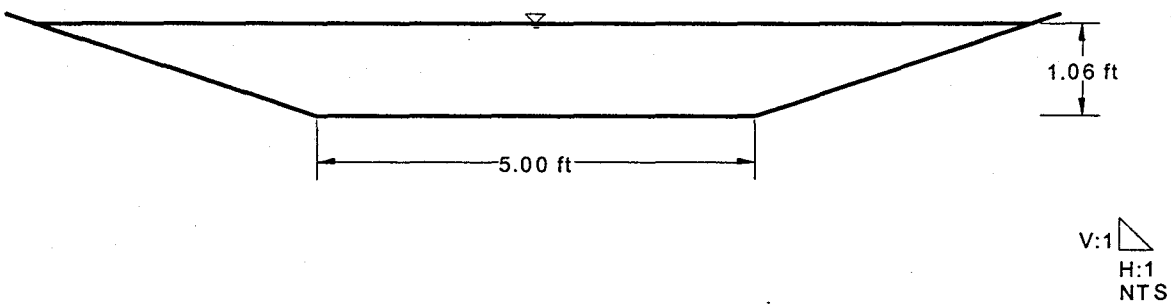
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	35.00	cfs

Results		
Depth	1.06	ft
Flow Area	8.7	ft²
Wetted Perimeter	11.74	ft
Top Width	11.40	ft
Critical Depth	0.94	ft
Critical Slope	0.015389	ft/ft
Velocity	4.04	ft/s
Velocity Head	0.25	ft
Specific Energy	1.31	ft
Froude Number	0.82	
Flow Type	Subcritical	

Cross Section for Easement 12
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Easement 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	1.06	ft
Left Side Slope	0.33	V : H
Right Side Slope	0.33	V : H
Bottom Width	5.00	ft
Discharge	35.00	cfs



SWALES

Trapezoidal Channel - Swale 1
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Swale 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.015000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	3.00	ft
Discharge	25.70	cfs

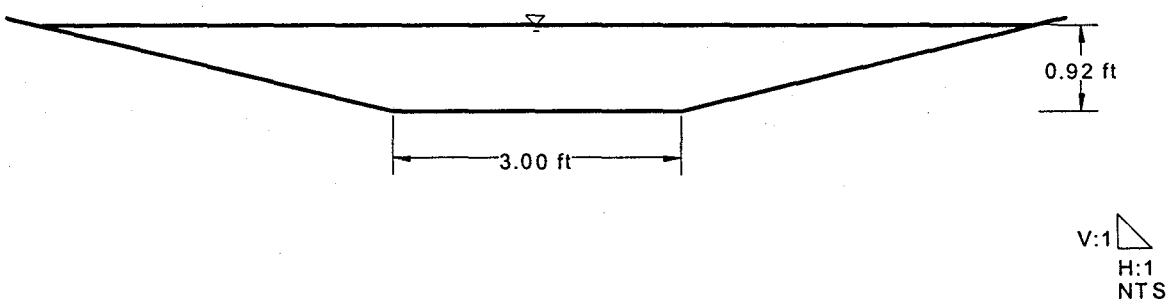
Results		
Depth	0.92	ft
Flow Area	6.1	ft²
Wetted Perimeter	10.55	ft
Top Width	10.33	ft
Critical Depth	0.90	ft
Critical Slope	0.016162	ft/ft
Velocity	4.21	ft/s
Velocity Head	0.28	ft
Specific Energy	1.19	ft
Froude Number	0.97	
Flow Type	Subcritical	

Notes: Use 4 inch to 6 inch round rock in all swales.

Cross Section for Trapezoidal Channel - Swale 1
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Swale 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.015000	ft/ft
Depth	0.92	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	3.00	ft
Discharge	25.70	cfs



Trapezoidal Channel - Swale 2
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Swale 2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

