APPENDIX VII-9

SEEP AND SPRING INVENTORY (DESCRIPTION AND PHOTOS)

SEEP AND SPRING INVENTORY

The following list is a compilation of springs and seeps in the Smoky Mountain region that have been investigated between October 1988 and May 1992. Photos are attached in the back of this report.

BRETTS SPRING

Location: T41S, R3E, SW 1/4 Section 32

Bretts Spring is shown but not named on the USGS 7 1/2' topographic map and the BLM 1:100,000 map. The spring is near Tibbet spring and occurs from the Drip Tank member of the Straight Cliffs formation. Water appears to emanate from the bottom of a small drainage. Water was not flowing when visited on 10/17/88 but had a slight flow (about 1 gpm) during the 2/5/92 visit. Flow appears along a 20' interval of the drainage bottom. Further downstream there was no sign of seepage or dampness. An efflorescence was present along the bottom the drainage. There was evidence of use by cattle at this site. Cottonwood trees grow along the side of the drainage in the area where the seepage occurs.

Refer to Figure 4.

CLINTS SPRING

Location: T41S, R3E, SW 1/4 Section 20

This spring is shown on the USGS 7 1/2' and BLM 1:100,000 maps. Water emanates from the Drip Tank member in the bottom of the drainage for a distance of about 50. This spring was visited on 10/18/88 and 2/5/92. Flow was estimated to be 3-5 gpm on both occasions. The flow from the spring continued down the channel for 200-300' before disappearing. Evidence of use by cattle was present on both visits.

Refer to Figure 4.

DRIP TANK SPRING

Location: T40S, R3E, NE 1/4 Section 24

Drip Tank Spring is shown on the USGS 7 1/2' and BLM 1:100,000 maps. The spring in located in Drip Tank Canyon, a tributary of Last Chance Creek. Water emanates from cracks in the sandstone wall beneath an overhang and forms a pool directly beneath. The site was being utilized by cattle during the 2/5/92 visit. Flow was estimated at about 3-5 gpm during the 10/17/88 visit but was lower (about 2 gpm) when visited on 2/5/92. Flow appears to emanate from bedding planes of the Drip Tank member. An efflorescence followed the flow downstream from the spring. Cottonwood trees are growing along the side of the drainage.

Refer to Figure 4.

14 NORTH SPRING

Location: T42S, R3E, NW 1/4 Section 14

Two seeps emanate at this location from the Calico Sandstone bed where it is exposed in the bottom of Tibbet Canyon. The seep in the main drainage was called 14 North and the seep emanating from the side canyon was called 14 South. A very slight flow was detected at each seep. A heavy efflorescence is present around the seep and down stream for about 1000' although the flow only continues 200-300' downstream. These springs are shown on the USGS 7 1/2' and BLM 1:100,000 maps. Flow was estimated at less than 1 gpm for each spring. Evidence of use by cattle and wildlife was present.

Refer to Figure 4.

14 SOUTH SPRING

Location: T42S, R3E, NW 1/4 Section 14

Refer to discussion for 14 North Spring.

JOHN HENRY SPRING

Location: T41S, R3E, NW 1/4 Section 20

This spring is shown on the USGS 7 1/2' and BLM 1:100,000 maps. Visits to the site were made on 10/17/88 and 2/5/92. The spring appears as seepage along the bottom of the wash from the Drip Tank member. A perceptible flow (about 4 gpm) was present during both visits. Cottonwood trees grow along the sides of the wash where the seepage emanates. Efflorescence is present in and along the wash below the spring. Evidence of use by cattle was present.

Refer to Figure 5.

NEEDLE EYE WATER

Location: T41S, R4E, SW 1/4 Section 4

Needle Eye Water is shown on the USGS 7 1/2' and BLM 1:100,000 map. The site was visited on 10/17/88 and 2/5/92 and has development structures associated with it. A catchment pond has been built around the source and is filled with grasses and cattails. No water was visible in the catchment pond on either visit. There appears to be pipes that run from the catchment pond (which is fenced off) to a watering basin below. Water appears to emanate from the side of the canyon within the Drip Tank member. There did not appear to be much usage at this site by cattle or wildlife during the 2/5/92 visit. Several tamarisk bushes were growing in the area but vegetation was generally sparse.

Refer to Figure 5.

SECTION 10 SPRING

Location: T42S, R3E, NE 1/4 Section 10

A spring is shown on the USGS 7 1/2' and BLM 1:100,000 map at this location. However, a search of the area found no evidence of a spring, seep, efflorescence, trees, unusual vegetation or signs of cattle or wildlife use. This site was visited on 10/17/88 and 2/5/92 and produced no evidence of water on either occasion. This site is located within the John Henry member of the Straight Cliffs formation. No other seeps or springs have been found to occur within this geologic unit. The notation of a spring at this location on the USGS/BLM maps is apparently incorrect.

Refer to Figure 5.

TIBBET SPRING

Location: T41S, R3E, NW 1/4 Section 32

Tibbet Spring was visited on 10/17/88 and again on 2/5/92. The spring is named on both the USGS 7 1/2' and BLM 1:100,000 maps and is probably the most highly developed spring of those investigated. The spring has been developed to be used as a filling point for portable water tanks. Portable tanks, piping, culverts and valves are present. The main catchment pond is fenced off to prevent entry by cattle. The spring does not have a measurable flow however, the drainage below the catchment pond has a low trickle of water which disappears a short distance down the wash. The wash is not damp beyond. A small grove of cottonwood trees surrounds the catchment pond and cattails are growing within the catchment pond. Flow at this site occurs from near the base of the Drip Tank member.

Refer to Figure 5.

The following locations were investigated during a seep and spring inventory of the permit area conducted by Roger Holland on 9/29/90. Sites were identified by studying aerial photographs, topographic maps and by hiking in the field. Sites were noted if they had at least one of the following characteristics: anomalous vegetation, efflorescence, dampness or standing water.

CALICO SEEP

Location: T42S, R3E, NW 1/4 Section 1

The Calico Seep was first visited on 10/18/88 and regular quarterly monitoring for this site began during the fourth quarter of 1989. Collection of a sample at this location is difficult because the seep occurs as a diffused dampness about 30 feet above the canyon floor along a steep slope. Samples are collected by catching drips beneath the small overhangs along the outcrop. The Calico Sandstone bed is located at the top of the Smoky Hollow member and is about 25' thick throughout the permit area. The Calico bed is located approximately 150' vertically below the coal seam to be mined and is separated by an interval of interbedded sandstone and shale. Seepage from the Calico bed has been found at only one other location in Tibbet Canyon (refer to the discussion for 14 North and 14 South springs).

Refer to Figure 3.

SEEP S-1

Location: NE 1/4 NW 1/4 Section 20, T41S, R4E

This site is located at the bottom of two converging drainages containing colluvial material. Geologically, the site is within the upper part of the Drip Tank member. Tamarisk was present in the bottom of the drainage but no water was observed. There was some speculation as to the source of the moisture. The colluvium in the bottom of the drainage may collect and store surface water runoff thus mimicking a seep. No wildlife usage was noted. The site was visited again in 2/5/92. No water was visible. Because of the location near the top of Smoky Mountain, the vegetation is probably a result of surface water infiltration and concentration in low, colluvium fill area. Due to the lack of flow at the site no monitoring other than visible observations has been conducted. Refer to Figure 1.

SEEP S-2

Location: Center of NW 1/4 Section 20, T41S, R4E

Seep S-2 is located at the base of a massive paleochannel in the Drip Tank member. Drips from the channel form a small pool (6' long x 4' wide x 2" deep) beneath the sandstone ledge. No water flowed from the pool. Vegetation such as reeds and bull thistle were found around the ledge. Access to the pool is very restrictive making the source inaccessible to all but small animals. This site has been monitored on a quarterly basis since the first quarter of 1991.

Refer to Figure 1.

SEEP S-3

Location: NE 1/4 NE 1/4 Section 14, T41S, R3E

This location was noted because of the surface coatings on the sandstone. No standing or flowing water was observed. The area is within the Drip Tank member and is near the base of a thick paleochannel sandstone. No anomalous vegetation was noted. No animal tracks or trails were observed. Due to the lack of water, this site does not appear to be a water resource and has not been included in the monitoring program.

Refer to Figure 3.

SEEP S-4

Location: NW 1/4 NE 1/4 Section 18, T41S, R4E

Seep S-4 is located at the base of a thick paleochannel sandstone in the upper portion of the Drip Tank member. Small vegetation grows around the seep. The seep consists of wet sandstone and a few small drips. No pool formed beneath the drips. No sign of wildlife use was present. This site has been monitored since the first quarter of 1991.

Refer to Figure 2.

SEEP S-5

Location: NW 1/4 NE 1/4 Section 23, T41S, R3E

This site was noted because of the damp sandstone and the surface coatings on the sandstone. As the site is located in the upper portion of the Drip Tank member, the dampness may have be related to surface runoff. Only a minor increase in vegetation was observed and no wildlife usage was noted. This site did not appear to be a source of water and has not been included in the monitoring program

Refer to Figure 3.

ADD FIGURES 1-5 HERE
(PHOTOS OF SEEPS AND SPRINGS)

APPENDIX VII-10

RENEWABLE RESOURCE LAND SURVEY

RENEWABLE RESOURCE LAND SURVEY

Renewable resource lands are by definition; "aquifers and areas for the recharge of aquifers and other underground waters, areas for agricultural or silvicultural production of food and fiber, and grazing lands". In the permit and adjacent area, land use primarily consists of grazing land.

The following discussions describe resources found in the area with regard to agriculture, ground water, surface water and food and fiber.

Surface Water Resources

Surface water is available in and around the proposed permit area only following significant precipitation events. Storm events are infrequent and unpredictable. The precipitation falls and runs off rapidly. Attempts to store runoff in catchment basins has not been very successful due to a high infiltration/evaporation rate as well as the high sediment load which quickly diminishes storage capacity in the small catchment structures.

Water is hauled to the top of Smoky Mountain from Big Water when it is required for uses such as exploration drilling.

Ground Water Resources

Two formal ground water surveys have been conducted in the region in and around the proposed permit area. The first survey was performed in September 1990 by Roger Holland, Consulting Geologist. Mr. Holland had worked on the exploration drilling program logging holes that summer. In addition, he has been performing the surface and ground water monitoring since August of 1989. The second survey was performed by EarthFax Engineering, Inc. and Roger Holland in February 1992.

A survey was conducted in September 1990, by Roger Holland, to determine the extent of ground water to be found within and adjacent to the proposed permit area. Refer to Appendix VII-1 for the complete report. The survey covered an area that extended at least one quarter mile beyond the boundary of the 30 year mine plan shown on Exhibit V-5A. Survey methodology incorporated aerial photographs, topographic and geologic structure maps. In this survey, 5 areas that were damp or showed efflorescence were located and photographed. Sampling was not feasible due to the lack of flow from sites S-2 and S-4. Due to the lack of dampness and indicator vegetation, it was decided that S-1, S-3 and S-5 were not water resources and monitoring would not be continued on them.

Seep S-2 was located at the base of a massive sandstone channel. Access from the top was prohibitive due to the steep rock cliff above. The route from the bottom involved climbing up steep slopes and massive boulders. A small pool of water, approximately 6' x 4' x 2" deep is hidden behind vegetation and the sandstone overhang. Tracks at the site indicate the water may be utilized by smaller mammals but would be infeasible for cattle watering.

Seep S-4 is located at the base of a thick sandstone channel in the upper portion of the Drip Tank member. Drips from the seep did not form a pool so a bucket was placed under the drips to collect the water.

The sites were visited again in February, 1991 and a sample obtained from S-2 (the small pool). Not enough water was available at S-4 so a container was placed below the seep to collect the drips. No water was apparent at S-1.

Another seep and spring survey was conducted during the week of February 3, 1992. In order to more fully evaluate ground water conditions in the region, the survey expanded much further from the permit boundary to springs located from one to five miles away. The survey included those seeps identified in the September 1990 survey plus all the springs shown to exist on topographic maps within 5 miles of the permit boundary. No resources other than those identified in the September 1990 survey were located in or near the permit area. Refer to Appendix VII-9 for a ground water inventory of the region. The springs, listed in Table VII-1, were visited, sampled and photographed. Refer to Chapter VII, R645-301-724 Baseline Information, for details on the seep and spring surveys and sample analyses.

The springs were located primarily on the downdip outcrop of the Drip Tank member of the Straight Cliffs formation or near the synclinal trough of the Warm Creek syncline. Seeps were found in the Calico Bed of the Smoky Hollow member of the Straight Cliffs formation at the outcrop in the bottom of Wesses Canyon and canyon wall in Smoky Hollow. Refer to Figure VII-13 for a stratigraphic column. None of the springs produced a flow greater than 4 gallons per minute. It would be unlikely that the seeps and springs located outside of the proposed permit area would be affected by the proposed mining activity.

Exploratory drilling in the 1960's and 1970's has provided hydrologic information for the area that has been used to create a hydrologic model for the permit and adjacent areas. The occurrence and availability of ground water in the Straight Cliffs Formation appears to be controlled primarily by structure. As shown on Exhibit VI-3, the Smoky Mountain Anticline plunges to the northwest against the regional drainage pattern. The dip of the flanks and plunge of the nose of the anticline preclude water from accumulating in the beds of the anticline. Water instead migrates toward the Warm Creek and Last Chance Synclines from the structural high (Smoky Mountain Anticline).

Observations made during the drilling program were often estimates of ground water flow, however, note can be made that water was encountered more often and in greater quantities in drill holes located near the bottom of the Warm Creek and Last Chance Synclines and near the plunging nose of the Smoky Mountain Anticline forming a horse-shoe shaped zone around the Smoky Mountain Anticline. Figures VII-10, VII-11, VII-12, VII-14 display the affect structure has on the regional ground water. Water migrates from the structural highs to the structurally low areas and form springs or seeps where the water-carrying formations outcrop in the canyons.

A total of 202 drill holes were drilled on 1/4 mile spacing through out the lease area. Of the 84 drill holes in the permit area only 24 (29%) exhibited moisture in the hole. Of the 24, 9 (38%) were located in the extreme western portion of the permit area near the axis of the Warm Creek Syncline. This occurrence would be expected due to the accumulation of water near the trough of the syncline. Eight of the 24 holes (33%) were within or adjacent to the bottom of the Smoky Hollow drainage.

The remaining seven holes that exhibited moisture occurred at various locations within the permit area. In only one case did two "wet" holes occur adjacent to each other. The perched saturated zones appear to be discontinuous and without correlation between drill holes.

Recharge to the perched zones is primarily through joints and fractures in the overlying formations. Direct infiltration is limited by the high evapotranspiration and the low precipitation within the region. According to Blanchard (1986), the potential groundwater recharge for the drainages in the Kaiparowits Plateau between the Escalante and Paria River drainages (i.e., the region that includes the permit and adjacent areas) is estimated to be approximately 3,000 acre-feet per year. Over the 1,670 square mile area, this represents an average of only 1 gpm/mi^2. The area within and adjacent to the permit area is not an area of significance for groundwater recharge to regional aquifers or perched zones.

Direct infiltration is also restricted by low permeability of the beds within the Straight Cliffs formation. Doelling and Davis (1989) describe the barren zones (stratigraphic sequences above and below the coal seam) as thick-bedded to massive cliff-forming sandstones with interbeds of mudstone, thin, friable to blocky sandstone beds and thin limestone beds. The U.S. BLM (1976) estimates the Straight Cliffs formation in the Smoky Mountain area to be more than 50 percent shale, mudstone, carbonaceous shale and coal. These repeated sequences of interbedded sandstones and mudstones greatly limit the potential of the Straight Cliffs formation as being a significant aquifer. Refer to Chapter VII, R645-301-724 Baseline Information for additional information of the permeability of mudstone above the coal seam to be mined.

In the Probable Hydrologic Consequences (PHC), Chapter VII, R645-301-728, interception of perched groundwater lenses is discussed as a potential impact due to subsidence. Because the perched groundwater zones are isolated and not hydraulically connected to any regional aquifer, the effect of dewatering perched zones on the hydrologic balance will be minimal.

Seeps S-2 and S-4 could be impacted by subsidence. However, since neither seep produce a measurable flow, the seeps are not considered a major source of water and the impact to the area, should subsidence affect them, would very minimal. Should subsidence cracks intercept either seep, there is a strong possibility that the clays within the strata will swell and seal the crack.

It is unlikely that the seeps and springs located outside of the permit area will be affected by the mining process because they are outside of the zone of subsidence and not hydraulically connected to the perched zones within the permit area. The closest spring, Needle Eye Water, is located more than 2 miles outside of the zone of subsidence for the mining area (refer to Exhibits V-8 and VII-5).

The Calico Sandstone bed lies approximately 150' below the coal seam to be mined and averages about 25' thick in the vicinity of the permit area. Seeps occur in Tibbet Canyon and Smoky Hollow where the Calico bed is exposed near the canyon bottom. Both locations have flow rates less than 1 gpm. There are no known water supply wells in the Calico bed (or other members of the Straight Cliffs formation) within or adjacent to the permit area.

In February 1992, a slug test was conducted on a monitoring well (MW-1) within the Calico bed. Results show the hydraulic conductivity of the Calico bed to be 0.2 ft/day at this site. A short term pumping test conducted in March 1992 which measured a pumping rate of 1/2 gallon per minute from the well. The calculated transmissivity of the Calico bed is sufficiently low to be classified as having poor potential for development as a water supply. Refer to Chapter VII, R645-301-724 Baseline for additional information on the Calico bed.

