RICK ENGINEERING COMPANY

March 16, 2020

Ms. Margaret Diss
County of San Diego
5500 Overland Avenue, #410
San Diego, California 92123

SUBJECT: SYCUAN SLOANE CANYON – DRAINAGE STUDY – SEGMENT 1-5 REALIGNMENT, INCLUSION OF SEGMENT 6A OR 6B, AND HYDRAULIC ANALYSIS
(RICK ENGINEERING COMPANY JOB NUMBER 18474-B)

Dear Ms. Diss:

The technical report titled, "Drainage Study for Sycuan Sloane Canyon Trail Project," dated August 30, 2019 (prepared by Rick Engineering Company), was previously approved by the County of San Diego in 2019 and provides hydrologic analysis for the preliminary alignment and design of trail segments 1 thru 5. Since the previous approval of the Drainage Study by the County of San Diego in 2019, changes to project alignments and locations have occurred. The drainage analysis will need to be revised following approvals of the final design, which will occur following this report's submittal for public review. The following revisions to the analysis will be required prior to construction of the final design:

1. The trail alignments for segments one (1) through five (5) have changed from the approved version of the report and will be updated to reflect the design for the final preferred alignments.
2. A new trail segment (i.e. – Segment 6A or Segment 6B, segment to be determined later) located west of Segment 1 along Dehesa Road is being incorporated into the project. The drainage (hydrologic and hydraulic) analyses will need to be updated to account for this new segment. The drainage study will be updated in accordance with the June 2003 County of San Diego Hydrology Manual and 2014 Hydraulic Design Manual.
3. With proposed puncheons in the floodplain, additional hydraulic analysis along with a no-rise certification may need to be prepared (based on the requirements of the County of San Diego Flood Control).

Updates to the analysis presented by this report are anticipated to provide additional detail where needed in support of subsequent plan sets and the final location of each trail segment. The revisions to the drainage analysis will be conducted during the final engineering stage (prior to construction) to ensure potential drainage related impacts/concern are addressed. For general project hydrologic information, please refer to the report titled, "Drainage Study for Sycuan Sloane Canyon Trail Project," dated August 30, 2019 (prepared by Rick Engineering Company).

Regards,

Rick Engineering Company

Brendan Hastie
R.C.E. #65809
Exp. 09/2021

DRAINAGE STUDY
FOR
SYCUAN SLOANE CANYON TRAIL PROJECT

Job Number 18474-B

February 28, 2019
Revised: August 30, 2019

RICK™
ENGINEERING COMPANY

DRAINAGE STUDY
FOR
SYCUAN SLOANE CANYON TRAIL PROJECT

Job Number 18474-B

Brendan Hastie
R.C.E #65809, Exp. 9/21

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February 28, 2019
Revised: August 30, 2019

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1 INTRODUCTION

This Drainage Report supports the preliminary alignment and design of the Sycuan Sloane Canyon Trail Project (herein referred to as the "project"). The project site is generally located along Dehesa Road and Sloane Canyon Road, within the County of San Diego's Right-of-Way and on Tribal lands. The adjacent Tribal lands are owned by the Sycuan Band of the Kumeyaay Nation (Sycuan) and the Kumeyaay Diegueno Land Conservancy. Please refer to the project vicinity map located in Appendix A for more information on the project location.

The project proposes to develop five (5) segments of trail along the project corridor to connect the Sweetwater Loop Trail and the California Riding and Hiking Trail. A sixth segment of trail is anticipated to be constructed in the future to the west of trail segment #1 along Dehesa Road, but was not analyzed as a part of this study.

1.1 General Drainage Characteristics

The trail segments are generally located along the Sweetwater River upstream of the Sweetwater Reservoir. There are several significant contributing streams to the Sweetwater River in the project location including Harbison Canyon Creek, North Fork of the Sweetwater River, and Beaver Hollow Creek.

The existing drainage conditions vary across the project area and for each trail segment. For a detailed discussion of the drainage conditions to each segment of trail, please see the applicable discussion within the Hydrology section of this report. Drainage Study Maps of the overall drainage areas and trail segment locations are located in Map Pocket 1.

1.2 FEMA Flood Zone Information

The major water courses through the project area have been studied by the Federal Emergency Management Agency (FEMA). Defined floodzones and/or floodways exist for portions of the Sweetwater River, Harbison Canyon Creek, North Fork of the Sweetwater, and Beaver Hollow Creek. A map illustrating FEMA floodplains in association with the project boundaries can be found in Appendix B of this report. Trail segments should avoid using fill where improvements are proposed within the flood plain to avoid potential impacts to the limits of flooding.