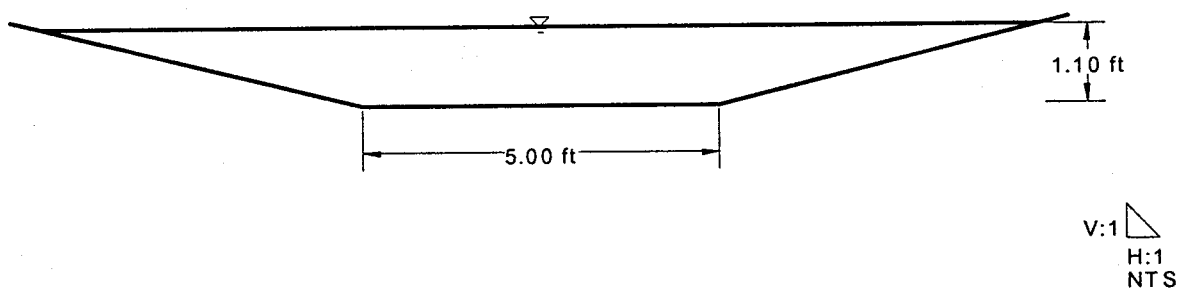
Input Data		
Mannings Coefficient	0.030	
Slope	0.015000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	5.00	ft
Discharge	51.30	cfs

Results		
Depth	1.10	ft
Flow Area	10.4	ft²
Wetted Perimeter	14.09	ft
Top Width	13.82	ft
Critical Depth	1.11	ft
Critical Slope	0.014796	ft/ft
Velocity	4.95	ft/s
Velocity Head	0.38	ft
Specific Energy	1.48	ft
Froude Number	1.01	
Flow Type	Supercritical	

Cross Section for Trapezoidal Channel - Swale 2
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Swale 2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.015000	ft/ft
Depth	1.10	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	5.00	ft
Discharge	51.30	cfs



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Triangular Channel - Swale 3
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 3
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

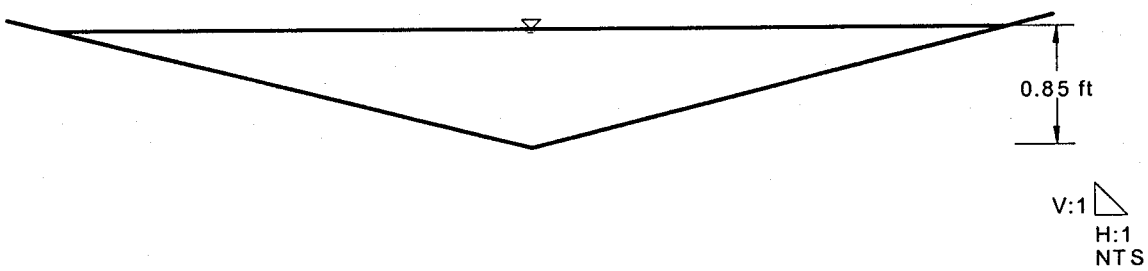
Input Data		
Mannings Coefficient	0.030	
Slope	0.020000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	11.10	cfs

Results		
Depth	0.85	ft
Flow Area	2.9	ft^2
Wetted Perimeter	6.98	ft
Top Width	6.77	ft
Critical Depth	0.86	ft
Critical Slope	0.018071	ft/ft
Velocity	3.87	ft/s
Velocity Head	0.23	ft
Specific Energy	1.08	ft
Froude Number	1.05	
Flow Type	Supercritical	

Cross Section for Triangular Channel Swale 3
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 3
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.020000	ft/ft
Depth	0.85	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	11.10	cfs



Triangular Channel - Swale 4
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 4
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

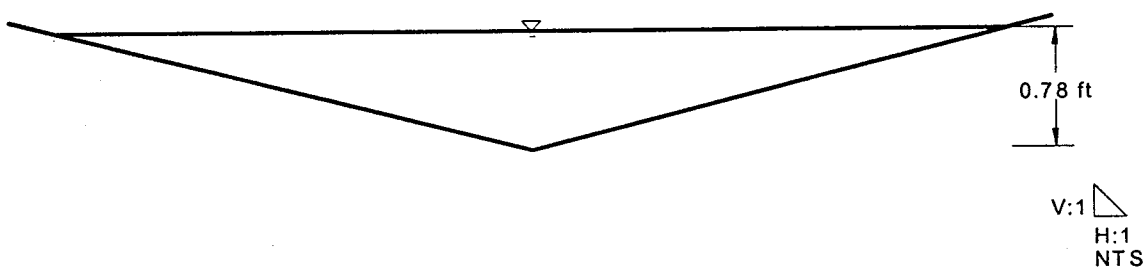
Input Data		
Mannings Coefficient	0.030	
Slope	0.030000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	11.10	cfs