Agriculture

Historically, the area in and around the permit area has not been used for agricultural production. There is no record of farming in or around the permit area. Both the Soil Conservation Service and the Bureau of Land Management evaluated the area as being unimportant as farmland (refer to Appendix II-3 for their comments). Although the canyons bottoms support vegetation, they are not suitable for farming due to their limited extent and lack of dependable water supply.

On top of Smoky Mountain, there is no record of farming either by the Indians or later settlers. The topography is rolling and no dependable water supply exists. Water is hauled to Smoky Mountain for the purposes of cattle watering and exploration drilling. Transportation of water for agricultural purposes would not be economical. Native vegetation consists primarily of pinyon-juniper trees, grasses and forbs. Precipitation on Smoky Mountain is approximately 8-10 inches per year.

Grazing

The Smoky Mountain area is used primarily for cattle grazing. Water resources in the vicinity, Seeps S-1, S-2 and S-4, have not been developed because they produce insufficient quantities of water to meet the needs for cattle watering. Water resources that have been developed near the permit area are Drip Tank Spring and Needle Eye Water to the north. Cattle were observed around Drip Tank Spring during the February 1992 Seep and Spring Survey. The flow was estimated at 2-5 gallons per minute.

No flow or cattle were observed at Needle Eye Water during the 1992 survey. The site did not appear to be maintained. Subsidence would not impact either the Drip Tank Spring or Needle Eye Water sources due to their distance from mining activities. Needle Eye Water, the closest of the two is over two miles to the northeast from the maximum extend of projected subsidence.

Should subsidence interrupt the surface area where grazing occurs, the area would be allowed to stabilize prior to regrading and reseeding. The area impacted by subsidence cracks is expected to be minimal and the potential for reseeding the area would be good. Surface effects of subsidence would be limited to panel ends. Broad downwarping throughout the panel area would not impact surface usage by livestock and wildlife.

Summary

The proposed permit and adjacent area do not appear to be significant aquifer recharge areas because of the low precipitation/infiltration rate and the interbedded nature of the flat-lying strata.

Existing groundwater resources within the permit area include S-2 and S-4. However, these seeps have a flow rate too low to measure.

The Calico Bed produces seeps in the bottom of Tibbet and Warm Creek Canyons outside of the proposed permit area. Mining will not impact this bed because it lies approximately 150' below the coal seam to be mined and is separated from the coal seam by interbedded sandstone and shale along with several massive shales beds.

The proposed permit and adjacent areas do not appear to be geographic areas which contribute significantly to the long-range productivity of water supply, food or fiber products or to be aquifer or aquifer recharge areas.

There are no surface water resources in or adjacent to the permit area. The nearest stream that would have flow other that following precipitation events would be Wahweap Creek near the town of Big Water.

Grazing resources would not be significantly affected. Should subsidence interrupt land use due to subsidence cracks, the interruption would only be temporary until the area could be put back into usage by regrading and reseeding the area.

The proposed mining activities would not affect any agricultural use of the land. No silviculture activities have occurred or presently occur in the permit or adjacent areas as there are no forests in the area.

APPENDIX VII-11

ENERGY DISSIPATOR DESIGN

Energy Dissipator for Culvert U-9

Purpose: During the design storm, 100-yr 6-hr, culvert U-9 discharges 770.1 cfs of water. The flow velocity at the culvert outlet is of concern. The energy dissipation system was designed to reduce the culvert outlet velocity to a value representative of the natural channel during the same design storm.

Methods ⇒

Culvert U-9 is enlarged so the velocity of the full flow culvert is approxately equal to the natural channel velocity. To keep the culvert at full flow conditions during the design storm, roughness elements will be installed. The effective roughness, (Manning's n value) is increased by the roughness elements. During low-flow events, the flow velocity is less than full-flow conditions. A gap will be left in the roughness element to prevent sediment build-up. The length of the enlarged culvert segment will be approximately 55 feet. The riprap at the outlet will be designed to accomodate flow velocities slightly greater than the design flow velocity as a factor of safety.

REGISTERED PROFESSIONAL ENGINEER
No. 8435
CAROL A.
BJORK
STATE OF UTAH

Carol A. Bjork
4/7/93

CULVERT U-9 ENERY DISSIPATOR

* Evaluate Natural Channel Section

Because x-section data are not available for the natural channel immediately downstream of culvert U-9 and the sediment pond spillway, an alternative section was chosen. X-section data from location SS-7 were used because this section appeared to be similar in shape to the area downstream of U-9.

The slope downstream of U-9 was measured from the contour map to be .02 ft/foot.

The "Hydro" software program was used to calculate a flow depth and velocity during the peak discharge of 770.10 cfs. A mannings n value of .04 was assumed representative of the main channel.

n = .054
Slope = .02 ft/ft
Q = 770.1 cfs

Results ⇒

flow depth = 6.3'
flow velocity = 7.7 ft/sec

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: FLOW DEPTH FOR Q=770.1 CFS

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,600.00	-25.00
2	4,593.42	-6.30
3	4,592.92	-4.30
4	4,589.12	-4.10
5	4,588.72	-1.30
6	4,588.72	0.00
7	4,588.92	2.70
8	4,589.52	4.70
9	4,590.12	7.70
10	4,590.12	9.70
11	4,592.02	10.70
12	4,593.02	11.70
13	4,593.42	12.10
14	4,600.00	40.00

With a channel slope of 2.00 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
6.30	99.79	35.78	2.79	769.5	7.71

Tailwater depth = 6.3 feet

(x-section data are from survey @ SS-7)

Culvert U-9

Enlarge culvert for some distance (to be determined) upstream of the outlet. The purpose is to increase the flow area and thus decrease exit velocity at outlet. Construct roughness elements in the culvert to force full-flow conditions.

The flow velocity within the natural channel @ Q=770.1 cfs is 7.7 ft/sec. Design culvert so that outlet velocity is approximately equal to 7.7 ft/s.

$$Q = VA \qquad A = \frac{Q}{V} = \frac{770.1 \text{ ft}^3/\text{s}}{7.7 \text{ ft/s}} = 100 \text{ ft}^2$$

$$\text{Culvert area} = \pi r^2 = 100 \text{ ft}^2$$

$$r = 5.64 \text{ ft}$$
$$D = 11.3 \text{ feet}$$

Design for culvert Diameter of 12 feet

Roughness Elements

Reference: U.S. Dept. of Transportation. 1975. "Hydraulic Design of Energy Dissipators for Culverts and Channels." Hydraulic Engineering Circular No. 14. Federal Highway Administration. Washington, D.C.

Methods used are located in Section VII-C of the referenced document.

Design procedure:

Determine the size of the roughness elements to assume that the culvert outlet velocities are approximately 7.7 ft/sec. Determine the effective roughness of the culvert.

$n = .025$ (Smooth Culvert)
$D = 12$ ft. Area $= 113$ ft^2
$Q = 770.1$ cfs
$S = .0143$ (culvert slope)

Trial #1

Determine full flow of 12' smooth culvert:

$$Q_{full} = \frac{.46}{n} (D)^{8/3} (S)^{1/2} = \frac{.46}{.025} (12)^{8/3} (.0143)^{1/2}$$

$$Q_{full} = 1660.7$$

$$V_{full} = \frac{Q_{full}}{Area} = \frac{1660.7 \text{ ft}^3/s}{113 \text{ ft}^2} = 14.7 \text{ ft/s}$$

$Q_{design} = 770.1$ cfs

$Q_{design} / Q_{full} = 770.1 / 1660.7 = .46$

$V_{design} / V_{full} = .98$ (Figure VII-C-3)

$V_{design} = .98(14.7) = 14.4$ ft/s
flow depth $= .48(12) = 5.76$ ft.
} for Smooth culvert at design Q.

* Reduce outlet velocity ⇒

Compute $\frac{n}{D^{1/6}} = \frac{.025}{(12)^{1/6}} = .0165$

Assume $\frac{L}{D_i} = 1$ D_i = effective culvert Diameter

Assume $h = .5'$; $D_i = 11'$

$\frac{h}{D_i} = \frac{.5\ ft}{11\ ft} = .046$

From Figure VII-C-6 : Flow Regime = isolated roughness.

Rough Pipe resistance ⇒

$n_r = n_{ir} = n(D_i/D)^{1/6}\left[1+67.2\,C_D\,(L_r/p)(h/L)\right]^{1/2}$

Assume $\frac{L_r}{p} = .9$ to allow for gap in roughness element for low flows.

Continuous Ring w/gap ← $C_D = 1.9$ for sharp-crested rectangular shapes.

$n_r = .025(11/12)^{1/6}\left[1+67.2(1.9)(.9)(.5/11)\right]^{1/2}$

$n_r = .0615$

* Full flow conditions for rough pipe :

$Q_{full} = \frac{.46}{.0615}(11)^{8/3}(.0143)^{1/2} = 535\ cfs$

$V_{full} = \frac{535}{\pi(11/2)^2} = 5.6\ ft/sec$

$V_{full}\ \left(\frac{0.59}{n_r}\right)\ D_i^{2/3}\ S_o^{1/2}$

9.5935 4.9461 .1195 = 5.8

This design is acceptable; however, another trial will be made with a lower n_r. This will allow a larger Q_{full} value which will minimize upgradient headwater requirements. Keep $\frac{L}{D_i}$ small enough so that the extent of the roughness elements is reasonable, and will be within the section of culvert remaining after reclamation.

Trial # 2

Try $\frac{L}{D_i} = 1.20$

$D_i = 11'$
$h = .5'$
$L = 13'$

$$\frac{h}{D_i} = .046$$

$$n_r = .025\left(\frac{11}{12}\right)^{1/6}\left[1+67.2(1.9)(.9)\left(\frac{.5}{13}\right)\right]^{1/2}$$

$$n_r = .057$$

$$Q_{full} = \frac{.46}{.057}(11)^{8/3}(.0143)^{1/2} = 578 \text{ cfs}$$

$$V_{full} = \frac{578}{\pi(5.5)^2} = 6.1 \text{ ft/s}$$

Design is Adequate

Because Q_{full} is less than Q_{design}, the culvert is under pressure flow during the design event. Check, using the Hazen-Williams Eq., that adequate headwater is available.

Hazen-Williams Formula ⇒

$$v = 1.318\, C_1\, r^{.63}\, s^{.54}$$

(Ref: King, H.W. 1954. Handbook of Hydraulics. McGraw-Hill)

C_1 = roughness coefficient.

The factor 1.318 was introduced to equalize the value of C_1 with the value of C in the Chezy formula. Therefore, $C_1 = c$ (Chezy).

The Chezy C can be correlated to the Manning's roughness coef. by the following equation ⇒

$$C = \frac{1.49}{n} R^{1/6}$$

(Ref: Chow, V.T. 1959. Open-Channel Hydraulics. McGraw-Hill)

For the roughened culvert, $n = .057$

$$C = \frac{1.49}{.057} (6)^{1/6} = 35$$

Use Flowmaster Software to determine head required to pass 770.1 cfs in the roughened culvert.

D_i = 11 ft = 132 inches
Q = 770.1 cfs = 346,545 gpm
C = 35
Length = 100 ft

Results ⇒ 1.23 feet of head is required at the upstream end of the 100 foot culvert length.

Since the slope is 1.43%, a 1.43' head difference will be realized in a 100-foot culvert section. The design is adequate.

Pressure Pipe Analysis & Design
Circular Pipe

Worksheet Name: CULVERT U-9

Comment: PRESSURE FLOW CONDITIONS

Solve For Elevation @ 1

Given Input Data:

Pressure @ 1......	0.00	psi
Elevation @ 2.....	0.00	ft
Pressure @ 2......	0.00	psi
Discharge.........	346545.00	gpm
Diameter..........	132.00	in
Length............	100.00	ft
Hazen-Williams C..	35.00	

Computed Results:

Elevation @ 1.....	1.23	ft
Velocity..........	8.12	fps
Headloss..........	1.23	ft
Energy Grade @ 1..	2.26	ft
Energy Grade @ 2..	1.03	ft
Friction Slope....	12.326	ft/1000 ft

Outlet velocities are calculated assuming the culvert is flowing full for the design storm.

for Dia. = 11 ft (assumes continuouse roughness ring)

$$V_{max} = \frac{770.1\ cfs}{\pi (5.5)^2} = 8.1\ ft/s$$

for Dia. = 12 ft (w/o roughness ring)

$$V_{max} = \frac{770.1}{\pi (6)^2} = 6.8\ ft/s$$

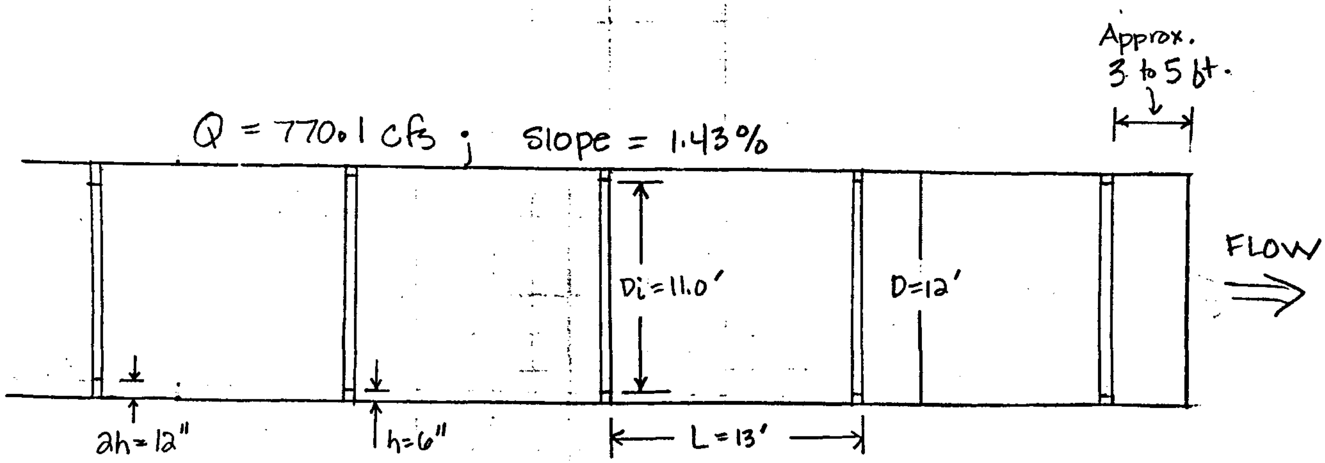
* Since the roughness rings will not be continuous (a gap will be left for low flows) the maximum exit velocity will be slightly less than 8 ft/sec. This velocity at the outlet is <u>acceptable</u>.

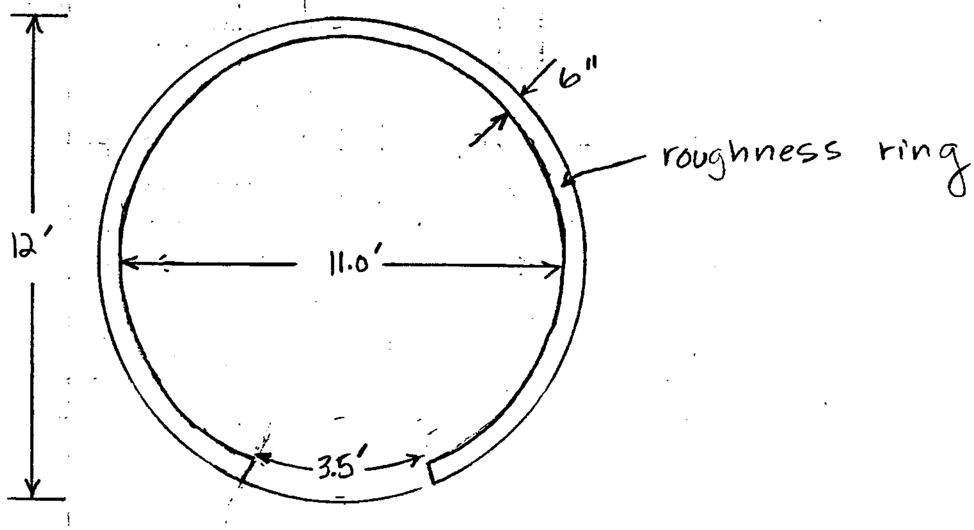
Summary:

$D = 12'$
$D_i = 11'$
$h = 0.5'$
$L = 13'$
$n_r = .057$

Use 5 roughness rings. The first ring should have a height of $2*h = 1.0$ ft.

Q = 770.1 cfs ; slope = 1.43%




6"
roughness ring
12'
11.0'
3.5'

Sedimentation Pond Spillway

Road Culvert outlet Design

Peak Discharge = 114.44 cfs

* Design for two 42-in. diameter culverts, each passing 57.22 cfs.

* Check inlet control: Refer to attached nomograph.

$D = 42''$
$Q = 57.2$ cfs

resulting $\frac{Hw}{D} = 1.1$ (for headwall inlet structure)

Required Headwater depth $= 1.1(42'')$
≈ 46 inches

available headwater > 4ft.