1.3 Water Quality

This project is anticipated to be considered as Standard project, as little to no impervious area is proposed. As such, no permanent Water Quality facilities are anticipated to be required. Standard Best Management Practices should be utilized during construction and in the long-term for ongoing trail operations.

1.4 Project Description and Features

As discussed previously, Segments 1 through 5 are proposed as multi-use trail to provide a connection between the Sweetwater Loop Trail and the California Riding and Hiking Trail, as depicted in the County of San Diego's Community Trails Master Plan (CTMP), via Dehesa Road and Sloane Canyon Road. The preliminary layout of the trail segments is to be within the County of San Diego's road Right-of-Way, as well as on Tribal lands (Sycuan and Kumeyaay Diegueno Land Conservancy). Descriptions of each of the five trail segments may be found below. The proposed trail segments are based on the County of San Diego Trails Program, Section 7, Design and Construction Guidelines.

For drainage characteristics of each trail segment, as well as design recommendations based on the hydrologic and hydraulic analysis, please refer to the Hydrology and Hydraulics sections of this report.

1.4.1 Segment 1

The alignment of Segment 1 is proposed outside of the public right-of-way and inside Tribal land (Sycuan and the Kumeyaay Diegueno Land Conservancy) adjacent to Dehesa Road. The trail alignment is understood to generally follow an existing dirt maintenance path, located to the south of Dehesa Road. At the eastern limit of the trail segment the trail will parallel Sloane Canyon Road to the south and terminate at the connection with Segment 2. The segment is understood to include an old mining site with manmade ponds. This segment of trail is proposed to be an unpaved, type "B" trail, with a width of 8 feet, to allow use by a vehicle for maintenance purposes. The surface is currently proposed to be compacted native surface material with headers on each edge. The trail profile and alignment are proposed to generally follow existing terrain limiting the amount of earthwork required for construction.

1.4.2 Segment 2

The alignment of Segment 2 is intended to remain with the existing ROW of Sloane Canyon Road to the extent practicable, but additional ROW may be needed from the adjacent tribal land owned by Sycuan for the trail to be situated on the cut slopes adjacent to the roadway. Segment 2 connects to the southerly portion of Segment 1 and extends south along Sloane Canyon Road to the northern end of Segment 4 and eastern end of Segment 3. This segment of trail is proposed to be an unpaved, type "B" trail, with a width of 5 feet. Alternative segment alignments for Segment 2 are currently being considered on the southern portion of the trail, in conjunction with alternative alignments for Segment 3. This drainage study includes analysis of the main segment of trail in addition to the considered alternatives.

1.4.3 Segment 3

The alignment of Segment 3 will go through land owned by Sycuan and the Kumeyaay Diegueno Land Conservancy, extending west from Sloane Canyon Road from the southern terminus of Segment 2 and near the northern terminus of Segment 4, connecting with the National Wildlife Refuge (NWR) Trail Plan. Segment 3 generally follows the alignment of an abandoned, overgrown maintenance roadway for the length of the segment. Without maintenance, the existing unpaved road has seen significant erosion in several sections. This segment of trail is proposed to be an unpaved, type "B" trail, utilizing the existing width of 10 feet, to allow use by a vehicle for maintenance purposes. Alternative segment alignments for Segment 3 are currently being considered on the northern portion of the trail, in conjunction with alternative alignments for Segment 2. This drainage study includes analysis of the main segment of trail in addition to the considered alternatives.

1.4.4 Segment 4

The alignment of Segment 4 will go through land owned by Sycuan and the Kumeyaay Diegueno Land Conservancy, paralleling Sloane Canyon Road from the southern end of Segment 2 and the eastern end of Segment 3, to the western end of Segment 5 at Model A Ford Lane. The trail is proposed to be situated in cut on the steep slope, as an unpaved, type "C" trail, with a graded width of 5 feet.

1.4.5 Segment 5

The alignment of Segment 5 will go through the Kumeyaay Diegueno Land Conservancy, generally paralleling Sloane Canyon Road to the south. The proposed alignment provides regional connection with the southern end of Segment 4 and the California riding and hiking trail. This segment of trail is proposed to be unpaved, type "B" trail, with a width of 5 feet.

1.5 Limitations of Study

This study has been prepared utilizing limited available information and resources to serve as a guide for the design of each of the trail segments. As the layout of the trail segments is preliminary in nature at this time, updates to the analysis presented by this report may be warranted to provide additional detail where needed in support of subsequent plan sets and the final location of each trail segment.