Results		
Depth	0.78	ft
Flow Area	2.5	ft²
Wetted Perimeter	6.47	ft
Top Width	6.28	ft
Critical Depth	0.86	ft
Critical Slope	0.018071	ft/ft
Velocity	4.51	ft/s
Velocity Head	0.32	ft
Specific Energy	1.10	ft
Froude Number	1.27	
Flow Type	Supercritical	

Cross Section for Triangular Channel Swale 4
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 4
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.030000	ft/ft
Depth	0.78	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	11.10	cfs



Triangular Channel - Swale 5
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 5
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

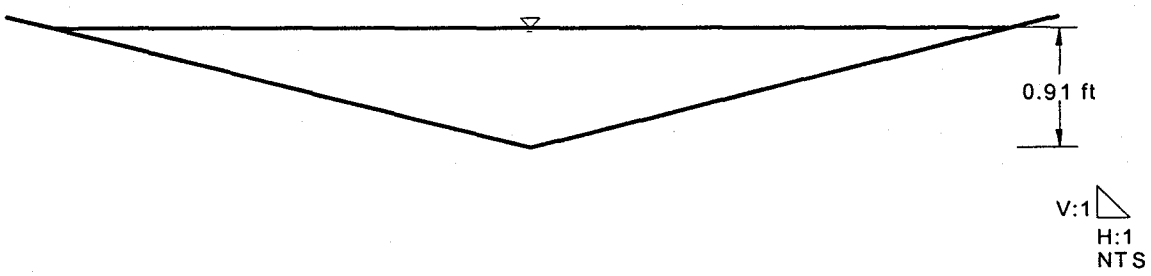
Input Data		
Mannings Coefficient	0.030	
Slope	0.017500	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	12.60	cfs

Results		
Depth	0.91	ft
Flow Area	3.3	ft²
Wetted Perimeter	7.51	ft
Top Width	7.28	ft
Critical Depth	0.91	ft
Critical Slope	0.017768	ft/ft
Velocity	3.80	ft/s
Velocity Head	0.22	ft
Specific Energy	1.13	ft
Froude Number	0.99	
Flow Type	Subcritical	

Cross Section for Triangular Channel Swale 5
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 5
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.017500	ft/ft
Depth	0.91	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	12.60	cfs



Trapezoidal Channel - Swale 6
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Swale 6
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.017500	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	3.00	ft
Discharge	22.60	cfs

Results		
Depth	0.83	ft
Flow Area	5.2	ft²
Wetted Perimeter	9.85	ft
Top Width	9.64	ft
Critical Depth	0.84	ft
Critical Slope	0.016453	ft/ft
Velocity	4.31	ft/s
Velocity Head	0.29	ft
Specific Energy	1.12	ft
Froude Number	1.03	
Flow Type	Supercritical	

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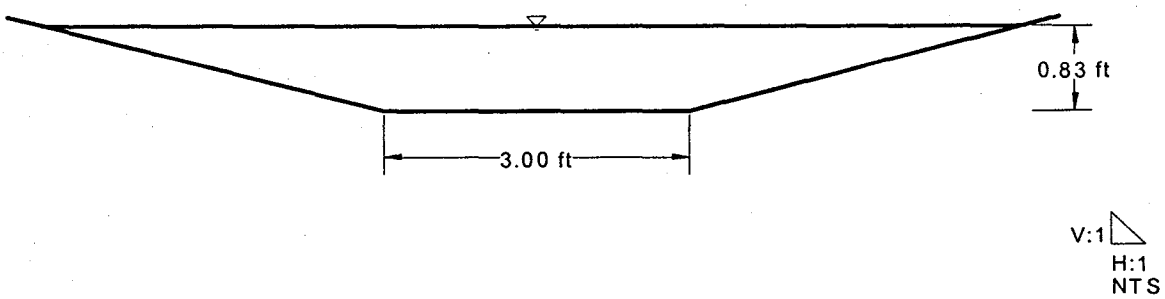
Cross Section for Trapezoidal Channel - Swale 6
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Swale 6
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.017500	ft/ft
Depth	0.83	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	3.00	ft
Discharge	22.60	cfs



Triangular Channel - Swale 7
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 7
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.017500	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	18.80	cfs