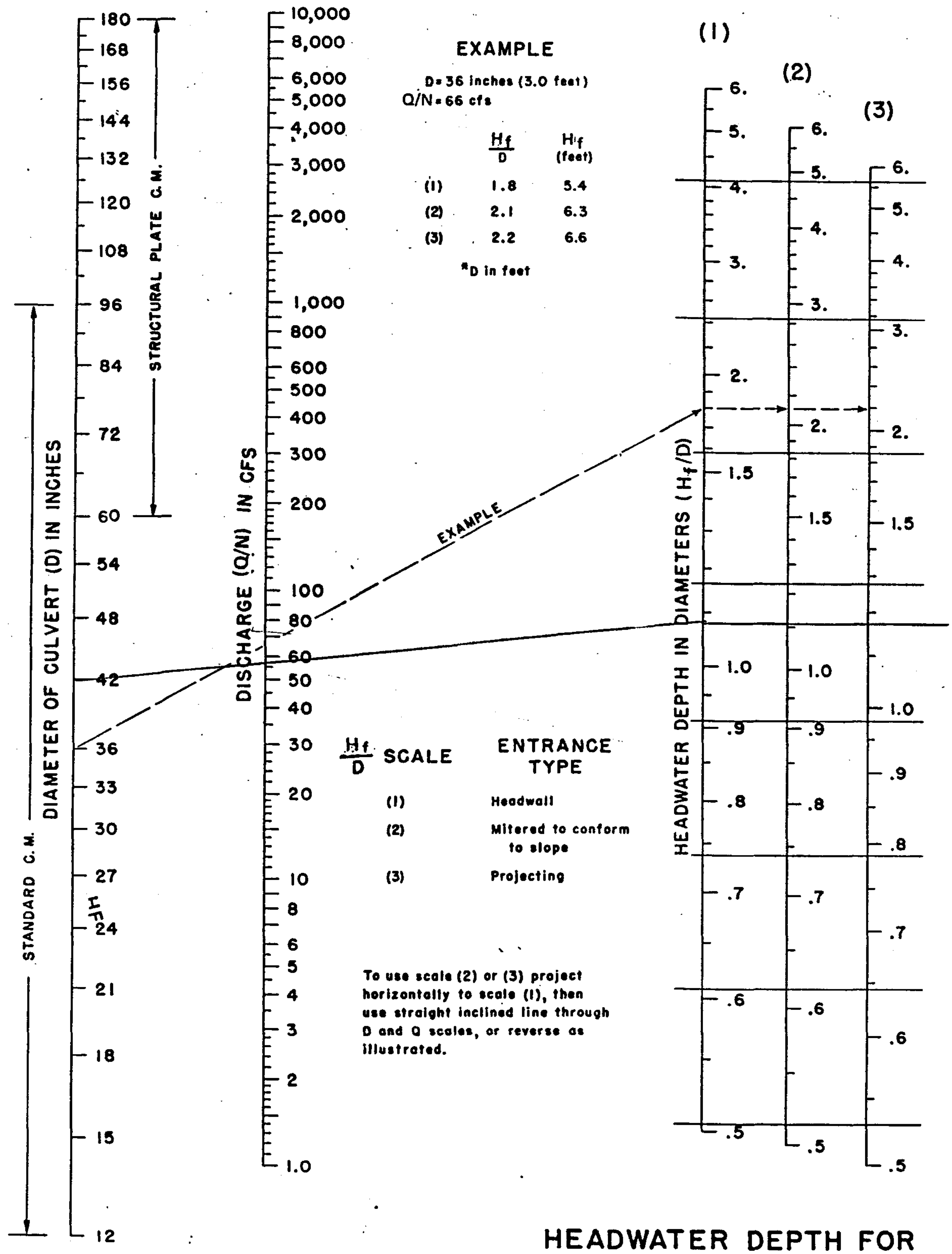
Culvert size is adequate.

Culvert outlets will not be submerged since they will discharge above culvert U-9.

From Manning's equation ⇒
slope = 2.5%
$n = .025$
$Q = 57.2$ cfs
$D = 3.5'$

outlet Velocity = 9.3 ft/sec
Flow Depth = 2.1 feet.

Chart 12



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: ROADWAY CULVERTS

Comment: 42-INCH CULVERT UNDER ROAD FROM SED. POND

Solve For Actual Depth

Given Input Data:

Diameter..........	3.50 ft
Slope.............	0.0250 ft/ft
Manning's n.......	0.025
Discharge.........	57.20 cfs

Computed Results:

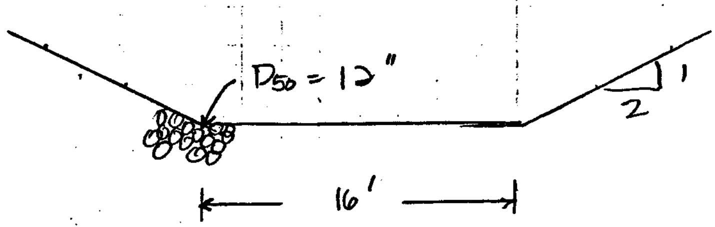
Depth.............	2.14 ft
Velocity..........	9.28 fps
Flow Area.........	6.16 sf
Critical Depth....	2.37 ft
Critical Slope....	0.0187 ft/ft
Percent Full......	61.15 %
Full Capacity.....	82.72 cfs
QMAX @.94D........	88.98 cfs
Froude Number.....	1.22 (flow is Supercritical)

Riprap downstream of culvert U-9

Outlet velocity = 8 ft/sec.

Place riprap with D_{50} = 12 inches downstream of culvert outlet for a length of approximately 15 feet. Transition to a trapezoidal channel that approximates the natural channel section: Bottom width = 16 feet, side slopes = 2H:1V.

From attached figure, for a D_{50} of 12 inches, a maximum velocity of 10.3 feet per second can be accommodated. This assumes 2H:1V side slopes. The channel bottom (with a slope of 2%) can withstand a velocity of 12.3 ft/s. Therefore, 12" rock will be adequate.



TYPICAL CHANNEL SECTION.

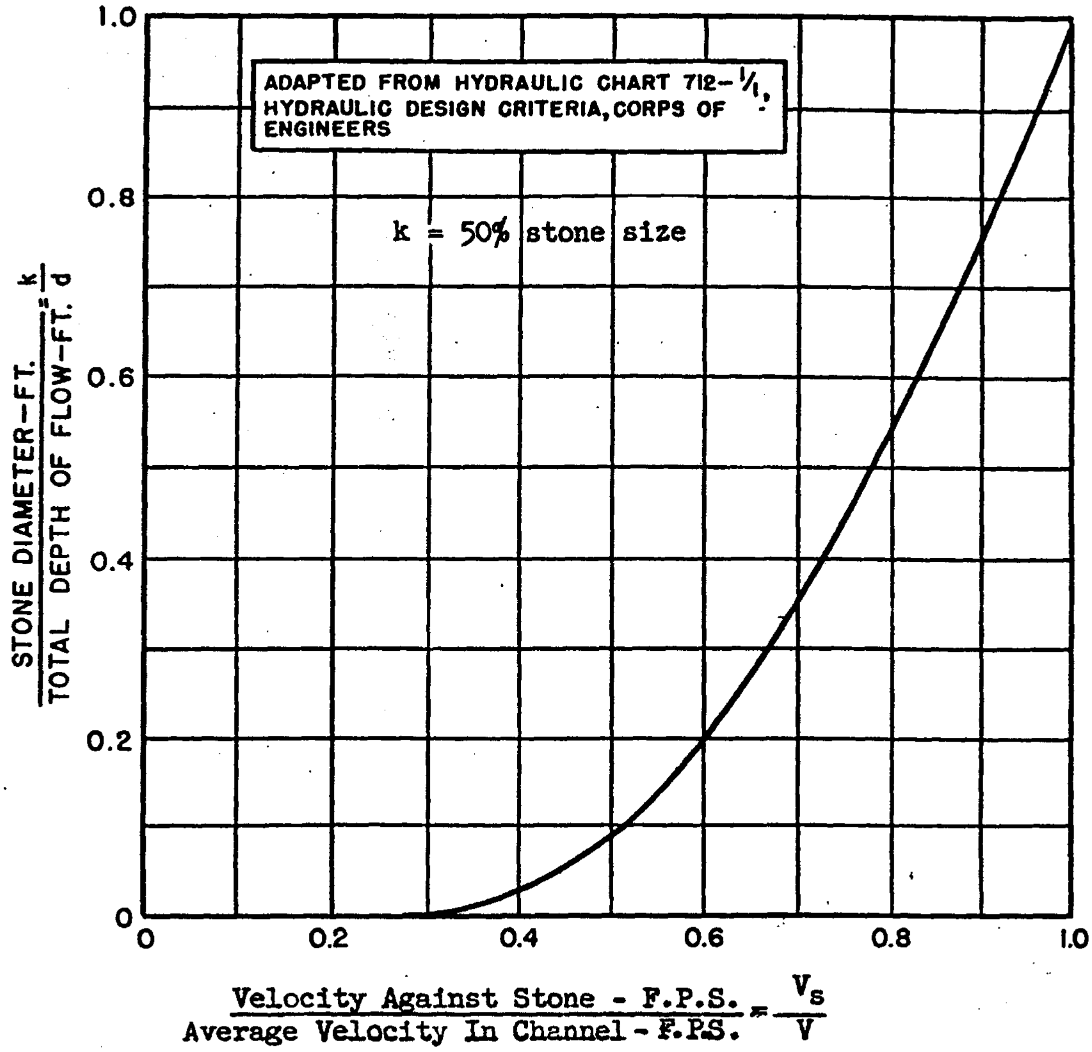


FIG. 1 - VELOCITY AGAINST STONE ON CHANNEL BOTTOM

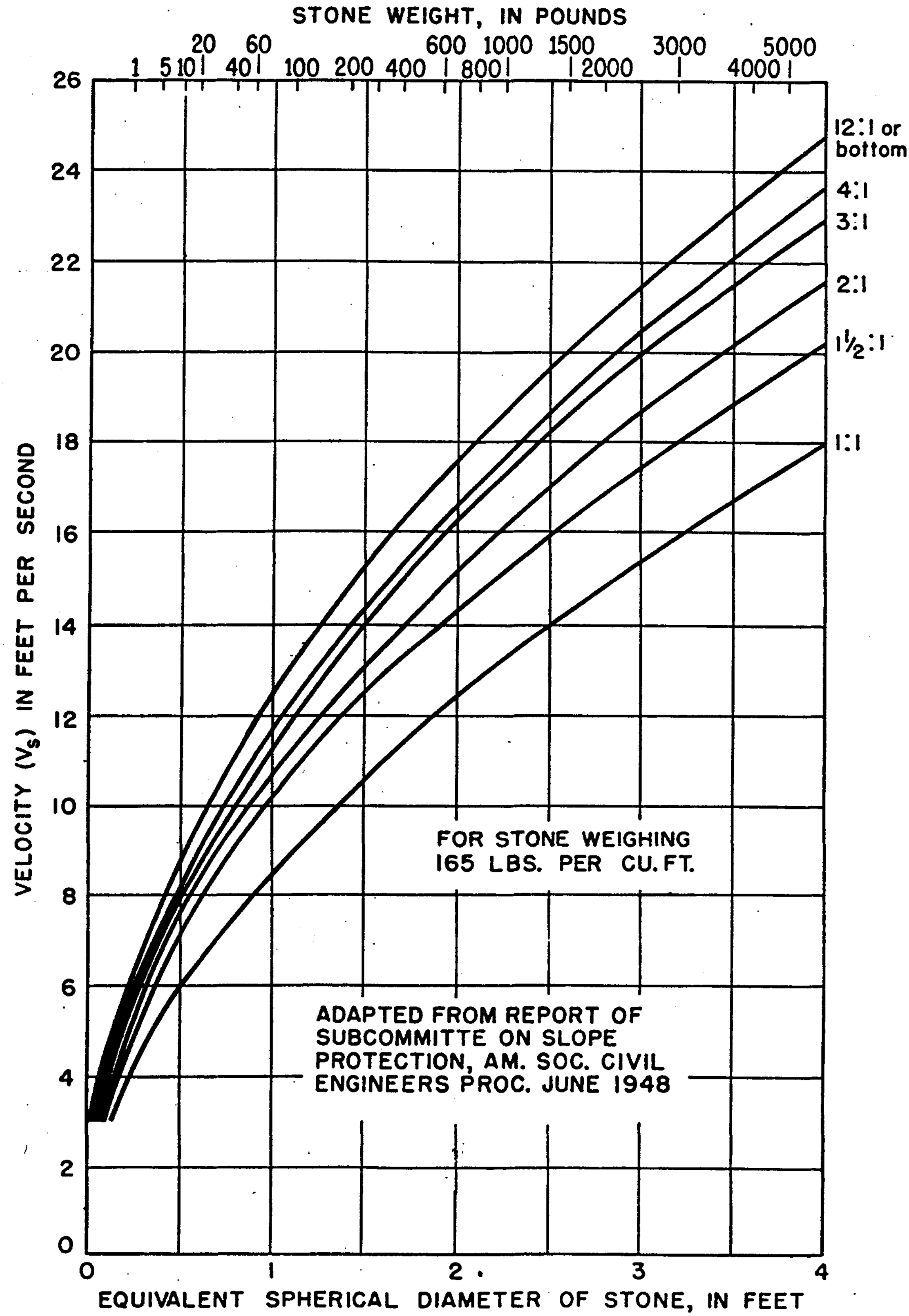
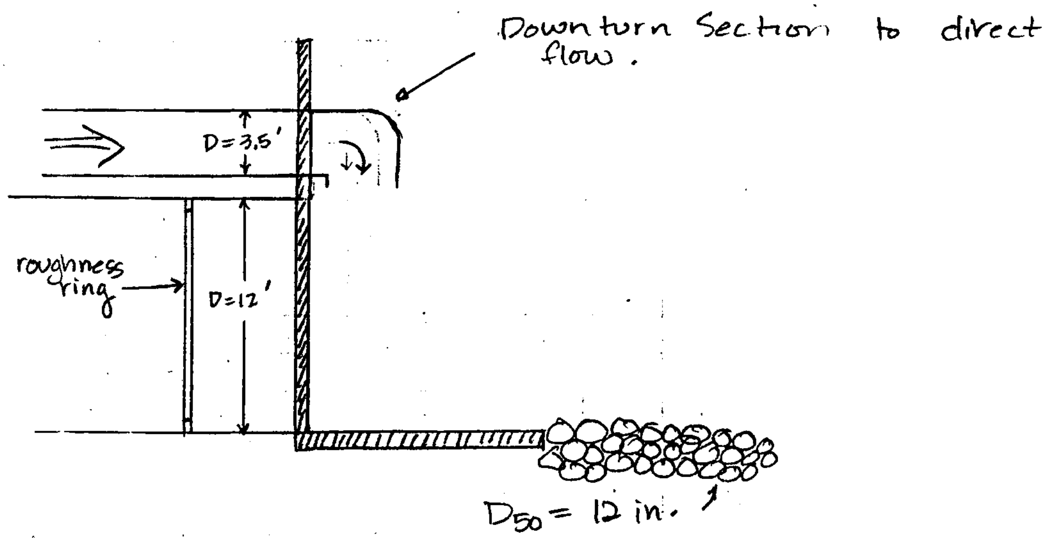
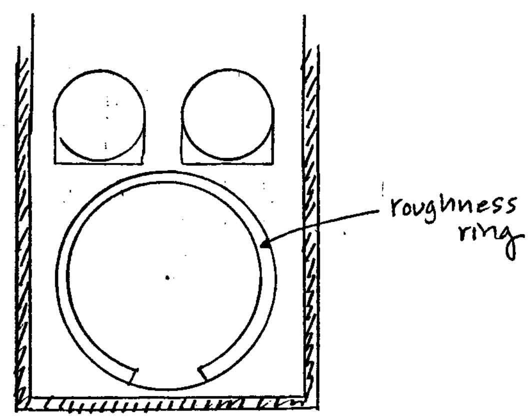


FIG. 2–SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES

TYPICAL SECTION AT OUTLET





APPENDIX VII-12

DISCHARGE DETERMINATION FOR NATURAL CHANNEL USING MANNING'S EQUATION DESIGN METHOD

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: SS-1 100-YEAR 6-HOUR STORM PEAK FLOW DEPTH

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,850.00	-140.00
2	4,840.00	-30.00
3	4,832.50	-8.00
4	4,831.25	-3.67
5	4,830.00	0.00
6	4,829.91	8.33
7	4,830.41	10.67
8	4,831.17	20.42
9	4,833.41	26.08
10	4,835.28	32.17
11	4,840.00	40.00
12	4,850.00	80.00

With a channel slope of 2.50 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
3.79	97.33	39.69	2.45	770.1	7.91

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: ANDALEX SINGLE-STAGE SAMPLER SS-1

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,850.00	-140.00
2	4,840.00	-30.00
3	4,832.50	-8.00
4	4,831.25	-3.67
5	4,830.00	0.00
6	4,829.91	8.33
7	4,830.41	10.67
8	4,831.17	20.42
9	4,833.41	26.08
10	4,835.28	32.17
11	4,840.00	40.00
12	4,850.00	80.00

With a channel slope of 2.50 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.05	0.12	4.86	0.02	0.0	0.4
0.10	0.48	8.84	0.05	0.3	0.6
0.15	0.93	9.23	0.10	0.9	0.9
0.20	1.40	9.62	0.15	1.7	1.2
0.25	1.88	10.02	0.19	2.7	1.4
0.30	2.39	10.41	0.23	3.9	1.6
0.35	2.91	10.80	0.27	5.3	1.8
0.40	3.46	11.19	0.31	6.9	2.0
0.45	4.02	11.59	0.35	8.6	2.1
0.50	4.60	11.98	0.38	10.6	2.3
0.55	5.21	12.76	0.41	12.5	2.4
0.60	5.86	13.56	0.43	14.6	2.5
0.65	6.55	14.35	0.46	16.9	2.6
0.70	7.28	15.15	0.48	19.4	2.7
0.75	8.04	15.94	0.50	22.2	2.8
0.80	8.85	16.74	0.53	25.2	2.8
0.85	9.69	17.53	0.55	28.4	2.9
0.90	10.57	18.33	0.58	31.9	3.0
0.95	11.49	19.12	0.60	35.6	3.1
1.00	12.46	19.92	0.63	39.6	3.2
1.05	13.46	20.72	0.65	43.9	3.3
1.10	14.49	21.51	0.67	48.5	3.3
1.15	15.57	22.31	0.70	53.3	3.4
1.20	16.69	23.10	0.72	58.5	3.5