2 HYDROLOGY

2.1 Criteria

The hydrologic conditions were analyzed in accordance with the June 2003 San Diego County Hydrology Manual criteria.

Design Storm:	100-year, 6-hour
100-Year 6-Hour Precip (inches):	P = 3.0 inches
Rainfall Intensity:	Intensity-Duration-Frequency (IDF) Curves within the June 2003 County of San Diego *Hydrology Manual* (inches per hour)

2.2 Rational Method

To calculate the flow rates for basins contributing to the trail segments, a Rational Method analysis was performed in accordance with the methodology presented in the June 2003 County of San Diego *Hydrology Manual* to determine 100-year peak discharge rates for watersheds less than 1 square-mile.

In order for the program to perform the hydrologic analysis; base information for the study area is required. This information includes the land uses, drainage facility locations, flow patterns, drainage basin boundaries, and topographic elevations, as discussed by the following Hydrologic Information section.

2.3 Hydrologic Information

The following information was considered for purposes of hydrologic calculations.

2.3.1 Topography

The topography used for the hydrologic study was derived from 2.5 foot Digital Elevation Model (DEM) data derived from projects in 2014, 2015, and 2017 by SANDAG, the County of San Diego, and SanGIS. Contours were generated from the DEM for analysis and reference purposes. While not as precise as a survey, this elevation source is considered as adequate for the hydrologic and hydraulic analysis purposes of this study when supplemented with site reconnaissance and research.

2.3.2 Existing drainage structures

As-builts of the storm drain infrastructure along Dehesa Road and Sloane Canyon Road were not available at the time this analysis was conducted. Several culvert inlets have been identified, and these inlet locations are represented on the Drainage Exhibits for reference. At this time the exact outfall locations of the storm drain system are not known. Drainage analysis has been conducted based on the understanding that the areas of concentrated flow identifiable on the topographic DEM may convey flows from culvert outfalls.

2.3.3 Area

Watersheds were delineated to distinguish areas with similar flow characteristics and hydrologic properties as well as to determine peak flows at confluence points, design trail crossings and proposed storm drain facilities, and to facilitate hydraulic analyses. Drainage basin boundaries, flow patterns, and topographic elevations are shown on the Drainage Study Maps included in Map Pocket 1.

2.3.4 Runoff Coefficient

Hydrologic soil groups within the project area vary from type “A” to type “D”. SANDAG Landuse Information and SSURGO hydrologic soil group information was used to calculate the weighted runoff coefficients of analyzed basins per Section 3.1.2 of the County of San Diego Hydrology Manual. Calculations are included in Appendix C.

2.3.5 Time of Concentration/Intensity

The time of concentration was calculated using Microsoft Excel as a function of the initial time of concentration and travel time, calculated in accordance with section 3.1.4 of the County of San Diego Hydrology Manual. The majority of area contributing to the trail segments is non-urbanized. Calculations are included in Appendix C of this report.

2.4 Summary of Research

In preparation for this study, the Flood Insurance Study for San Diego County, California, April 2016, prepared by the Federal Emergency Management Agency, was utilized to determine flow rates and velocities at major stream crossings along the proposed trail segments. Relevant portions of this report are included in Appendix C for reference.

2.5 Drainage Characteristics and Hydrologic Results

Descriptions of the drainage characteristics and results of the hydrologic analysis along each of the five trail segments is presented by the following discussion.

2.5.1 Segment 1

The existing terrain is relatively flat grassland. The area receives run-on from the southern half of Dehesa Road, generally as sheet flow. Several culvert inlets have been identified along northern shoulder of Dehesa Road that collect flow from the area of north of Dehesa Road. These inlet locations are represented on the Drainage Exhibits for reference. At this time the location and configuration of storm drain outfalls along Dehesa Road are not known, though it is anticipated that flows may travel from north to south across the proposed segment. Drainage analysis has been conducted based on the understanding that the areas of concentrated flow identifiable on the topographic DEM may convey flows from outfalls along Dehesa Road. At the southeastern limit, flow from an agricultural field and a staging area at the south eastern corner of Dehesa Road and Sloane Canyon Road is understood to flow across Sloane Canyon Road and the location of the proposed trail segment. Since there is an existing maintenance path along this segment, additional observations may be made of the flow regime across the proposed segment by studying the condition of the existing road.