Results		
Depth	1.06	ft
Flow Area	4.5	ft²
Wetted Perimeter	8.72	ft
Top Width	8.46	ft
Critical Depth	1.07	ft
Critical Slope	0.016845	ft/ft
Velocity	4.20	ft/s
Velocity Head	0.27	ft
Specific Energy	1.33	ft
Froude Number	1.02	
Flow Type	Supercritical	

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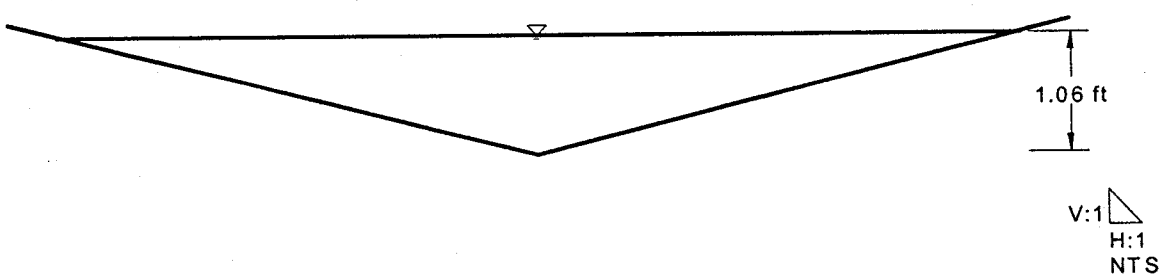
Cross Section for Triangular Channel Swale 7
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 7
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.017500	ft/ft
Depth	1.06	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	18.80	cfs



Triangular Channel - Swale 8
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 8
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

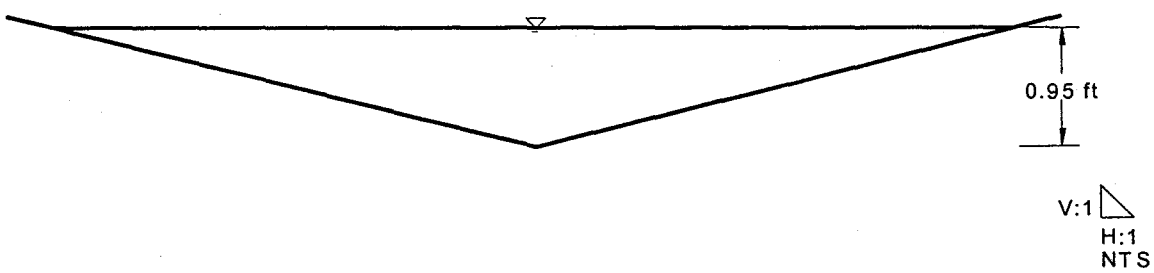
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	10.80	cfs

Results		
Depth	0.95	ft
Flow Area	3.6	ft²
Wetted Perimeter	7.87	ft
Top Width	7.64	ft
Critical Depth	0.85	ft
Critical Slope	0.018137	ft/ft
Velocity	2.96	ft/s
Velocity Head	0.14	ft
Specific Energy	1.09	ft
Froude Number	0.76	
Flow Type	Subcritical	

Cross Section for Triangular Channel Swale 8
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 8
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.95	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	10.80	cfs



Triangular Channel - Swale 9
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 9
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

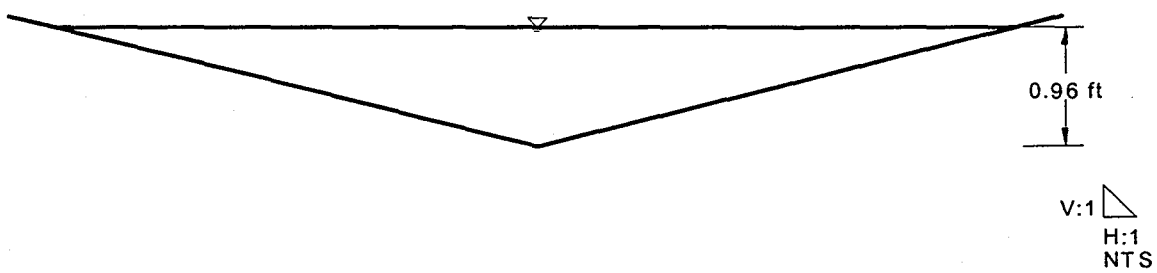
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	11.00	cfs