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
1.25	17.85	23.90	0.75	63.9	3.6
1.29	19.04	24.34	0.78	70.3	3.7
1.34	20.25	24.63	0.82	77.3	3.8
1.39	21.46	24.94	0.86	84.5	3.9
1.44	22.70	25.26	0.90	92.0	4.1
1.49	23.95	25.57	0.94	99.7	4.2
1.54	25.21	25.89	0.97	107.7	4.3
1.59	26.49	26.20	1.01	116.1	4.4
1.64	27.77	26.52	1.05	124.6	4.5
1.69	29.09	26.83	1.08	133.6	4.6
1.74	30.41	27.15	1.12	142.7	4.7
1.79	31.75	27.46	1.16	152.1	4.8
1.84	33.11	27.78	1.19	161.9	4.9
1.89	34.47	28.09	1.23	171.9	5.0
1.94	35.85	28.41	1.26	182.2	5.1
1.99	37.24	28.72	1.30	192.7	5.2
2.04	38.66	29.04	1.33	203.5	5.3
2.09	40.08	29.35	1.37	214.7	5.4
2.14	41.53	29.67	1.40	226.1	5.4
2.19	42.98	29.98	1.43	237.8	5.5
2.24	44.46	30.30	1.47	249.8	5.6
2.29	45.95	30.61	1.50	262.1	5.7
2.34	47.44	30.93	1.53	274.6	5.8
2.39	48.96	31.24	1.57	287.4	5.9
2.44	50.49	31.56	1.60	300.6	6.0
2.49	52.03	31.87	1.63	313.8	6.0
2.54	53.59	32.19	1.67	327.6	6.1
2.59	55.17	32.50	1.70	341.6	6.2
2.64	56.76	32.79	1.73	356.0	6.3
2.69	58.37	33.08	1.76	370.8	6.4
2.74	59.98	33.37	1.80	385.8	6.4
2.79	61.61	33.66	1.83	401.1	6.5
2.84	63.26	33.95	1.86	416.8	6.6
2.89	64.92	34.24	1.90	432.7	6.7
2.94	66.58	34.53	1.93	448.8	6.7
2.99	68.27	34.82	1.96	465.3	6.8
3.04	69.96	35.11	1.99	482.1	6.9
3.09	71.67	35.40	2.02	499.1	7.0
3.14	73.40	35.69	2.06	516.5	7.0
3.19	75.13	35.98	2.09	534.1	7.1
3.24	76.89	36.27	2.12	552.1	7.2
3.29	78.66	36.56	2.15	570.5	7.3
3.34	80.43	36.85	2.18	588.9	7.3
3.39	82.22	37.14	2.21	607.7	7.4
3.44	84.03	37.43	2.25	626.9	7.5
3.49	85.85	37.72	2.28	646.4	7.5
3.54	87.69	38.03	2.31	665.9	7.6
3.59	89.53	38.35	2.33	685.5	7.7
3.64	91.39	38.68	2.36	705.5	7.7
3.69	93.28	39.00	2.39	725.9	7.8
3.74	95.18	39.33	2.42	746.5	7.8

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
3.79	97.09	39.65	2.45	767.5	7.9
3.83	99.00	39.97	2.48	788.4	8.0

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: SS-2 100-YEAR 6-HOUR STORM PEAK FLOW DEPTH

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,720.00	-30.00
2	4,710.59	-24.00
3	4,709.17	-21.50
4	4,708.92	-11.50
5	4,707.84	-4.75
6	4,708.00	0.00
7	4,710.34	3.83
8	4,712.67	9.00
9	4,720.00	30.00

With a channel slope of 9.40 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
1.44	16.24	24.27	0.67	104.8	6.45

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: ANDALEX SINGLE STAGE SAMPLER SS-2

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,720.00	-30.00
2	4,710.59	-24.00
3	4,709.17	-21.50
4	4,708.92	-11.50
5	4,707.84	-4.75
6	4,708.00	0.00
7	4,710.34	3.83
8	4,712.67	9.00
9	4,720.00	30.00

With a channel slope of 9.40 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.05	0.05	1.83	0.03	0.0	0.7

Project: ANDALEX SINGLE STAGE SAMPLER SS-2

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.10	0.19	3.66	0.05	0.2	1.2
0.15	0.42	5.49	0.08	0.6	1.5
0.20	0.71	6.12	0.12	1.4	2.0
0.25	1.04	6.54	0.16	2.6	2.5
0.30	1.37	6.96	0.20	3.9	2.9
0.36	1.73	7.38	0.24	5.6	3.2
0.41	2.11	7.80	0.27	7.5	3.5
0.46	2.52	8.21	0.31	9.6	3.8
0.51	2.94	8.63	0.34	12.1	4.1
0.56	3.38	9.05	0.37	14.8	4.4
0.61	3.84	9.47	0.41	17.7	4.6
0.66	4.32	9.89	0.44	21.0	4.9
0.71	4.83	10.31	0.47	24.5	5.1
0.76	5.35	10.73	0.50	28.4	5.3
0.81	5.89	11.15	0.53	32.5	5.5
0.86	6.45	11.57	0.56	36.9	5.7
0.91	7.04	11.98	0.59	41.7	5.9
0.96	7.64	12.40	0.62	46.7	6.1
1.02	8.27	12.82	0.64	52.0	6.3
1.07	8.91	13.24	0.67	57.7	6.5
1.12	9.60	14.91	0.64	60.4	6.3
1.17	10.40	17.04	0.61	63.1	6.1
1.22	11.29	19.17	0.59	66.9	5.9
1.27	12.30	21.30	0.58	72.0	5.9
1.32	13.41	23.43	0.57	78.0	5.8
1.37	14.60	24.00	0.61	88.5	6.1
1.42	15.80	24.20	0.65	100.3	6.3
1.47	17.01	24.40	0.70	112.8	6.6
1.52	18.23	24.60	0.74	126.0	6.9
1.57	19.46	24.80	0.78	139.7	7.2
1.63	20.69	25.00	0.83	153.9	7.4
1.68	21.93	25.20	0.87	168.7	7.7
1.73	23.19	25.40	0.91	184.1	7.9
1.78	24.45	25.60	0.96	200.1	8.2
1.83	25.72	25.80	1.00	216.6	8.4
1.88	27.00	26.00	1.04	233.6	8.7
1.93	28.29	26.20	1.08	251.2	8.9
1.98	29.59	26.40	1.12	269.3	9.1
2.03	30.89	26.60	1.16	288.0	9.3
2.08	32.20	26.80	1.20	307.0	9.5
2.13	33.53	27.00	1.24	326.8	9.7
2.18	34.86	27.20	1.28	347.0	10.0
2.23	36.20	27.40	1.32	367.8	10.2
2.29	37.55	27.60	1.36	389.0	10.4
2.34	38.91	27.80	1.40	410.7	10.6
2.39	40.28	28.00	1.44	433.0	10.8
2.44	41.65	28.20	1.48	455.7	10.9
2.49	43.04	28.40	1.52	479.1	11.1
2.54	44.43	28.62	1.55	502.6	11.3
2.59	45.83	28.85	1.59	526.4	11.5
2.64	47.25	29.08	1.62	550.9	11.7

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
2.69	48.67	29.30	1.66	575.9	11.8
2.74	50.11	29.53	1.70	601.5	12.0
2.79	51.55	29.72	1.73	627.9	12.2
2.84	53.00	29.90	1.77	655.0	12.4
2.89	54.46	30.09	1.81	682.4	12.5
2.95	55.93	30.27	1.85	710.5	12.7
3.00	57.40	30.45	1.88	739.0	12.9
3.05	58.88	30.64	1.92	767.9	13.0

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: SS-3 100-YEAR 6-HOUR STORM PEAK FLOW DEPTH

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,620.00	-108.00
2	4,610.00	-65.00
3	4,600.00	-63.00
4	4,598.84	-12.00
5	4,595.75	-10.00
6	4,594.25	-1.67
7	4,593.92	0.00
8	4,594.09	1.92
9	4,595.09	3.58
10	4,598.67	3.75
11	4,600.00	6.50
12	4,605.00	40.00
13	4,605.00	55.00
14	4,610.00	120.00
15	4,620.00	180.00

With a channel slope of 1.70 percent and
a Manning's n of 0.054, the flow conditions
at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
6.57	144.03	79.16	1.82	770.2	5.35

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: ANDALEX SINGLE-STAGE SAMPLER SS-3

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,620.00	-108.00
2	4,610.00	-65.00
3	4,600.00	-63.00
4	4,598.84	-12.00
5	4,595.75	-10.00
6	4,594.25	-1.67
7	4,593.92	0.00
8	4,594.09	1.92
9	4,595.09	3.58
10	4,598.67	3.75
11	4,600.00	6.50
12	4,605.00	40.00
13	4,605.00	55.00
14	4,610.00	120.00
15	4,620.00	180.00

With a channel slope of 1.70 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.05	0.02	0.82	0.02	0.0	0.3
0.10	0.08	1.64	0.05	0.0	0.5
0.15	0.18	2.47	0.07	0.1	0.6
0.20	0.32	3.01	0.11	0.3	0.8
0.25	0.48	3.37	0.14	0.5	1.0
0.30	0.65	3.72	0.17	0.7	1.1
0.35	0.84	4.08	0.21	1.1	1.3
0.40	1.05	4.46	0.23	1.4	1.4
0.45	1.27	4.84	0.26	1.9	1.5
0.50	1.52	5.21	0.29	2.4	1.6
0.55	1.78	5.59	0.32	3.0	1.7
0.60	2.06	5.97	0.34	3.6	1.8
0.65	2.35	6.35	0.37	4.4	1.9
0.70	2.67	6.72	0.40	5.2	1.9
0.75	3.00	7.10	0.42	6.1	2.0
0.80	3.35	7.48	0.45	7.1	2.1
0.85	3.72	7.86	0.47	8.1	2.2
0.90	4.11	8.23	0.50	9.3	2.3
0.95	4.51	8.61	0.52	10.5	2.3
1.00	4.94	8.99	0.55	11.9	2.4
1.05	5.38	9.37	0.57	13.3	2.5

Project: ANDALEX SINGLE-STAGE SAMPLER SS-3

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
1.10	5.83	9.74	0.60	14.9	2.5
1.15	6.31	10.12	0.62	16.5	2.6
1.20	6.80	10.48	0.65	18.3	2.7
1.25	7.31	10.81	0.68	20.2	2.8
1.29	7.83	11.14	0.70	22.2	2.8
1.34	8.37	11.47	0.73	24.3	2.9
1.39	8.92	11.80	0.76	26.5	3.0
1.44	9.48	12.13	0.78	28.9	3.0
1.49	10.06	12.46	0.81	31.3	3.1
1.54	10.65	12.79	0.83	33.8	3.2
1.59	11.25	13.12	0.86	36.4	3.2
1.64	11.87	13.45	0.88	39.2	3.3
1.69	12.51	13.78	0.91	42.1	3.4
1.74	13.15	14.12	0.93	45.0	3.4
1.79	13.81	14.45	0.96	48.1	3.5
1.84	14.49	14.72	0.98	51.4	3.5
1.89	15.16	14.83	1.02	55.2	3.6
1.94	15.85	14.94	1.06	59.1	3.7
1.99	16.53	15.05	1.10	63.2	3.8
2.04	17.21	15.16	1.14	67.2	3.9
2.09	17.90	15.27	1.17	71.4	4.0
2.14	18.59	15.38	1.21	75.7	4.1
2.19	19.28	15.48	1.24	80.0	4.2
2.24	19.97	15.59	1.28	84.5	4.2
2.29	20.67	15.70	1.32	89.0	4.3
2.34	21.36	15.81	1.35	93.6	4.4
2.39	22.05	15.92	1.39	98.3	4.5
2.44	22.75	16.03	1.42	103.1	4.5
2.49	23.45	16.14	1.45	107.9	4.6
2.54	24.15	16.25	1.49	112.9	4.7
2.59	24.85	16.36	1.52	117.9	4.7
2.64	25.56	16.47	1.55	122.9	4.8
2.69	26.27	16.58	1.58	128.1	4.9
2.74	26.97	16.69	1.62	133.3	4.9
2.79	27.69	16.80	1.65	138.6	5.0
2.84	28.40	16.90	1.68	144.0	5.1
2.89	29.11	17.01	1.71	149.4	5.1
2.94	29.83	17.12	1.74	155.0	5.2
2.99	30.54	17.23	1.77	160.5	5.3
3.04	31.26	17.34	1.80	166.1	5.3
3.09	31.98	17.45	1.83	171.8	5.4
3.14	32.71	17.56	1.86	177.6	5.4
3.19	33.43	17.67	1.89	183.5	5.5
3.24	34.16	17.78	1.92	189.4	5.5
3.29	34.88	17.89	1.95	195.3	5.6
3.34	35.61	18.00	1.98	201.4	5.7
3.39	36.35	18.11	2.01	207.5	5.7
3.44	37.07	18.21	2.04	213.6	5.8
3.49	37.81	18.32	2.06	219.9	5.8
3.54	38.55	18.43	2.09	226.2	5.9
3.59	39.28	18.54	2.12	232.5	5.9

Project: ANDALEX SINGLE-STAGE SAMPLER SS-3

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
3.64	40.02	18.65	2.15	238.9	6.0
3.69	40.77	18.76	2.17	245.4	6.0
3.74	41.51	18.87	2.20	251.9	6.1
3.79	42.25	18.98	2.23	258.5	6.1
3.83	42.99	19.09	2.25	265.1	6.2
3.88	43.74	19.20	2.28	271.8	6.2
3.93	44.50	19.31	2.30	278.6	6.3
3.98	45.25	19.42	2.33	285.4	6.3
4.03	46.00	19.52	2.36	292.3	6.4
4.08	46.76	19.63	2.38	299.2	6.4
4.13	47.52	19.74	2.41	306.2	6.4
4.18	48.28	19.85	2.43	313.2	6.5
4.23	49.03	19.96	2.46	320.2	6.5
4.28	49.79	20.07	2.48	327.4	6.6
4.33	50.56	20.18	2.51	334.6	6.6
4.38	51.32	20.29	2.53	341.9	6.7
4.43	52.09	20.40	2.55	349.2	6.7
4.48	52.86	20.51	2.58	356.6	6.7
4.53	53.63	20.62	2.60	364.0	6.8
4.58	54.41	20.73	2.63	371.5	6.8
4.63	55.17	20.84	2.65	378.9	6.9
4.68	55.95	20.94	2.67	386.5	6.9
4.73	56.73	21.05	2.69	394.1	6.9
4.78	57.51	21.20	2.71	401.4	7.0
4.83	58.30	21.38	2.73	408.4	7.0
4.88	59.09	21.55	2.74	415.3	7.0
4.93	59.89	22.18	2.70	416.7	7.0
4.98	60.78	24.49	2.48	399.8	6.6
5.03	61.78	26.79	2.31	386.9	6.3
5.08	62.89	29.10	2.16	377.2	6.0
5.13	64.12	31.40	2.04	370.3	5.8
5.18	65.46	33.71	1.94	365.6	5.6
5.23	66.91	36.01	1.86	362.9	5.4
5.28	68.48	38.31	1.79	361.9	5.3
5.33	70.16	40.62	1.73	362.4	5.2
5.38	71.96	42.92	1.68	364.4	5.1
5.43	73.87	45.23	1.63	367.6	5.0
5.48	75.90	47.53	1.60	372.0	4.9
5.53	78.04	49.84	1.57	377.6	4.8
5.58	80.29	52.14	1.54	384.1	4.8
5.63	82.66	54.44	1.52	391.8	4.7
5.68	85.14	56.75	1.50	400.3	4.7
5.73	87.74	59.05	1.49	409.9	4.7
5.78	90.45	61.36	1.47	420.4	4.6
5.83	93.28	63.66	1.47	431.7	4.6
5.88	96.21	65.97	1.46	443.9	4.6
5.93	99.26	68.27	1.45	457.1	4.6
5.98	102.44	70.58	1.45	471.2	4.6
6.03	105.71	72.88	1.45	486.0	4.6
6.08	109.10	75.18	1.45	501.7	4.6
6.13	112.61	75.72	1.49	526.4	4.7

Project: ANDALEX SINGLE-STAGE SAMPLER SS-3

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
6.18	116.08	76.11	1.53	551.8	4.8
6.23	119.57	76.50	1.56	577.8	4.8
6.28	123.11	76.89	1.60	604.5	4.9
6.33	126.64	77.27	1.64	631.6	5.0
6.38	130.20	77.66	1.68	659.3	5.1
6.42	133.77	78.05	1.71	687.4	5.1
6.47	137.34	78.44	1.75	715.9	5.2
6.52	140.96	78.83	1.79	745.1	5.3
6.57	144.58	79.22	1.83	774.8	5.4
6.62	148.21	79.60	1.86	804.8	5.4

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: SS-4 100-YEAR 6-HOUR STORM PEAK FLOW DEPTH

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,540.00	-45.00
2	4,530.00	-25.00
3	4,529.60	-21.00
4	4,527.60	-19.00
5	4,525.60	-18.00
6	4,525.00	-16.00
7	4,525.20	-13.00
8	4,524.90	-12.00
9	4,525.00	-8.00
10	4,525.00	-4.00
11	4,525.00	0.00
12	4,526.30	4.00
13	4,526.70	9.00
14	4,526.90	12.00
15	4,526.90	17.00
16	4,527.30	24.00
17	4,527.30	35.00
18	4,527.60	38.00
19	4,527.90	42.00
20	4,528.20	45.00
21	4,528.70	47.00
22	4,529.20	49.00
23	4,529.60	51.00
24	4,540.00	200.00