Table 1 – Segment 1 Hydrologic Summary (100-Year Peak Flow Rates)

Drainage Node Number	Crossing Flow Regime	Drainage Area, A (acres)	Time of Concentration, Tc (min.)	Q_{100} (cfs)
10008	CONCENTRATED	21.0	29.4	18.0
11280	CONCENTRATED	37.0	14.5	45.7
11378	CONCENTRATED	160.1	14.7	195.5
11560	CONCENTRATED	90.6	12.4	135.5

2.5.2 Segment 2

Segment 2 is generally located upstream of Sloane Canyon Road, and receives run-on as sheet flow or concentrated flow from the adjacent hillside. There are two major crossings along Segment 2, where the trail is already proposed to cross via existing structures, with striping to

identify the trail alignment. These major crossings are over Harbison Canyon Creek and the North Fork of the Sweetwater River.

Table 2 – Segment 2 Hydrologic Summary (100-Year Peak Flow Rates)

Drainage Node Number	Crossing Flow Regime	Drainage Area, A (acres)	Time of Concentration, Tc (min.)	Q_{100} (cfs)
20080	MAJOR CROSSING	N/A	N/A – Seen note 1	4,700
20110	CONCENTRATED	3.4	9.7	4.2
20120	CONCENTRATED	2.4	8.9	3.3
20174	CONCENTRATED	3.0	7.6	4.5
20206	CONCENTRATED	2.6	8.4	3.7
20226	CONCENTRATED	1.7	7.3	2.6
20248	CONCENTRATED	1.2	7.6	1.9
20295	MAJOR CROSSING	N/A	N/A – See note 2	N/A
20356	CONCENTRATED	0.8	9.3	1.3

Note 1 – Crossing of Harbison Canyon Creek. Flow from FEMA FIS Report

Note 2 – Crossing of North Fork of Sweetwater River. Flow not calculated by FEMA FIS

2.5.3 Segment 3

Segment 3 is understood to have been previously graded into the hillside by others, with berms and/or cut slopes along both sides of the trail. Segment 3 has seen significant erosion in several locations along the existing alignment, and would require extensive regrading to be restored to the proposed cross-section. It is understood that up to 5 CMP culverts have been installed with the initial roadway to convey flows, but these are currently filled with sediment and not in operation. Receiving sheet flow from the adjacent hillside, and originating near the highest, western-most extent of the trail, the cross-section of Segment 3 is currently conveying flows as an open channel and discharging on to Sloane Canyon Road. Additional erosion may be anticipated if flows are not bypassed or repairs are not made to the drainage conveyance along this portion. A proposed alternative alignment of Segment 3, located to the north of the main segment, follows unofficial ATV paths along the ridgeline of the hill. This alternative portion of Segment 3 may also experience significant erosion if design measures are not taken to bypass or dissipate flows.

Table 3 – Segment 3 Hydrologic Summary (100-Year Peak Flow Rates)

Drainage Node Number	Crossing Flow Regime	Drainage Area, A (acres)	Time of Concentration, Tc (min.)	Q_{100} (cfs)
30002	CONVEYANCE	7.0	13.6	7.5
30084	CONVEYANCE	4.0	8.9	5.5
30370	CONVEYANCE	0.3	10.3	0.4

2.5.4 Segment 4

Segment 4 is generally located upstream of Sloane Canyon Road, and receives run-on as sheet flow or concentrated flow from the adjacent hillside.

Table 4 – Segment 4 Hydrologic Summary (100-Year Peak Flow Rates)

Drainage Node Number	Crossing Flow Regime	Drainage Area, A (acres)	Time of Concentration, Tc (min.)	Q_{100} (cfs)
40486	CONCENTRATED	9.7	8.9	13.7
40488	CONCENTRATED	2.2	8	3.2
40500	CONCENTRATED	0.7	7.5	1.1
40535	CONCENTRATED	0.7	7	1.2
40582	CONCENTRATED	1.1	9.5	1.8
40606	CONCENTRATED	0.5	5.2	1.2
40612	CONCENTRATED	0.5	6.3	1.0
40690	CONCENTRATED	30.5	8.1	54.7

2.5.5 Segment 5

Segment 5 is generally located upstream of Sloane Canyon Road, and receives run-on as sheet flow or concentrated flow from the adjacent hillside. Several of the areas of concentrated flow, including Beaver Hollow Creek, are considered to be major crossings.