Results		
Depth	0.96	ft
Flow Area	3.7	ft²
Wetted Perimeter	7.92	ft
Top Width	7.69	ft
Critical Depth	0.86	ft
Critical Slope	0.018093	ft/ft
Velocity	2.98	ft/s
Velocity Head	0.14	ft
Specific Energy	1.10	ft
Froude Number	0.76	
Flow Type	Subcritical	

Cross Section for Triangular Channel Swale 9
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 9
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.96	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	11.00	cfs



Worksheet for Easement 10
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement 1
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

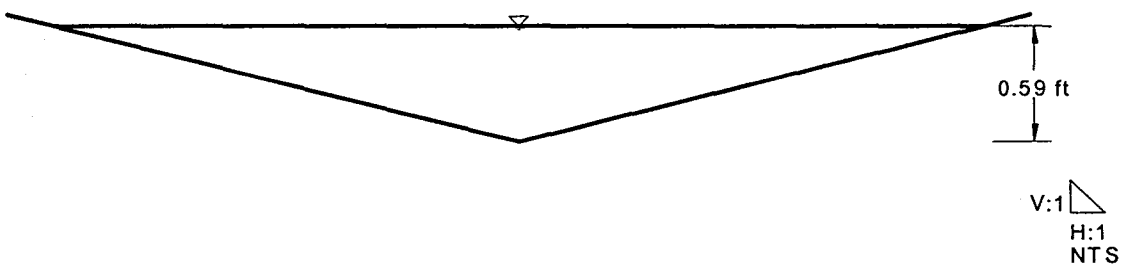
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	3.00	cfs

Results		
Depth	0.59	ft
Flow Area	1.4	ft^2
Wetted Perimeter	4.87	ft
Top Width	4.72	ft
Critical Depth	0.51	ft
Critical Slope	0.021515	ft/ft
Velocity	2.15	ft/s
Velocity Head	0.07	ft
Specific Energy	0.66	ft
Froude Number	0.70	
Flow Type	Subcritical	

Cross Section for Easement 10
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Easement 1
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	0.59	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	3.00	cfs



Trapezoidal Channel - Swale 11
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Swale 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

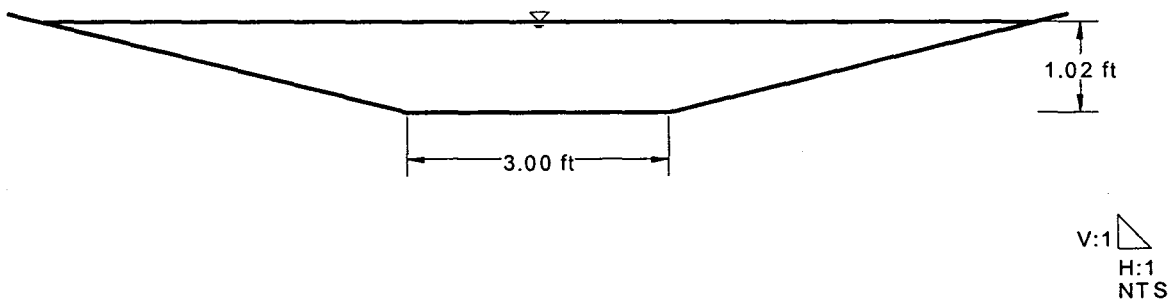
Input Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	3.00	ft
Discharge	26.30	cfs

Results		
Depth	1.02	ft
Flow Area	7.2	ft²
Wetted Perimeter	11.40	ft
Top Width	11.15	ft
Critical Depth	0.91	ft
Critical Slope	0.016111	ft/ft
Velocity	3.65	ft/s
Velocity Head	0.21	ft
Specific Energy	1.23	ft
Froude Number	0.80	
Flow Type	Subcritical	

Cross Section for Trapezoidal Channel - Swale 11
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - Swale 1'
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.010000	ft/ft
Depth	1.02	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	3.00	ft
Discharge	26.30	cfs



Triangular Channel - Swale 12
Worksheet for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 12
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