With a channel slope of 2.70 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
3.41	117.36	67.12	1.75	770.2	6.56

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: ANDALEX SINGLE-STAGE SAMPLER SS-4

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,540.00	-45.00
2	4,530.00	-25.00
3	4,529.60	-21.00
4	4,527.60	-19.00
5	4,525.60	-18.00
6	4,525.00	-16.00
7	4,525.20	-13.00
8	4,524.90	-12.00
9	4,525.00	-8.00
10	4,525.00	-4.00
11	4,525.00	0.00
12	4,526.30	4.00
13	4,526.70	9.00
14	4,526.90	12.00
15	4,526.90	17.00
16	4,527.30	24.00
17	4,527.30	35.00
18	4,527.60	38.00
19	4,527.90	42.00
20	4,528.20	45.00
21	4,528.70	47.00
22	4,529.20	49.00
23	4,529.60	51.00
24	4,540.00	200.00

With a channel slope of 2.70 percent and
a Manning's n of 0.054, the flow conditions
at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.05	0.05	2.16	0.02	0.0	0.4
0.10	0.21	4.33	0.05	0.1	0.6
0.15	0.02	0.91	0.02	0.0	0.3
0.20	0.09	1.83	0.05	0.1	0.6
0.25	0.20	2.75	0.07	0.2	0.8
0.30	0.36	3.68	0.10	0.4	1.0
0.35	4.03	17.72	0.23	6.8	1.7
0.40	4.91	18.06	0.27	9.3	1.9
0.45	5.81	18.39	0.32	12.2	2.1
0.50	6.72	18.72	0.36	15.4	2.3
0.55	7.66	19.06	0.40	18.9	2.5
0.60	8.61	19.39	0.44	22.6	2.6

Project: ANDALEX SINGLE-STAGE SAMPLER SS-4

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.65	9.57	19.73	0.48	26.7	2.8
0.70	10.55	20.06	0.53	31.1	2.9
0.75	11.54	20.29	0.57	35.8	3.1
0.80	12.54	20.50	0.61	40.8	3.3
0.85	13.55	20.72	0.65	46.2	3.4
0.90	14.57	20.94	0.70	51.7	3.6
0.95	15.60	21.15	0.74	57.6	3.7
1.00	16.63	21.37	0.78	63.6	3.8
1.05	17.68	21.59	0.82	70.0	4.0
1.10	18.74	21.80	0.86	76.6	4.1
1.15	19.80	22.02	0.90	83.4	4.2
1.20	20.87	22.24	0.94	90.4	4.3
1.25	21.95	22.45	0.98	97.8	4.5
1.29	23.05	22.67	1.02	105.4	4.6
1.34	24.14	22.89	1.05	113.1	4.7
1.39	25.25	23.10	1.09	121.2	4.8
1.44	26.38	23.73	1.11	128.0	4.9
1.49	27.53	24.41	1.13	134.8	4.9
1.54	28.72	25.09	1.14	142.1	4.9
1.59	29.95	25.77	1.16	149.7	5.0
1.64	31.19	26.45	1.18	157.4	5.0
1.69	32.48	27.13	1.20	165.6	5.1
1.74	33.81	27.81	1.22	174.1	5.2
1.79	35.15	28.49	1.23	182.8	5.2
1.84	36.54	29.28	1.25	191.5	5.2
1.89	37.97	30.08	1.26	200.5	5.3
1.94	39.43	30.89	1.28	209.8	5.3
1.99	40.92	31.70	1.29	219.4	5.4
2.04	42.68	37.61	1.13	210.0	4.9
2.09	44.52	38.53	1.16	221.6	5.0
2.14	46.39	39.46	1.18	233.7	5.0
2.19	48.32	40.39	1.20	246.2	5.1
2.24	50.29	41.32	1.22	259.2	5.2
2.29	52.31	42.25	1.24	272.8	5.2
2.34	54.36	43.18	1.26	286.6	5.3
2.39	56.47	44.11	1.28	301.1	5.3
2.44	59.05	55.73	1.06	277.5	4.7
2.49	61.76	56.29	1.10	297.1	4.8
2.54	64.52	56.84	1.13	317.4	4.9
2.59	67.28	57.40	1.17	338.2	5.0
2.64	70.06	57.96	1.21	359.5	5.1
2.69	72.89	58.51	1.25	381.6	5.2
2.74	75.75	59.21	1.28	403.7	5.3
2.79	78.64	59.95	1.31	426.1	5.4
2.84	81.56	60.68	1.34	449.2	5.5
2.89	84.51	61.42	1.38	472.7	5.6
2.94	87.50	62.16	1.41	497.0	5.7
2.99	90.53	62.89	1.44	521.9	5.8
3.04	93.58	63.50	1.47	548.0	5.9
3.09	96.66	64.07	1.51	574.9	5.9
3.14	99.80	64.64	1.54	602.8	6.0

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
3.19	102.95	65.21	1.58	631.1	6.1
3.24	106.10	65.78	1.61	659.8	6.2
3.29	109.29	66.36	1.65	689.3	6.3
3.34	112.53	66.71	1.69	721.0	6.4
3.39	115.75	66.98	1.73	753.7	6.5
3.44	118.98	67.26	1.77	787.0	6.6

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: SS-5 100-YEAR 6-HOUR STORM PEAK FLOW DEPTH

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,790.00	-100.00
2	4,780.00	-35.00
3	4,778.00	-15.00
4	4,777.30	-13.00
5	4,777.20	-11.00
6	4,777.10	-9.00
7	4,776.60	-7.00
8	4,775.50	-6.50
9	4,775.40	-5.00
10	4,775.10	-3.00
11	4,775.10	-1.00
12	4,775.00	0.00
13	4,775.30	3.00
14	4,775.50	5.00
15	4,775.70	7.00
16	4,775.90	9.00
17	4,775.90	11.00
18	4,776.80	13.00
19	4,779.00	15.00
20	4,780.00	28.00
21	4,790.00	40.00

With a channel slope of 5.00 percent and
a Manning's n of 0.054, the flow conditions
at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
3.66	77.95	38.32	2.03	770.0	9.88

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: ANDALEX SINGLE-STAGE SAMPLER SS-5

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,790.00	-100.00
2	4,780.00	-35.00
3	4,778.00	-15.00
4	4,777.30	-13.00
5	4,777.20	-11.00
6	4,777.10	-9.00
7	4,776.60	-7.00
8	4,775.50	-6.50
9	4,775.40	-5.00
10	4,775.10	-3.00
11	4,775.10	-1.00
12	4,775.00	0.00
13	4,775.30	3.00
14	4,775.50	5.00
15	4,775.70	7.00
16	4,775.90	9.00
17	4,775.90	11.00
18	4,776.80	13.00
19	4,779.00	15.00
20	4,780.00	28.00
21	4,790.00	40.00

With a channel slope of 5.00 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.05	0.02	1.00	0.02	0.0	0.5
0.10	0.10	2.00	0.05	0.1	0.8
0.15	0.32	4.84	0.07	0.3	1.0
0.20	0.58	5.68	0.10	0.8	1.3
0.25	0.88	6.51	0.14	1.4	1.6
0.30	1.22	7.35	0.17	2.3	1.9
0.35	1.61	8.19	0.20	3.3	2.1
0.40	2.04	9.02	0.23	4.6	2.3
0.45	2.51	10.26	0.24	6.0	2.4
0.50	3.05	11.51	0.27	7.8	2.5
0.55	3.64	12.09	0.30	10.0	2.8
0.60	4.25	12.64	0.34	12.6	3.0
0.65	4.88	13.20	0.37	15.5	3.2
0.70	5.55	13.75	0.40	18.6	3.4
0.75	6.24	14.31	0.44	22.1	3.5

Project: ANDALEX SINGLE-STAGE SAMPLER SS-5

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.80	6.95	14.86	0.47	25.8	3.7
0.85	7.69	15.42	0.50	29.7	3.9
0.90	8.46	15.98	0.53	34.1	4.0
0.95	9.33	18.18	0.51	36.8	3.9
1.00	10.23	18.35	0.56	42.6	4.2
1.05	11.12	18.53	0.60	48.7	4.4
1.10	12.02	18.71	0.64	55.1	4.6
1.15	12.94	18.88	0.69	61.9	4.8
1.20	13.85	19.06	0.73	68.9	5.0
1.25	14.77	19.24	0.77	76.2	5.2
1.29	15.70	19.41	0.81	83.8	5.3
1.34	16.64	19.59	0.85	91.9	5.5
1.39	17.58	19.76	0.89	100.1	5.7
1.44	18.53	19.94	0.93	108.6	5.9
1.49	19.50	20.12	0.97	117.5	6.0
1.54	20.46	20.29	1.01	126.6	6.2
1.59	21.42	20.47	1.05	135.9	6.3
1.64	22.41	20.78	1.08	145.0	6.5
1.69	23.39	21.10	1.11	154.2	6.6
1.74	24.41	21.43	1.14	163.8	6.7
1.79	25.44	21.76	1.17	173.7	6.8
1.84	26.48	22.04	1.20	184.2	7.0
1.89	27.52	22.31	1.23	194.8	7.1
1.94	28.59	22.58	1.27	205.9	7.2
1.99	29.67	22.85	1.30	217.2	7.3
2.04	30.75	23.13	1.33	228.8	7.4
2.09	31.86	23.40	1.36	240.8	7.6
2.14	32.98	24.33	1.36	248.6	7.5
2.19	34.16	25.39	1.35	256.2	7.5
2.24	35.39	26.46	1.34	264.3	7.5
2.29	36.68	27.53	1.33	273.3	7.5
2.34	38.00	27.90	1.36	287.3	7.6
2.39	39.33	28.12	1.40	302.7	7.7
2.44	40.66	28.33	1.44	318.3	7.8
2.49	42.01	28.55	1.47	334.4	8.0
2.54	43.37	28.77	1.51	350.8	8.1
2.59	44.73	28.99	1.54	367.5	8.2
2.64	46.11	29.21	1.58	384.7	8.3
2.69	47.50	29.43	1.61	402.3	8.5
2.74	48.89	29.64	1.65	420.0	8.6
2.79	50.30	29.86	1.68	438.2	8.7
2.84	51.71	30.08	1.72	456.7	8.8
2.89	53.14	30.30	1.75	475.5	8.9
2.94	54.56	30.52	1.79	494.6	9.1
2.99	56.01	30.73	1.82	514.2	9.2
3.04	57.46	31.22	1.84	531.0	9.2
3.09	58.95	31.79	1.85	547.5	9.3
3.14	60.45	32.35	1.87	564.2	9.3
3.19	61.99	32.92	1.88	581.6	9.4
3.24	63.55	33.49	1.90	599.4	9.4
3.29	65.15	34.06	1.91	617.7	9.5

Project: ANDALEX SINGLE-STAGE SAMPLER SS-5

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
3.34	66.78	34.63	1.93	636.6	9.5
3.39	68.41	35.19	1.94	655.7	9.6
3.44	70.09	35.76	1.96	675.4	9.6
3.49	71.79	36.33	1.98	695.6	9.7
3.54	73.52	36.90	1.99	716.3	9.7
3.59	75.27	37.47	2.01	737.4	9.8
3.64	77.05	38.03	2.03	759.1	9.9

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: SS-6 100-YEAR 6-HOUR STORM PEAK FLOW DEPTH

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,730.00	-30.00
2	4,720.00	-12.00
3	4,718.40	-10.00
4	4,717.60	-8.00
5	4,716.20	-6.00
6	4,715.30	-5.25
7	4,715.10	-4.00
8	4,715.00	-2.00
9	4,715.00	0.00
10	4,715.00	3.00
11	4,715.60	4.00
12	4,716.00	6.00
13	4,716.20	8.00
14	4,716.30	10.00
15	4,716.30	12.00
16	4,716.00	13.00
17	4,715.40	15.00
18	4,715.70	16.00
19	4,715.90	18.00
20	4,716.60	20.00
21	4,718.50	22.00
22	4,719.40	23.00
23	4,720.00	24.00
24	4,730.00	65.00

With a channel slope of 8.00 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
1.34	17.63	26.42	0.67	104.8	5.94

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: ANDALEX SINGLE-STAGE SAMPLER SS-6

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,730.00	-30.00
2	4,720.00	-12.00
3	4,718.40	-10.00
4	4,717.60	-8.00
5	4,716.20	-6.00
6	4,715.30	-5.25
7	4,715.10	-4.00
8	4,715.00	-2.00
9	4,715.00	0.00
10	4,715.00	3.00
11	4,715.60	4.00
12	4,716.00	6.00
13	4,716.20	8.00
14	4,716.30	10.00
15	4,716.30	12.00
16	4,716.00	13.00
17	4,715.40	15.00
18	4,715.70	16.00
19	4,715.90	18.00
20	4,716.60	20.00
21	4,718.50	22.00
22	4,719.40	23.00
23	4,720.00	24.00
24	4,730.00	65.00

With a channel slope of 8.00 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.05	0.28	6.09	0.05	0.3	1.0
0.10	0.60	7.19	0.08	0.9	1.5
0.15	0.97	7.61	0.13	1.9	2.0
0.20	1.36	8.02	0.17	3.2	2.4
0.25	1.76	8.43	0.21	4.8	2.7
0.30	2.19	8.84	0.25	6.7	3.1
0.35	2.63	9.01	0.29	9.0	3.4
0.40	3.07	9.17	0.34	11.5	3.8
0.45	3.52	9.33	0.38	14.3	4.1
0.50	3.98	9.49	0.42	17.4	4.4
0.55	4.45	9.66	0.46	20.6	4.6
0.60	4.92	9.82	0.50	24.1	4.9

Project: ANDALEX SINGLE-STAGE SAMPLER SS-6

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.65	5.39	10.13	0.53	27.6	5.1
0.70	5.89	10.45	0.56	31.3	5.3
0.75	6.40	10.77	0.59	35.2	5.5
0.80	6.92	11.09	0.62	39.4	5.7
0.85	7.46	11.40	0.65	43.7	5.9
0.90	8.01	11.72	0.68	48.4	6.0
0.95	8.58	12.04	0.71	53.2	6.2
1.00	9.16	12.36	0.74	58.4	6.4
1.05	9.76	12.91	0.76	63.0	6.5
1.10	10.38	13.47	0.77	68.0	6.5
1.15	11.04	14.04	0.79	73.2	6.6
1.20	11.72	14.60	0.80	78.8	6.7
1.25	12.44	15.64	0.80	83.2	6.7
1.29	13.21	16.73	0.79	87.9	6.7

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: SS-7 100-YEAR 6-HOUR STORM PEAK FLOW DEPTH

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,600.00	-25.00
2	4,593.42	-6.30
3	4,592.92	-4.30
4	4,589.12	-4.10
5	4,588.72	-1.30
6	4,588.72	0.00
7	4,588.92	2.70
8	4,589.52	4.70
9	4,590.12	7.70
10	4,590.12	9.70
11	4,592.02	10.70
12	4,593.02	11.70
13	4,593.42	12.10
14	4,600.00	40.00

With a channel slope of 2.00 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
6.30	99.79	35.78	2.79	769.5	7.71

EarthFax Engineering, Inc.
Discharge Determination for Natural Channel
Using Manning's Equation Design Method

Project: ANDALEX SINGLE-STAGE SAMPLER SS-7

Evaluation of discharge for cross-section:

Point Num.	GS Elev.	Dist.
1	4,600.00	-25.00
2	4,593.42	-6.30
3	4,592.92	-4.30
4	4,589.12	-4.10
5	4,588.72	-1.30
6	4,588.72	0.00
7	4,588.92	2.70
8	4,589.52	4.70
9	4,590.12	7.70
10	4,590.12	9.70
11	4,592.02	10.70
12	4,593.02	11.70
13	4,593.42	12.10
14	4,600.00	40.00

With a channel slope of 2.00 percent and a Manning's n of 0.054, the flow conditions at the cross-section are:

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
0.05	0.09	2.33	0.04	0.0	0.4
0.10	0.23	3.35	0.07	0.2	0.7
0.15	0.42	4.38	0.10	0.3	0.8
0.20	0.67	5.41	0.12	0.6	1.0
0.25	0.95	5.94	0.16	1.1	1.1
0.30	1.26	6.47	0.19	1.6	1.3
0.35	1.59	6.99	0.23	2.3	1.4
0.40	1.94	7.52	0.26	3.1	1.6
0.45	2.32	7.75	0.30	4.0	1.7
0.50	2.71	7.97	0.34	5.1	1.9
0.55	3.10	8.20	0.38	6.3	2.0
0.60	3.50	8.42	0.42	7.6	2.2
0.65	3.91	8.64	0.45	9.0	2.3
0.70	4.33	8.86	0.49	10.4	2.4
0.75	4.75	9.09	0.52	12.0	2.5
0.80	5.19	9.31	0.56	13.7	2.6
0.85	5.63	9.61	0.59	15.4	2.7
0.90	6.09	9.91	0.61	17.1	2.8
0.95	6.56	10.22	0.64	19.0	2.9
1.00	7.04	10.52	0.67	21.0	3.0
1.05	7.54	10.83	0.70	23.0	3.1
1.10	8.04	11.13	0.72	25.2	3.1

Project: ANDALEX SINGLE-STAGE SAMPLER SS-7

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
1.15	8.56	11.43	0.75	27.5	3.2
1.20	9.10	11.74	0.77	29.9	3.3
1.25	9.64	12.04	0.80	32.4	3.4
1.29	10.20	12.34	0.83	35.0	3.4
1.34	10.77	12.65	0.85	37.7	3.5
1.39	11.35	12.95	0.88	40.5	3.6
1.44	12.03	15.08	0.80	40.3	3.3
1.49	12.73	15.19	0.84	44.0	3.5
1.54	13.42	15.29	0.88	47.9	3.6
1.59	14.11	15.40	0.92	51.8	3.7
1.64	14.81	15.50	0.96	55.9	3.8
1.69	15.51	15.61	0.99	60.1	3.9
1.74	16.21	15.72	1.03	64.4	4.0
1.79	16.91	15.82	1.07	68.8	4.1
1.84	17.61	15.93	1.11	73.3	4.2
1.89	18.31	16.03	1.14	77.9	4.3
1.94	19.02	16.14	1.18	82.6	4.3
1.99	19.72	16.25	1.21	87.3	4.4
2.04	20.43	16.35	1.25	92.2	4.5
2.09	21.14	16.46	1.28	97.2	4.6
2.14	21.85	16.57	1.32	102.3	4.7
2.19	22.57	16.67	1.35	107.5	4.8
2.24	23.28	16.78	1.39	112.7	4.8
2.29	23.99	16.88	1.42	118.0	4.9
2.34	24.71	16.99	1.45	123.4	5.0
2.39	25.43	17.10	1.49	128.9	5.1
2.44	26.15	17.20	1.52	134.5	5.1
2.49	26.87	17.31	1.55	140.2	5.2
2.54	27.59	17.41	1.58	145.9	5.3
2.59	28.31	17.52	1.62	151.7	5.4
2.64	29.04	17.63	1.65	157.6	5.4
2.69	29.76	17.73	1.68	163.6	5.5
2.74	30.49	17.84	1.71	169.6	5.6
2.79	31.22	17.95	1.74	175.8	5.6
2.84	31.95	18.05	1.77	181.9	5.7
2.89	32.68	18.16	1.80	188.2	5.8
2.94	33.42	18.26	1.83	194.5	5.8
2.99	34.15	18.37	1.86	200.9	5.9
3.04	34.88	18.48	1.89	207.4	5.9
3.09	35.63	18.58	1.92	214.0	6.0
3.14	36.36	18.69	1.95	220.6	6.1
3.19	37.10	18.79	1.97	227.2	6.1
3.24	37.85	18.90	2.00	234.0	6.2
3.29	38.59	19.01	2.03	240.8	6.2
3.34	39.34	19.12	2.06	247.6	6.3
3.39	40.08	19.24	2.08	254.4	6.3
3.44	40.84	19.36	2.11	261.3	6.4
3.49	41.59	19.48	2.13	268.3	6.5
3.54	42.34	19.61	2.16	275.3	6.5
3.59	43.11	19.73	2.19	282.5	6.6
3.64	43.86	19.85	2.21	289.6	6.6

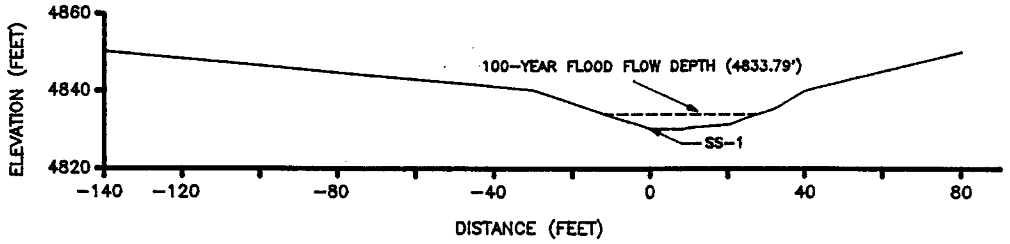
Project: ANDALEX SINGLE-STAGE SAMPLER SS-7

Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
3.69	44.63	19.97	2.24	296.9	6.7
3.74	45.39	20.09	2.26	304.2	6.7
3.79	46.16	20.21	2.28	311.6	6.8
3.83	46.93	20.33	2.31	319.1	6.8
3.88	47.70	20.45	2.33	326.6	6.8
3.93	48.49	20.57	2.36	334.2	6.9
3.98	49.27	20.69	2.38	341.9	6.9
4.03	50.04	20.81	2.41	349.6	7.0
4.08	50.83	20.93	2.43	357.4	7.0
4.13	51.62	21.05	2.45	365.3	7.1
4.18	52.41	21.17	2.48	373.2	7.1
4.23	53.20	21.39	2.49	380.0	7.1
4.28	54.01	21.67	2.49	386.3	7.2
4.33	54.83	21.95	2.50	392.9	7.2
4.38	55.66	22.22	2.50	399.5	7.2
4.43	56.50	22.50	2.51	406.3	7.2
4.48	57.36	22.77	2.52	413.2	7.2
4.53	58.23	23.05	2.53	420.3	7.2
4.58	59.11	23.33	2.53	427.6	7.2
4.63	60.00	23.60	2.54	435.0	7.2
4.68	60.91	23.88	2.55	442.5	7.3
4.73	61.83	24.21	2.55	449.5	7.3
4.78	62.76	24.58	2.55	456.3	7.3
4.83	63.72	24.94	2.55	463.4	7.3
4.88	64.69	25.31	2.56	470.6	7.3
4.93	65.68	25.68	2.56	478.0	7.3
4.98	66.69	26.05	2.56	485.7	7.3
5.03	67.71	26.41	2.56	493.5	7.3
5.08	68.75	26.78	2.57	501.6	7.3
5.13	69.81	27.15	2.57	509.9	7.3
5.18	70.89	27.51	2.58	518.5	7.3
5.23	71.98	27.88	2.58	527.2	7.3
5.28	73.09	28.25	2.59	536.1	7.3
5.33	74.22	28.61	2.59	545.3	7.3
5.38	75.37	28.98	2.60	554.7	7.4
5.43	76.53	29.35	2.61	564.3	7.4
5.48	77.72	29.72	2.62	574.1	7.4
5.53	78.92	30.08	2.62	584.2	7.4
5.58	80.13	30.45	2.63	594.4	7.4
5.63	81.37	30.82	2.64	604.9	7.4
5.68	82.62	31.18	2.65	615.7	7.5
5.73	83.89	31.55	2.66	626.6	7.5
5.78	85.19	31.92	2.67	637.9	7.5
5.83	86.49	32.29	2.68	649.2	7.5
5.88	87.81	32.65	2.69	660.9	7.5
5.93	89.15	33.02	2.70	672.7	7.5
5.98	90.51	33.39	2.71	684.8	7.6
6.03	91.88	33.75	2.72	697.1	7.6
6.08	93.28	34.12	2.73	709.8	7.6
6.13	94.69	34.49	2.75	722.5	7.6
6.18	96.12	34.85	2.76	735.6	7.7

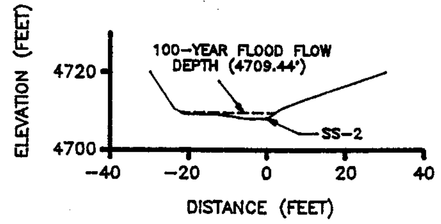
Flow Depth (ft)	Area (ft^2)	WP (ft)	R (ft)	Discharge (cfs)	Velocity (fps)
6.23	97.56	35.22	2.77	748.8	7.7
6.28	99.03	35.59	2.78	762.4	7.7

03/30/93

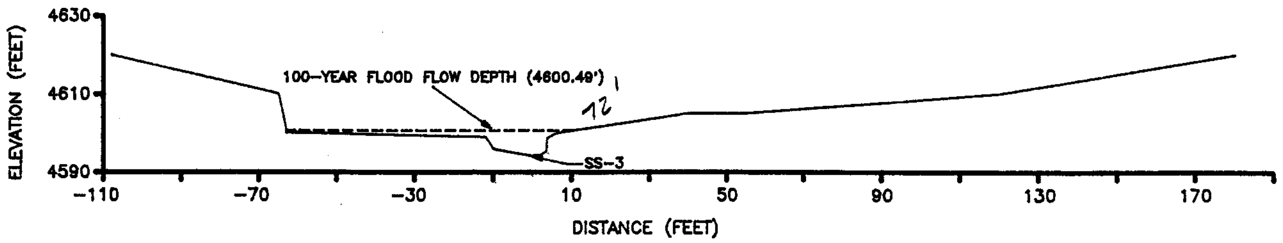
STREAM CHANNEL CROSS SECTIONS



SAMPLER SS-1



SAMPLER SS-2



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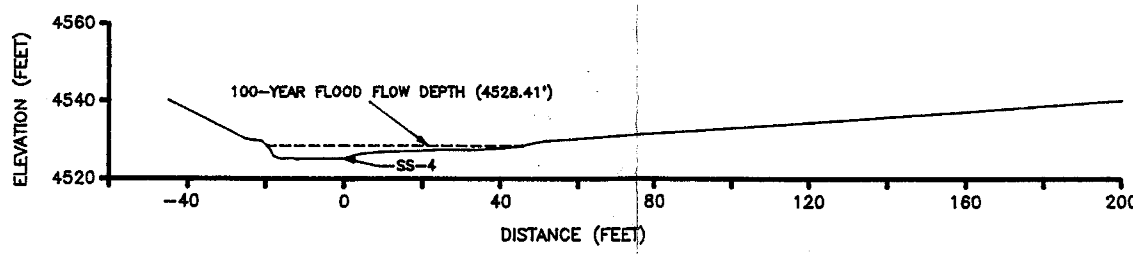

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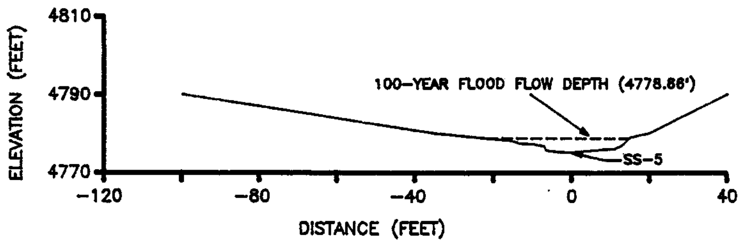
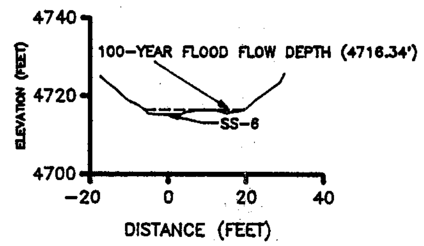
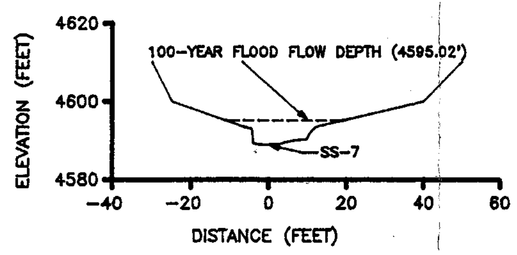


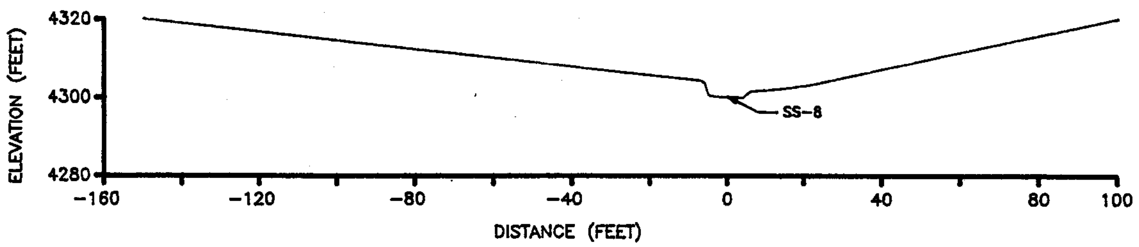
SAMPLER SS-5



SAMPLER SS-6



SAMPLER SS-7



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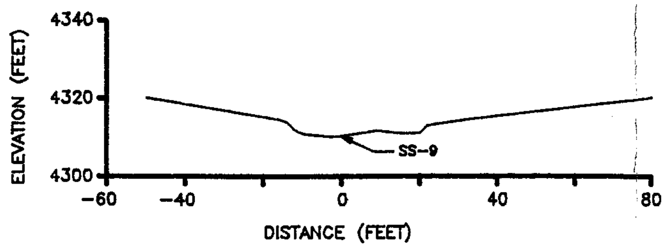


SAMPLER SS-9

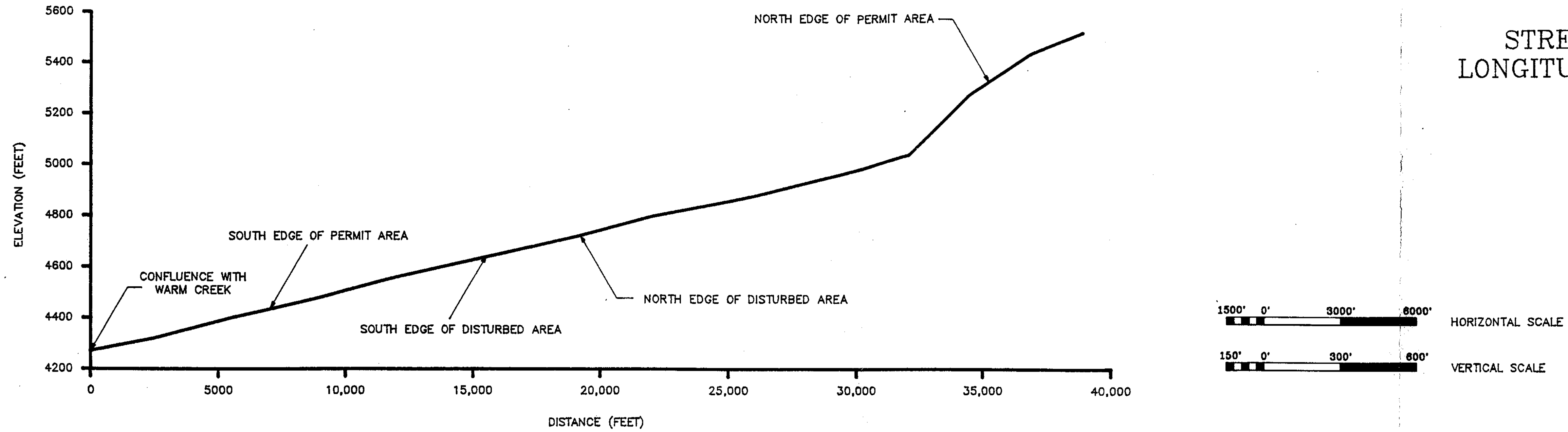
20' 0' 40' 80'

NOTE: REFER TO EXHIBIT VII-5 FOR SAMPLER LOCATIONS

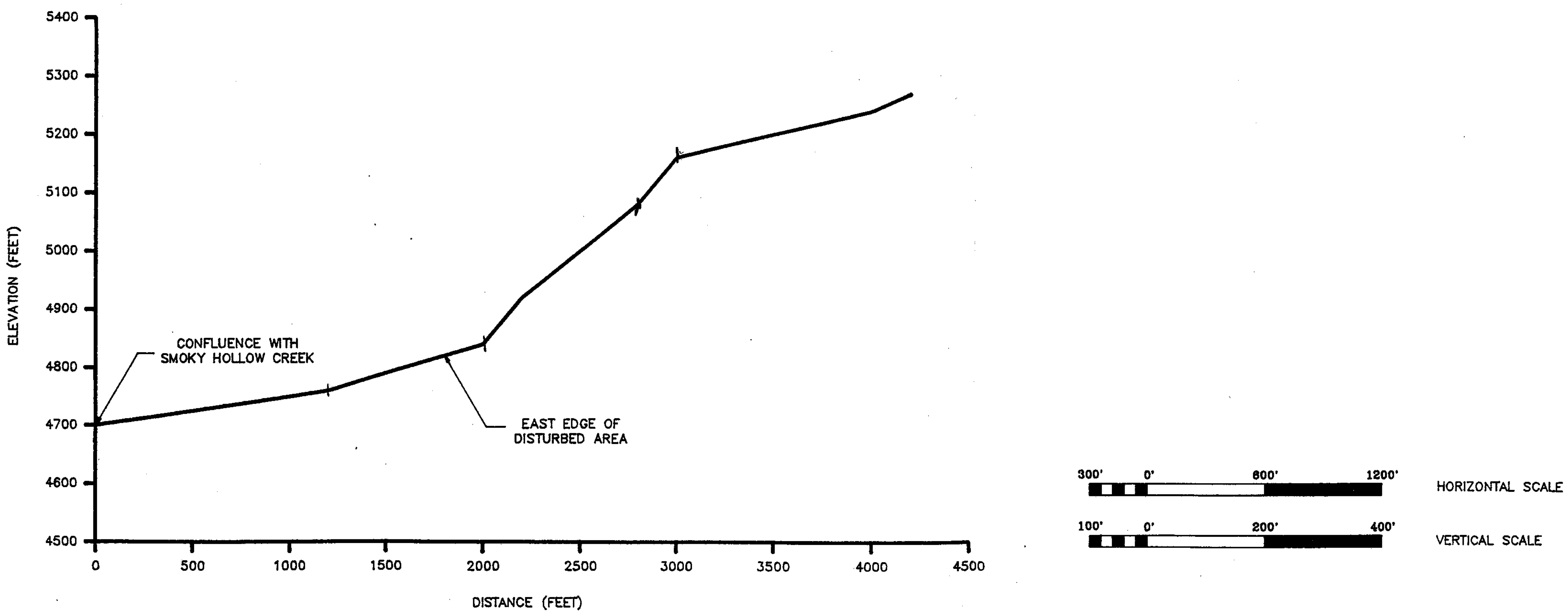
FIGURE 1

03/30/93

STREAM CHANNEL LONGITUDINAL PROFILES



SMOKY HOLLOW CREEK PROFILE



TRIBUTARY PROFILE

FIGURE 2

Appendix 2-1 —

3/30/93

APPENDIX VII-13

SYSTEMATIC PROCEDURE FOR ESTIMATION OF MANNING'S "n-VALUE"

SYSTEMATIC PROCEDURE FOR THE ESTIMATION OF n VALUE

A single Manning roughness coefficient n value was determined for the stream channels in the permit and adjacent areas using the technique developed by the U.S. Soil Conservation Service (1963). The general procedure for estimating the n value involves: first, the selection of a basic value of n for a straight, uniform, smooth channel in the natural materials involved; then, through consideration of the factors listed below, the selection of a modifying value associated with each factor. The modifying values are added to the basic value to obtain the n value for the channel under consideration.