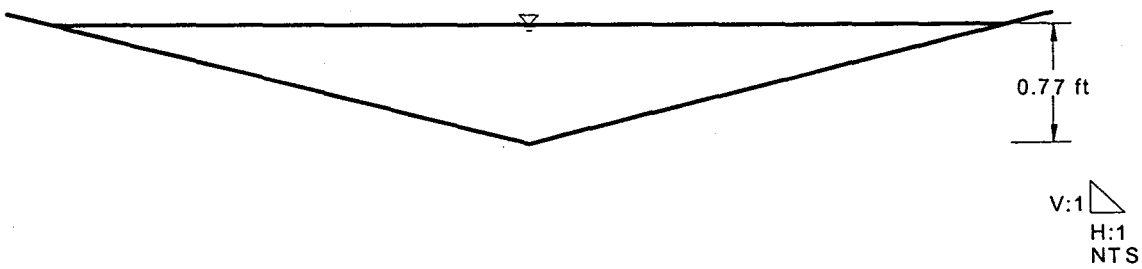
Input Data		
Mannings Coefficient	0.030	
Slope	0.020000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	8.70	cfs

Results		
Depth	0.77	ft
Flow Area	2.4	ft²
Wetted Perimeter	6.37	ft
Top Width	6.18	ft
Critical Depth	0.78	ft
Critical Slope	0.018668	ft/ft
Velocity	3.64	ft/s
Velocity Head	0.21	ft
Specific Energy	0.98	ft
Froude Number	1.03	
Flow Type	Supercritical	

Cross Section for Triangular Channel Swale 12
Cross Section for Triangular Channel

Project Description	
Worksheet	Triangular Channel - Swale 12
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Slope	0.020000	ft/ft
Depth	0.77	ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Discharge	8.70	cfs



DIP for channel 2 @ Granite Mtn. Rd and Rancho Vista Drive
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	DIP for channel 2 @ Granite Mtn.Rd and RanchoVista Dr
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.016700	ft/ft
Left Side Slope	0.05	V : H
Right Side Slope	0.05	V : H
Bottom Width	100.00	ft
Discharge	90.00	cfs

Results		
Depth	0.30	ft
Flow Area	32.3	ft²
Wetted Perimeter	112.18	ft
Top Width	112.17	ft
Critical Depth	0.29	ft
Critical Slope	0.020230	ft/ft
Velocity	2.79	ft/s
Velocity Head	0.12	ft
Specific Energy	0.43	ft
Froude Number	0.92	
Flow Type	Subcritical	

BROOKS, HERSEY AND ASSOCIATES, INC.
ENGINEERS/SURVEYORS
4602 E. Elwood Street, 16
Phoenix, Arizona 85040
(602) 437-3733