The modifying factors and selected modifying factors include:

Character of channel	**Basic n: 0.024**
Degree of irregularity	**Modifying factor: 0.010**
Character of variations in and shape of cross-sections	**Modifying factor: 0.005**
Relative effect of obstructions	**Modifying factor: 0.015**
Modifying effect of vegetation	**Modifying factor: 0.0**
Modifying effect of meandering	**Modifying factor: 0.0**
Estimation of n:	**0.054**

0.030

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     DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:   ect Title           = UD-7 25/24                                                  :
:WATERSHED HYDROGRAPH                                                                 :
:     Inflow into structure #  1                                                      :
:     Structure type:         Null                                                    :
:                                                                                     :
:                                                                                     :
:-- Watershed data for watershed # 1                                                  :
:    Curve number           =     89.0                                                :
:    Area                   =      4.8 acres                                          :
:    Hydraulic length       =     0.00 feet                                           :
:    Elevation change       =      0.0 feet.                                          :
:    Concentration time     =     0.05 hours                                          :
:    Unit hydrograph type = Disturbed                                                 :
:                                                                                     :
:-- Total Area             =      4.8 acres                                           :
:                                                                                     :
:-- Storm data                                                                        :
:    Total precipitation    =      2.3 inches                                         :
:    Storm type             = SCS Type 2 storm, 24 hour storm                         :
:    Peak Discharge         =     5.90 cfs                                            :
:    Discharge volume       =     0.52 acre ft                                        :
:                                                                                     :
: <press return to continue or {esc} to skip detail printout>                         :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
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```
V  DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:  ject Title          = UD-8 10/6                                              :
:WATERSHED HYDROGRAPH                                                           :
:      Inflow into structure #  1                                               :
:      Structure type:          Null                                            :
:                                                                               :
:                                                                               :
:-- Watershed data for watershed # 1                                            :
:     Curve number           =    89.0                                          :
:     Area                   =     4.4 acres                                    :
:     Hydraulic length       =    0.00 feet                                     :
:     Elevation change       =     0.0 feet.                                    :
:     Concentration time     =    0.03 hours                                    :
:     Unit hydrograph type = Disturbed                                          :
:                                                                               :
:-- Total Area              =      4.4 acres                                    :
:                                                                               :
:-- Storm data                                                                  :
:     Total precipitation    =      1.5 inches                                  :
:     Storm type             = SCS 6 hour design storm                          :
:     Peak Discharge         =    2.24 cfs                                      :
:     Discharge volume       =    0.24 acre ft                                  :
:                                                                               :
: <press return to continue or {esc} to skip detail printout>                   :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=

V  DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:  ject Title          = UD-8 25/6                                              :
:WATERSHED HYDROGRAPH                                                           :
:      Inflow into structure #  1                                               :
:      Structure type:          Null                                            :
:                                                                               :
:                                                                               :
:-- Watershed data for watershed # 1                                            :
:     Curve number           =    89.0                                          :
:     Area                   =     4.4 acres                                    :
:     Hydraulic length       =    0.00 feet                                     :
:     Elevation change       =     0.0 feet.                                    :
:     Concentration time     =    0.03 hours                                    :
:     Unit hydrograph type = Disturbed                                          :
:                                                                               :
:-- Total Area              =      4.4 acres                                    :
:                                                                               :
:-- Storm data                                                                  :
:     Total precipitation    =      1.8 inches                                  :
:     Storm type             = SCS 6 hour design storm                          :
:     Peak Discharge         =    2.99 cfs                                      :
:     Discharge volume       =    0.32 acre ft                                  :
:                                                                               :
: <press return to continue or {esc} to skip detail printout>                   :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

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V    )DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:Project Title        = UD-8 100/6                                            :
:WATERSHED HYDROGRAPH                                                          :
:     Inflow into structure #  1                                               :
:     Structure type:          Null                                            :
:                                                                              :
:                                                                              :
:-- Watershed data for watershed # 1                                           :
:    Curve number            =    89.0                                         :
:    Area                    =     4.4 acres                                   :
:    Hydraulic length        =    0.00 feet                                    :
:    Elevation change        =     0.0 feet.                                   :
:    Concentration time      =    0.03 hours                                   :
:    Unit hydrograph type = Disturbed                                          :
:                                                                              :
:-- Total Area               =    4.4 acres                                    :
:                                                                              :
:-- Storm data                                                                 :
:    Total precipitation     =     2.2 inches                                  :
:    Storm type              = SCS 6 hour design storm                         :
:    Peak Discharge          =    4.18 cfs                                     :
:    Discharge volume        =    0.45 acre ft                                 :
:                                                                              :
: <press return to continue or {esc} to skip detail printout>                  :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=

V.  )DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:Project Title        = UD-8 10/24                                             :
:WATERSHED HYDROGRAPH                                                          :
:     Inflow into structure #  1                                               :
:     Structure type:          Null                                            :
:                                                                              :
:                                                                              :
:-- Watershed data for watershed # 1                                           :
:    Curve number            =    89.0                                         :
:    Area                    =     4.4 acres                                   :
:    Hydraulic length        =    0.00 feet                                    :
:    Elevation change        =     0.0 feet.                                   :
:    Concentration time      =    0.03 hours                                   :
:    Unit hydrograph type = Disturbed                                          :
:                                                                              :
:-- Total Area               =    4.4 acres                                    :
:                                                                              :
:-- Storm data                                                                 :
:    Total precipitation     =     1.9 inches                                  :
:    Storm type              = SCS Type 2 storm, 24 hour storm                 :
:    Peak Discharge          =    3.62 cfs                                     :
:    Discharge volume        =    0.36 acre ft                                 :
:                                                                              :
: <press return to continue or {esc} to skip detail printout>                  :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
:. ect Title            = UD-8 25/24
:WATERSHED HYDROGRAPH
:     Inflow into structure #  1
:     Structure type:          Null
:
:
:-- Watershed data for watershed # 1
:    Curve number           =    89.0
:    Area                   =     4.4 acres
:    Hydraulic length       =    0.00 feet
:    Elevation change       =     0.0 feet.
:    Concentration time     =    0.03 hours
:    Unit hydrograph type = Disturbed
:
:-- Total Area             =     4.4 acres
:
:-- Storm data
:    Total precipitation    =     2.3 inches
:    Storm type             = SCS Type 2 storm, 24 hour storm
:    Peak Discharge         =    4.75 cfs
:    Discharge volume       =    0.48 acre ft
:
: <press return to continue or {esc} to skip detail printout>
```

```
ject Title            = UD-9 10/6
WATERSHED HYDROGRAPH
    Inflow into structure #  1
    Structure type:          Null


-- Watershed data for watershed # 1
   Curve number           =    87.0
   Area                   =    16.9 acres
   Hydraulic length       =    0.00 feet
   Elevation change       =     0.0 feet.
   Concentration time     =    0.04 hours
   Unit hydrograph type   = Disturbed

-- Total Area            =    16.9 acres

-- Storm data
   Total precipitation    =     1.5 inches
   Storm type             = SCS 6 hour design storm
   Peak Discharge         =    7.85 cfs
   Discharge volume       =    0.77 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
ject Title            = UD-9 25/6
WATERSHED HYDROGRAPH
    Inflow into structure #  1
    Structure type:          Null


-- Watershed data for watershed # 1
   Curve number           =    87.0
   Area                   =    16.9 acres
   Hydraulic length       =    0.00 feet
   Elevation change       =     0.0 feet.
   Concentration time     =    0.04 hours
   Unit hydrograph type   = Disturbed

-- Total Area            =    16.9 acres

-- Storm data
   Total precipitation    =     1.8 inches
   Storm type             = SCS 6 hour design storm
   Peak Discharge         =   10.79 cfs
   Discharge volume       =    1.06 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
  ect Title          = UD-9 100/6                                           :
:WATERSHED HYDROGRAPH                                                         :
:     Inflow into structure #  1                                              :
:     Structure type:          Null                                           :
:                                                                             :
:                                                                             :
:-- Watershed data for watershed # 1                                          :
:    Curve number            =    87.0                                        :
:    Area                    =    16.9 acres                                  :
:    Hydraulic length        =    0.00 feet                                   :
:    Elevation change        =     0.0 feet.                                  :
:    Concentration time      =    0.04 hours                                  :
:    Unit hydrograph type = Disturbed                                         :
:                                                                             :
:-- Total Area              =    16.9 acres                                   :
:                                                                             :
:-- Storm data                                                                :
:    Total precipitation     =     2.2 inches                                 :
:    Storm type              = SCS 6 hour design storm                        :
:    Peak Discharge          =   15.58 cfs                                    :
:    Discharge volume        =    1.53 acre ft                                :
:                                                                             :
: <press return to continue or {esc} to skip detail printout>                 :
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:Project Title          = UD-9 10/24                                          :
:WATERSHED HYDROGRAPH                                                         :
:     Inflow into structure #  1                                              :
:     Structure type:          Null                                           :
:                                                                             :
:                                                                             :
:-- Watershed data for watershed # 1                                          :
:    Curve number            =    87.0                                        :
:    Area                    =    16.9 acres                                  :
:    Hydraulic length        =    0.00 feet                                   :
:    Elevation change        =     0.0 feet.                                  :
:    Concentration time      =    0.04 hours                                  :
:    Unit hydrograph type = Disturbed                                         :
:                                                                             :
:-- Total Area              =    16.9 acres                                   :
:                                                                             :
:-- Storm data                                                                :
:    Total precipitation     =     1.9 inches                                 :
:    Storm type              = SCS Type 2 storm, 24 hour storm                :
:    Peak Discharge          =   13.45 cfs                                    :
:    Discharge volume        =    1.20 acre ft                                :
:                                                                             :
: <press return to continue or {esc} to skip detail printout>                 :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
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VI  `DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:P.  ect Title           = UD-9 25/24                                            :
:WATERSHED HYDROGRAPH                                                            :
:     Inflow into structure #  1                                                 :
:     Structure type:          Null                                              :
:                                                                                :
:                                                                                :
:-- Watershed data for watershed # 1                                             :
:    Curve number            =     87.0                                          :
:    Area                    =     16.9 acres                                    :
:    Hydraulic length        =     0.00 feet                                     :
:    Elevation change        =      0.0 feet.                                    :
:    Concentration time      =     0.04 hours                                    :
:    Unit hydrograph type = Disturbed                                            :
:                                                                                :
:-- Total Area               =     16.9 acres                                    :
:                                                                                :
:-- Storm data                                                                   :
:    Total precipitation     =      2.3 inches                                   :
:    Storm type              = SCS Type 2 storm, 24 hour storm                   :
:    Peak Discharge          =    18.03 cfs                                      :
:    Discharge volume        =     1.64 acre ft                                  :
:                                                                                :
: <press return to continue or {esc} to skip detail printout>                    :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
Project Title          = UD-10 10/6
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null

-- Watershed data for watershed # 1
    Curve number           =    89.0
    Area                   =     9.3 acres
    Hydraulic length       =    0.00 feet
    Elevation change       =     0.0 feet.
    Concentration time     =    0.05 hours
    Unit hydrograph type = Disturbed

-- Total Area              =     9.3 acres

-- Storm data
    Total precipitation    =     1.5 inches
    Storm type             = SCS 6 hour design storm
    Peak Discharge         =    5.32 cfs
    Discharge volume       =    0.50 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
Project Title          = UD-10 25/6
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null

   Watershed data for watershed # 1
    Curve number           =    89.0
    Area                   =     9.3 acres
    Hydraulic length       =    0.00 feet
    Elevation change       =     0.0 feet.
    Concentration time     =    0.05 hours
    Unit hydrograph type = Disturbed

-- Total Area              =     9.3 acres

-- Storm data
    Total precipitation    =     1.8 inches
    Storm type             = SCS 6 hour design storm
    Peak Discharge         =    7.12 cfs
    Discharge volume       =    0.67 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
Project Title            = UD-10 100/6
WATERSHED HYDROGRAPH
      Inflow into structure #  1
      Structure type:          Null


-- Watershed data for watershed # 1
     Curve number            =    89.0
     Area                    =     9.3 acres
     Hydraulic length        =    0.00 feet
     Elevation change        =     0.0 feet.
     Concentration time      =    0.05 hours
     Unit hydrograph type = Disturbed

-- Total Area             =     9.3 acres

-- Storm data
     Total precipitation     =     2.2 inches
     Storm type              = SCS 6 hour design storm
     Peak Discharge          =    9.98 cfs
     Discharge volume        =    0.94 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
Project Title            = UD-10 10/24
WATERSHED HYDROGRAPH
      Inflow into structure #  1
      Structure type:          Null


-- Watershed data for watershed # 1
     Curve number            =    89.0
     Area                    =     9.3 acres
     Hydraulic length        =    0.00 feet
     Elevation change        =     0.0 feet.
     Concentration time      =    0.05 hours
     Unit hydrograph type = Disturbed

-- Total Area             =     9.3 acres

-- Storm data
     Total precipitation     =     1.9 inches
     Storm type              = SCS Type 2 storm, 24 hour storm
     Peak Discharge          =    8.66 cfs
     Discharge volume        =    0.75 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
ect Title           = UD-10 25/24
WATERSHED HYDROGRAPH
    Inflow into structure #  1
    Structure type:         Null


-- Watershed data for watershed # 1
   Curve number           =    89.0
   Area                   =     9.3 acres
   Hydraulic length       =    0.00 feet
   Elevation change       =     0.0 feet.
   Concentration time     =    0.05 hours
   Unit hydrograph type = Disturbed