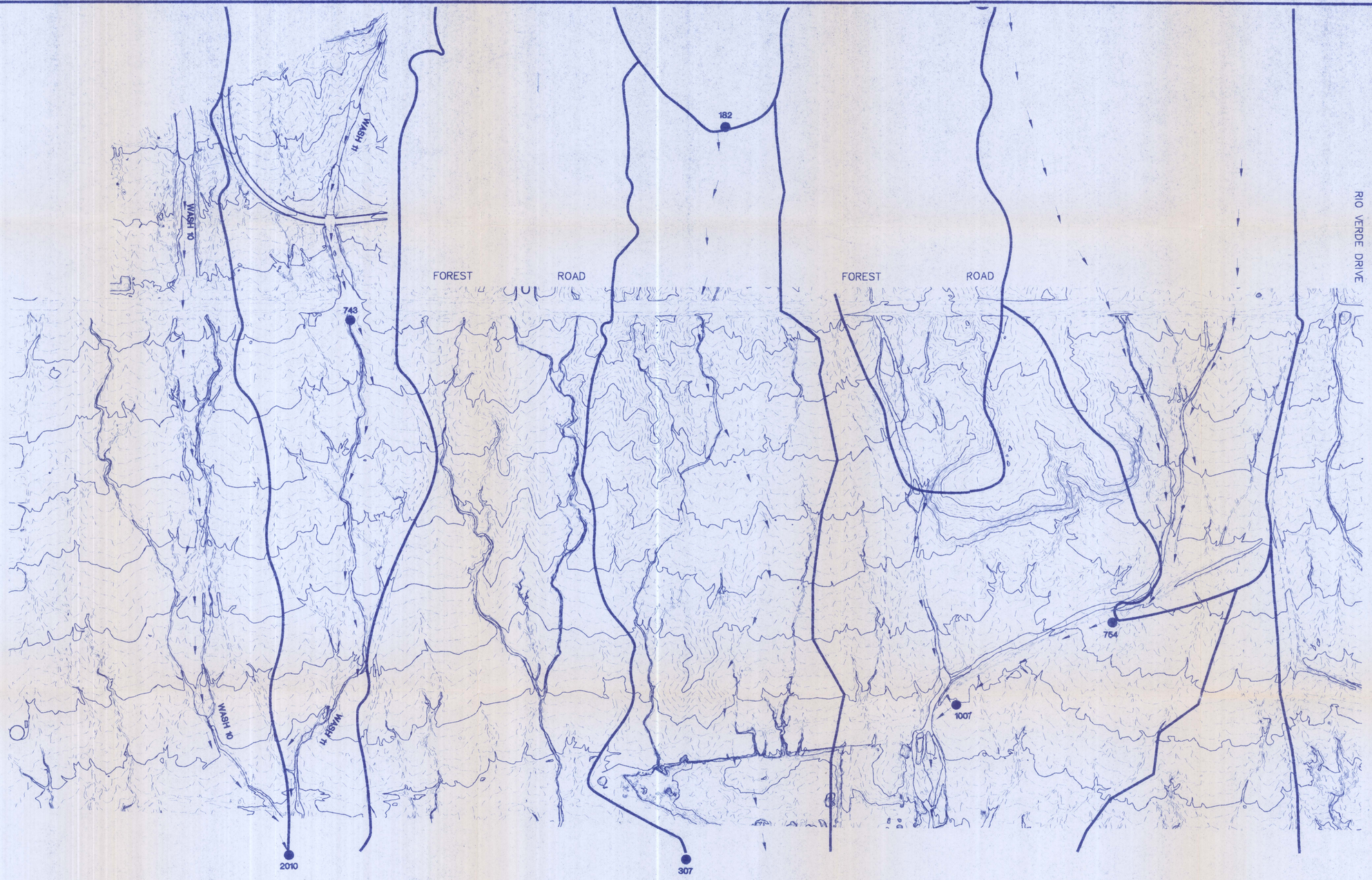
25005
L. (LUTE)
OBAIDI
DATE SIGNED 12/24/98
Arizona U.S.A.

TONTO VERDE UNIT 7 PROPOSED DRAINAGE MAP

DESIGN:	LO
DRAWN:	GZ
CHECK:	LO
SCALE:	
HORZ:	1"=200'
VERT:	N/A

JOB NO. 519-16FP DATE: 12/24/98 SHEET 2 OF 2

XREF: G:\PROJECTS\519-16TM\DRAINAGE\TV-Y-DRN&TON-TRY&TON-Y-ON&TONTO
XREF: G:\PROJECTS\519-16TM\DRAINAGE\TV-Y-DRN&TON-TRY&TON-Y-ON&TONTO
FILE: G:\PROJECTS\519-16TM\DRAINAGE
PLOT: -DRPRO PATH: G:\PROJECTS\519-16TM\DRAINAGE



LEGEND:

- 5' CONTOUR
- 1' CONTOUR
- SUB-BASIN DRAINAGE DIVIDE
- FLOW DIRECTION

N

SCALE

200 0 100 200

HORIZ: 1" = 200'

BROOKS, HERSEY AND ASSOCIATES, INC.
ENGINEERS/SURVEYORS
4602 E. Elwood Street, 16
Phoenix, Arizona 85040
(602) 437-3733

REGISTERED PROFESSIONAL ENGINEER (CIVIL) 25005 L. (LUTE) OBADE DATE SIGNED 8-26-98 ARIZONA U.S.A.

TONTO VERDE
UNIT 7
EXISTING DRAINAGE MAP

DESIGN:	LO
DRAWN:	GZ
CHECK:	LO
SCALE:	
HORZ:	1"=200'
VERT:	N/A

JOB NO. 519-16TM DATE: 8/26/98 SHEET 1 OF 2

XREF: C:\PROJECTS\519-16TM\DRAINAGE\TV-X-DRN&TON-TRY&TON-X-ONE&TONTO
8/26/98 SERFER
PLOT: 1"=1" GZ
PLOT-STYLE PATH: C:\PROJECTS\519-16TM\DRAINAGE