-- Total Area            =     9.3 acres

-- Storm data
   Total precipitation    =     2.3 inches
   Storm type             = SCS Type 2 storm, 24 hour storm
   Peak Discharge         =   11.36 cfs
   Discharge volume       =    1.00 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
VDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:  ect Title          = UD-11 100/6                                         :
:WATERSHED HYDROGRAPH                                                       :
:     Inflow into structure #  1                                            :
:     Structure type:          Null                                         :
:                                                                           :
:                                                                           :
:-- Watershed data for watershed # 1                                        :
:    Curve number              =     89.0                                   :
:    Area                      =     19.7 acres                             :
:    Hydraulic length          =     0.00 feet                              :
:    Elevation change          =      0.0 feet.                             :
:    Concentration time        =     0.13 hours                             :
:    Unit hydrograph type = Disturbed                                       :
:                                                                           :
:-- Total Area                =     19.7 acres                              :
:                                                                           :
:-- Storm data                                                              :
:    Total precipitation       =      2.2 inches                            :
:    Storm type                = SCS 6 hour design storm                    :
:    Peak Discharge            =    20.59 cfs                               :
:    Discharge volume          =     2.01 acre ft                           :
:                                                                           :
: <press return to continue or {esc} to skip detail printout>               :
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V    DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:  ect Title          = UD-11 10/25                                         :
:WATERSHED HYDROGRAPH                                                       :
:     Inflow into structure #  1                                            :
:     Structure type:          Null                                         :
:                                                                           :
:                                                                           :
:-- Watershed data for watershed # 1                                        :
:    Curve number              =     89.0                                   :
:    Area                      =     19.7 acres                             :
:    Hydraulic length          =     0.00 feet                              :
:    Elevation change          =      0.0 feet.                             :
:    Concentration time        =     0.13 hours                             :
:    Unit hydrograph type = Disturbed                                       :
:                                                                           :
:-- Total Area                =     19.7 acres                              :
:                                                                           :
:-- Storm data                                                              :
:    Total precipitation       =      1.9 inches                            :
:    Storm type                = SCS Type 2 storm, 24 hour storm            :
:    Peak Discharge            =    17.94 cfs                               :
:    Discharge volume          =     1.60 acre ft                           :
:                                                                           :
: <press return to continue or {esc} to skip detail printout>               :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
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V   ?DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:  ject Title          = UD-11 25/24                                          :
:WATERSHED HYDROGRAPH                                                         :
:     Inflow into structure #  1                                              :
:     Structure type:         Null                                            :
:                                                                             :
:                                                                             :
:-- Watershed data for watershed # 1                                          :
:    Curve number             =    89.0                                       :
:    Area                     =    19.7 acres                                 :
:    Hydraulic length         =    0.00 feet                                  :
:    Elevation change         =     0.0 feet.                                 :
:    Concentration time       =    0.13 hours                                 :
:    Unit hydrograph type = Disturbed                                         :
:                                                                             :
:-- Total Area               =    19.7 acres                                  :
:                                                                             :
:-- Storm data                                                                :
:    Total precipitation      =     2.3 inches                                :
:    Storm type               = SCS Type 2 storm, 24 hour storm               :
:    Peak Discharge           =   23.75 cfs                                   :
:    Discharge volume         =    2.14 acre ft                               :
:                                                                             :
: <press return to continue or {esc} to skip detail printout>                 :
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DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
   ject Title          = UD-12 10/6                                          :
:WATERSHED HYDROGRAPH                                                        :
:     Inflow into structure #  1                                             :
:     Structure type:         Null                                           :
:                                                                            :
:                                                                            :
:-- Watershed data for watershed # 1                                         :
:    Curve number            =    89.0                                       :
:    Area                    =     4.1 acres                                 :
:    Hydraulic length        =    0.00 feet                                  :
:    Elevation change        =     0.0 feet.                                 :
:    Concentration time      =    0.02 hours                                 :
:    Unit hydrograph type = Disturbed                                        :
:                                                                            :
:-- Total Area              =      4.1 acres                                 :
:                                                                            :
:-- Storm data                                                               :
:    Total precipitation     =     1.5 inches                                :
:    Storm type              = SCS 6 hour design storm                       :
:    Peak Discharge          =    1.85 cfs                                   :
:    Discharge volume        =    0.22 acre ft                               :
:                                                                            :
: <press return to continue or {esc} to skip detail printout>               :
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:  ject Title          = UD-12 25/6                                          :
:WATERSHED HYDROGRAPH                                                        :
:     Inflow into structure #  1                                             :
:     Structure type:         Null                                           :
:                                                                            :
:                                                                            :
:   Watershed data for watershed # 1                                         :
:    Curve number            =    89.0                                       :
:    Area                    =     4.1 acres                                 :
:    Hydraulic length        =    0.00 feet                                  :
:    Elevation change        =     0.0 feet.                                 :
:    Concentration time      =    0.02 hours                                 :
:    Unit hydrograph type = Disturbed                                        :
:                                                                            :
:-- Total Area              =      4.1 acres                                 :
:                                                                            :
:-- Storm data                                                               :
:    Total precipitation     =     1.8 inches                                :
:    Storm type              = SCS 6 hour design storm                       :
:    Peak Discharge          =    2.46 cfs                                   :
:    Discharge volume        =    0.29 acre ft                               :
:                                                                            :
: <press return to continue or {esc} to skip detail printout>               :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
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 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
 ject Title         = UD-12 100/6                                          :
:WATERSHED HYDROGRAPH                                                        :
:     Inflow into structure #  1                                             :
:     Structure type:          Null                                          :
:                                                                            :
:                                                                            :
:-- Watershed data for watershed # 1                                         :
:    Curve number             =    89.0                                      :
:    Area                     =     4.1 acres                                :
:    Hydraulic length         =    0.00 feet                                 :
:    Elevation change         =     0.0 feet.                                :
:    Concentration time       =    0.02 hours                                :
:    Unit hydrograph type = Disturbed                                        :
:                                                                            :
:-- Total Area               =      4.1 acres                                :
:                                                                            :
:-- Storm data                                                               :
:    Total precipitation      =     2.2 inches                               :
:    Storm type               = SCS 6 hour design storm                      :
:    Peak Discharge           =    3.45 cfs                                  :
:    Discharge volume         =    0.42 acre ft                              :
:                                                                            :
: <press return to continue or {esc} to skip detail printout>                :
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 ject Title         = UD-12 10/24                                          :
:WATERSHED HYDROGRAPH                                                        :
:     Inflow into structure #  1                                             :
:     Structure type:          Null                                          :
:                                                                            :
:                                                                            :
: - Watershed data for watershed # 1                                         :
:    Curve number             =    89.0                                      :
:    Area                     =     4.1 acres                                :
:    Hydraulic length         =    0.00 feet                                 :
:    Elevation change         =     0.0 feet.                                :
:    Concentration time       =    0.02 hours                                :
:    Unit hydrograph type = Disturbed                                        :
:                                                                            :
:-- Total Area               =      4.1 acres                                :
:                                                                            :
:-- Storm data                                                               :
:    Total precipitation      =     1.9 inches                               :
:    Storm type               = SCS Type 2 storm, 24 hour storm              :
:    Peak Discharge           =    2.99 cfs                                  :
:    Discharge volume         =    0.33 acre ft                              :
:                                                                            :
: <press return to continue or {esc} to skip detail printout>                :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
ODDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:  ject Title          = UD-12 25/24                                         :
:WATERSHED HYDROGRAPH                                                        :
:     Inflow into structure #  1                                             :
:     Structure type:          Null                                          :
:                                                                            :
:                                                                            :
:-- Watershed data for watershed # 1                                         :
:    Curve number            =    89.0                                       :
:    Area                    =     4.1 acres                                 :
:    Hydraulic length        =    0.00 feet                                  :
:    Elevation change        =     0.0 feet.                                 :
:    Concentration time      =    0.02 hours                                 :
:    Unit hydrograph type = Disturbed                                        :
:                                                                            :
:-- Total Area               =     4.1 acres                                 :
:                                                                            :
:-- Storm data                                                               :
:    Total precipitation     =     2.3 inches                                :
:    Storm type              = SCS Type 2 storm, 24 hour storm               :
:    Peak Discharge          =    3.92 cfs                                   :
:    Discharge volume        =    0.44 acre ft                               :
:                                                                            :
: <press return to continue or {esc} to skip detail printout>                :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

APPENDIX 2B

COMPUTER BACKUP DATA

FOR

TABLE 8A

```
Project Title          = D-1 100/6
WATERSHED HYDROGRAPH
      Inflow into structure #  1
      Structure type:          Null


-- Watershed data for watershed # 1
    Curve number           =     90.0
    Area                   =      0.9 acres
    Hydraulic length       =     0.00 feet
    Elevation change       =      0.0 feet.
    Concentration time     =     0.06 hours
    Unit hydrograph type = Disturbed

-- Total Area             =      0.9 acres

-- Storm data
    Total precipitation    =      2.2 inches
    Storm type             = SCS 6 hour design storm
    Peak Discharge         =     1.00 cfs
    Discharge volume       =     0.09 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
Project Title          = D-2 10/6
WATERSHED HYDROGRAPH
      Inflow into structure #  1
      Structure type:          Null


-- Watershed data for watershed # 1
    Curve number           =     90.0
    Area                   =      0.9 acres
    Hydraulic length       =     0.00 feet
    Elevation change       =      0.0 feet.
    Concentration time     =     0.06 hours
    Unit hydrograph type = Disturbed

-- Total Area             =      0.9 acres

-- Storm data
    Total precipitation    =      1.5 inches
    Storm type             = SCS 6 hour design storm
    Peak Discharge         =     0.55 cfs
    Discharge volume       =     0.05 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:  ject Title           = D-3 10/6                                              :
:WATERSHED HYDROGRAPH                                                           :
:      Inflow into structure #  1                                               :
:      Structure type:          Null                                            :
:                                                                               :
:                                                                               :
:-- Watershed data for watershed # 1                                            :
:     Curve number             =    90.0                                        :
:     Area                     =     3.2 acres                                  :
:     Hydraulic length         =    0.00 feet                                   :
:     Elevation change         =     0.0 feet.                                  :
:     Concentration time       =    0.04 hours                                  :
:     Unit hydrograph type = Disturbed                                          :
:                                                                               :
:-- Total Area               =      3.2 acres                                   :
:                                                                               :
:-- Storm data                                                                  :
:     Total precipitation      =     1.5 inches                                 :
:     Storm type               = SCS 6 hour design storm                        :
:     Peak Discharge           =    1.90 cfs                                    :
:     Discharge volume         =    0.19 acre ft                                :
:                                                                               :
: <press return to continue or {esc} to skip detail printout>                   :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:Project Title           = D-4 10/6                                             :
:WATERSHED HYDROGRAPH                                                           :
:      Inflow into structure #  1                                               :
:      Structure type:          Null                                            :
:                                                                               :
:                                                                               :
:-- Watershed data for watershed # 1                                            :
:     Curve number             =    90.0                                        :
:     Area                     =     7.4 acres                                  :
:     Hydraulic length         =    0.00 feet                                   :
:     Elevation change         =     0.0 feet.                                  :
:     Concentration time       =    0.09 hours                                  :
:     Unit hydrograph type = Disturbed                                          :
:                                                                               :
:-- Total Area               =      7.4 acres                                   :
:                                                                               :
:-- Storm data                                                                  :
:     Total precipitation      =     1.5 inches                                 :
:     Storm type               = SCS 6 hour design storm                        :
:     Peak Discharge           =    4.75 cfs                                    :
:     Discharge volume         =    0.43 acre ft                                :
:                                                                               :
: <press return to continue or {esc} to skip detail printout>                   :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
 ject Title          = D-5 10/6                                              :
:WATERSHED HYDROGRAPH                                                        :
:     Inflow into structure #  1                                             :
:     Structure type:          Null                                          :
:                                                                            :
:                                                                            :
:-- Watershed data for watershed # 1                                         :
:    Curve number             =    90.0                                      :
:    Area                     =    11.1 acres                                :
:    Hydraulic length         =    0.00 feet                                 :
:    Elevation change         =     0.0 feet.                                :
:    Concentration time       =    0.07 hours                                :
:    Unit hydrograph type = Disturbed                                        :
:                                                                            :
:-- Total Area               =    11.1 acres                                 :
:                                                                            :
:-- Storm data                                                               :
:    Total precipitation      =     1.5 inches                               :
:    Storm type               = SCS 6 hour design storm                      :
:    Peak Discharge           =    7.13 cfs                                  :
:    Discharge volume         =    0.64 acre ft                              :
:                                                                            :
: <press return to continue or {esc} to skip detail printout>                :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=

 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:Project Title          = D-6 10/6                                           :
:WATERSHED HYDROGRAPH                                                        :
:     Inflow into structure #  1                                             :
:     Structure type:          Null                                          :
:                                                                            :
:                                                                            :
:-- Watershed data for watershed # 1                                         :
:    Curve number             =    90.0                                      :
:    Area                     =    12.1 acres                                :
:    Hydraulic length         =    0.00 feet                                 :
:    Elevation change         =     0.0 feet.                                :
:    Concentration time       =    0.02 hours                                :
:    Unit hydrograph type = Disturbed                                        :
:                                                                            :
:-- Total Area               =    12.1 acres                                 :
:                                                                            :
:-- Storm data                                                               :
:    Total precipitation      =     1.5 inches                               :
:    Storm type               = SCS 6 hour design storm                      :
:    Peak Discharge           =    5.88 cfs                                  :
:    Discharge volume         =    0.70 acre ft                              :
:                                                                            :
: <press return to continue or {esc} to skip detail printout>                :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
Project Title          = D-7 10/6
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number            =    90.0
    Area                    =    13.4 acres
    Hydraulic length        =    0.00 feet
    Elevation change        =     0.0 feet.
    Concentration time      =    0.06 hours
    Unit hydrograph type = Disturbed

-- Total Area              =    13.4 acres

-- Storm data
    Total precipitation     =     1.5 inches
    Storm type              = SCS 6 hour design storm
    Peak Discharge          =    8.58 cfs
    Discharge volume        =    0.78 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
Project Title          = D-8 10/6
WATERSHED HYDROGRAPH
     Inflow into structure #  1
     Structure type:          Null


-- Watershed data for watershed # 1
    Curve number            =    90.0
    Area                    =    26.1 acres
    Hydraulic length        =    0.00 feet
    Elevation change        =     0.0 feet.
    Concentration time      =    0.20 hours
    Unit hydrograph type = Disturbed

-- Total Area              =    26.1 acres

-- Storm data
    Total precipitation     =     1.5 inches
    Storm type              = SCS 6 hour design storm
    Peak Discharge          =   14.30 cfs
    Discharge volume        =    1.52 acre ft

 <press return to continue or {esc} to skip detail printout>
```

```
ject Title            = D-9 10/6
:WATERSHED HYDROGRAPH
:     Inflow into structure #  1
:     Structure type:         Null
:
:
:-- Watershed data for watershed # 1
:    Curve number          =    90.0
:    Area                  =    39.6 acres
:    Hydraulic length      =    0.00 feet
:    Elevation change      =     0.0 feet.
:    Concentration time    =    0.04 hours
:    Unit hydrograph type = Disturbed
:
:-- Total Area           =    39.6 acres
:
:-- Storm data
:    Total precipitation   =     1.5 inches
:    Storm type            = SCS 6 hour design storm
:    Peak Discharge        =   23.46 cfs
:    Discharge volume      =    2.31 acre ft
:
: <press return to continue or {esc} to skip detail printout>
```

```
oject Title            = D-10 10/6
:WATERSHED HYDROGRAPH
:     Inflow into structure #  1
:     Structure type:         Null
:
:
:-- Watershed data for watershed # 1
:    Curve number          =    90.0
:    Area                  =     6.3 acres
:    Hydraulic length      =    0.00 feet
:    Elevation change      =     0.0 feet.
:    Concentration time    =    0.18 hours
:    Unit hydrograph type = Disturbed
:
:-- Total Area           =     6.3 acres
:
:-- Storm data
:    Total precipitation   =     1.5 inches
:    Storm type            = SCS 6 hour design storm
:    Peak Discharge        =    3.47 cfs
:    Discharge volume      =    0.37 acre ft
:
: <press return to continue or {esc} to skip detail printout>
```

```
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:Project Title          = D-11 10/6                                      :
:WATERSHED HYDROGRAPH                                                    :
:      Inflow into structure #  1                                        :
:      Structure type:          Null                                     :
:                                                                        :
:                                                                        :
:-- Watershed data for watershed # 1                                     :
:    Curve number            =    90.0                                   :
:    Area                    =     3.1 acres                             :
:    Hydraulic length        =    0.00 feet                              :
:    Elevation change        =     0.0 feet.                             :
:    Concentration time      =    0.10 hours                             :
:    Unit hydrograph type = Disturbed                                    :
:                                                                        :
:-- Total Area               =     3.1 acres                             :
:                                                                        :
:-- Storm data                                                           :
:    Total precipitation     =     1.5 inches                            :
:    Storm type              = SCS 6 hour design storm                   :
:    Peak Discharge          =    1.93 cfs                               :
:    Discharge volume        =    0.18 acre ft                           :
:                                                                        :
: <press return to continue or {esc} to skip detail printout>            :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=

 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:Project Title          = D-12 10/6                                      :
:WATERSHED HYDROGRAPH                                                    :
:      Inflow into structure #  1                                        :
:      Structure type:          Null                                     :
:                                                                        :
:                                                                        :
:-- Watershed data for watershed # 1                                     :
:    Curve number            =    90.0                                   :
:    Area                    =    49.3 acres                             :
:    Hydraulic length        =    0.00 feet                              :
:    Elevation change        =     0.0 feet.                             :
:    Concentration time      =    0.04 hours                             :
:    Unit hydrograph type = Disturbed                                    :
:                                                                        :
:-- Total Area               =    49.3 acres                             :
:                                                                        :
:-- Storm data                                                           :
:    Total precipitation     =     1.5 inches                            :
:    Storm type              = SCS 6 hour design storm                   :
:    Peak Discharge          =   29.23 cfs                               :
:    Discharge volume        =    2.87 acre ft                           :
:                                                                        :
: <press return to continue or {esc} to skip detail printout>            :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:Project Title         = D-13 10/6                                             :
:WATERSHED HYDROGRAPH                                                          :
:     Inflow into structure #  1                                               :
:     Structure type:         Null                                             :
:                                                                              :
:                                                                              :
:-- Watershed data for watershed # 1                                           :
:    Curve number            =    90.0                                         :
:    Area                    =     1.1 acres                                   :
:    Hydraulic length        =    0.00 feet                                    :
:    Elevation change        =     0.0 feet.                                   :
:    Concentration time      =    0.02 hours                                   :
:    Unit hydrograph type = Disturbed                                          :
:                                                                              :
:-- Total Area              =     1.1 acres                                    :
:                                                                              :
:-- Storm data                                                                 :
:    Total precipitation     =     1.5 inches                                  :
:    Storm type              = SCS 6 hour design storm                         :
:    Peak Discharge          =    0.54 cfs                                     :
:    Discharge volume        =    0.06 acre ft                                 :
:                                                                              :
: <press return to continue or {esc} to skip detail printout>                 :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
V   DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
:   ject Title           = D-12 100/6                                         :
:WATERSHED HYDROGRAPH                                                         :
:     Inflow into structure #  1                                              :
:     Structure type:          Null                                           :
:                                                                             :
:                                                                             :
:-- Watershed data for watershed # 1                                          :
:    Curve number            =    90.0                                        :
:    Area                    =    49.3 acres                                  :
:    Hydraulic length        =    0.00 feet                                   :
:    Elevation change        =     0.0 feet.                                  :
:    Concentration time      =    0.04 hours                                  :
:    Unit hydrograph type = Disturbed                                         :
:                                                                             :
:-- Total Area              =    49.3 acres                                   :
:                                                                             :
:-- Storm data                                                                :
:    Total precipitation     =     2.2 inches                                 :
:    Storm type              = SCS 6 hour design storm                        :
:    Peak Discharge          =   53.19 cfs                                    :
:    Discharge volume        =    5.31 acre ft                                :
:                                                                             :
: <press return to continue or {esc} to skip detail printout>                 :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```

```
V   DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD7
: oject Title            = D-13 100/6                                         :
:WATERSHED HYDROGRAPH                                                         :
:     Inflow into structure #  1                                              :
:     Structure type:          Null                                           :
:                                                                             :
:                                                                             :
:-- Watershed data for watershed # 1                                          :
:    Curve number            =    90.0                                        :
:    Area                    =     1.1 acres                                  :
:    Hydraulic length        =    0.00 feet                                   :
:    Elevation change        =     0.0 feet.                                  :
:    Concentration time      =    0.02 hours                                  :
:    Unit hydrograph type = Disturbed                                         :
:                                                                             :
:-- Total Area              =     1.1 acres                                   :
:                                                                             :
:-- Storm data                                                                :
:    Total precipitation     =     2.2 inches                                 :
:    Storm type              = SCS 6 hour design storm                        :
:    Peak Discharge          =    0.98 cfs                                    :
:    Discharge volume        =    0.12 acre ft                                :
:                                                                             :
: <press return to continue or {esc} to skip detail printout>                 :
SDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD=
```