Table 5 – Segment 5 Hydrologic Summary (100-Year Peak Flow Rates)

Drainage Node Number	Crossing Flow Regime	Drainage Area, A (acres)	Time of Concentration, Tc (min.)	Q_{100} (cfs)
50700	MAJOR CROSSING	238.3	16.7	302.8
50710	CONCENTRATED	14.9	10.7	25.3
50780	CONCENTRATED	2.0	6.8	4.6
50802	CONCENTRATED	21.5	11.2	34.4
50834	CONCENTRATED	3.1	8	5.9
50835	MAJOR CROSSING	5 mi^2	N/A – See note 1	4,000
50860	CONCENTRATED	11.2	9.8	18.9
50898	CONCENTRATED	69.9	12.1	109.4
50918	CONCENTRATED	2.1	7	4.7
50948	CONCENTRATED	7.4	10.8	12.5
50986	CONCENTRATED	41.1	11.6	66.1
51034	CONCENTRATED	1.6	8.6	2.6

Note 1 – Crossing of Beaver Hollow Creek. Flow from FEMA FIS Report

2.6 Post-project Drainage Characteristics

In the post-project condition, the drainage characteristics are anticipated to be similar to the pre-project condition. The design intent is to maintain the same overall drainage characteristics as compared to the pre-project condition. As no impervious surface areas are proposed by the project, the post-project peak flows will be not increased from the pre-project condition.

3 HYDRAULICS

3.1 Criteria

The 100-year post-project peak flow rates determined using the Rational Method were used to determine the applicability of various drainage crossings methods. This includes hydraulic analyses such as storm drain sizing and open channel sizing pursuant to the San Diego County Hydraulics Design Manual (September 2014). Final engineering analysis such as inlet sizing and energy dissipaters may be included with updated analysis to accompany trail segment plan sets.

3.1.1 Open Channel Sizing

Open channels, including existing and proposed channels and berms, will be designed to convey surface flows away from trail improvements and to minimize erosion. Proposed channels will generally maintain a minimum of a 2% longitudinal slope, and will be sized based on the general calculations provided in Appendix E.

3.1.2 Preliminary Culvert Design

Storm drain pipe sizes for culverts, if applicable, were determined based on a normal depth calculation to verify storm drain capacity based on Manning's equation.

$$Q = (1.486/n)\, A\, R^{2/3}\, S^{1/2}$$

Where:

Q = Discharge (cfs)

n = Manning's roughness coefficient

A = Cross-sectional Area of flow (sq. ft.)

R = Hydraulic radius (ft.) (where hydraulic radius is defined as the cross-section area of flow divide by the wetted perimeter, R= A/P)

S = Slope of pipe (ft./ft.)

The Manning's roughness coefficient "n" of 0.024 was typically used for the hydraulic calculations. This value is typically used for corrugated metal pipe (CMP). To establish preliminary pipe sizes, the pipe sizes were evaluated based on the Rational Method flow rates with a 30% "bump up" sizing factor to account for hydraulic losses within the system.

3.2 Analysis of Drainage Crossings

The tables presented within the hydrologic analysis section of this report identify locations where stabilized drainage crossings may be necessary. At these locations the potential for concentrated flow was identified, either along or across the trail. The flow rates are determined through the methodology presented by the previous Hydrology section. Calculations of flow velocity and depth, as applicable, are presented in Appendix D of this report.

Three potential methods of trail stabilization/crossing have been considered for this analysis. These structures are intended to be designed for user safety while also minimizing disturbance and minimizing the number of required crossings. Where applicable, the guidance presented by the County of San Diego Trails Program, Section 7, Design and Construction Guidelines should also be implemented for drainage crossings. Typical details for consideration are included in Appendix E of this report.

Method A. Ford/Low Flow Crossing

- Utilizes the natural water crossing to the extent practicable. The trail and/or stream are stabilized as necessary to convey surface flow while limiting erosion. Typical material for stabilization may be riprap or cobble, size varying based on the anticipated flow velocity and tractive force. Geogrid may also be considered.

Method B. Bridge or Culvert

- Placement of culverts or drainage facilities within trail easements should be avoided and only placed underground. These devices are not allowed to discharge drainage on to the trail easement. Erosion control measures should be taken to prevent erosion at the outfalls of drainage structures. For user safety, surfaces should be solid, non-slip and all-weather.

Method C. Existing Bridge or Concrete Drainage Structure

- Where the trail crosses existing bridges or concrete drainage structures, striping on the concrete structure is proposed to identify the trail crossing. Railings or fall protection may be considered as appropriate.

Information to help determine the feasibility of each method at the various crossing locations is provided in the summary table included with Appendix D. During final design evaluation and selection of the method of crossing will be conducted on a location-specific basis. It should be noted that if dredging or fill is required within water crossings, jurisdictional permits may be required.

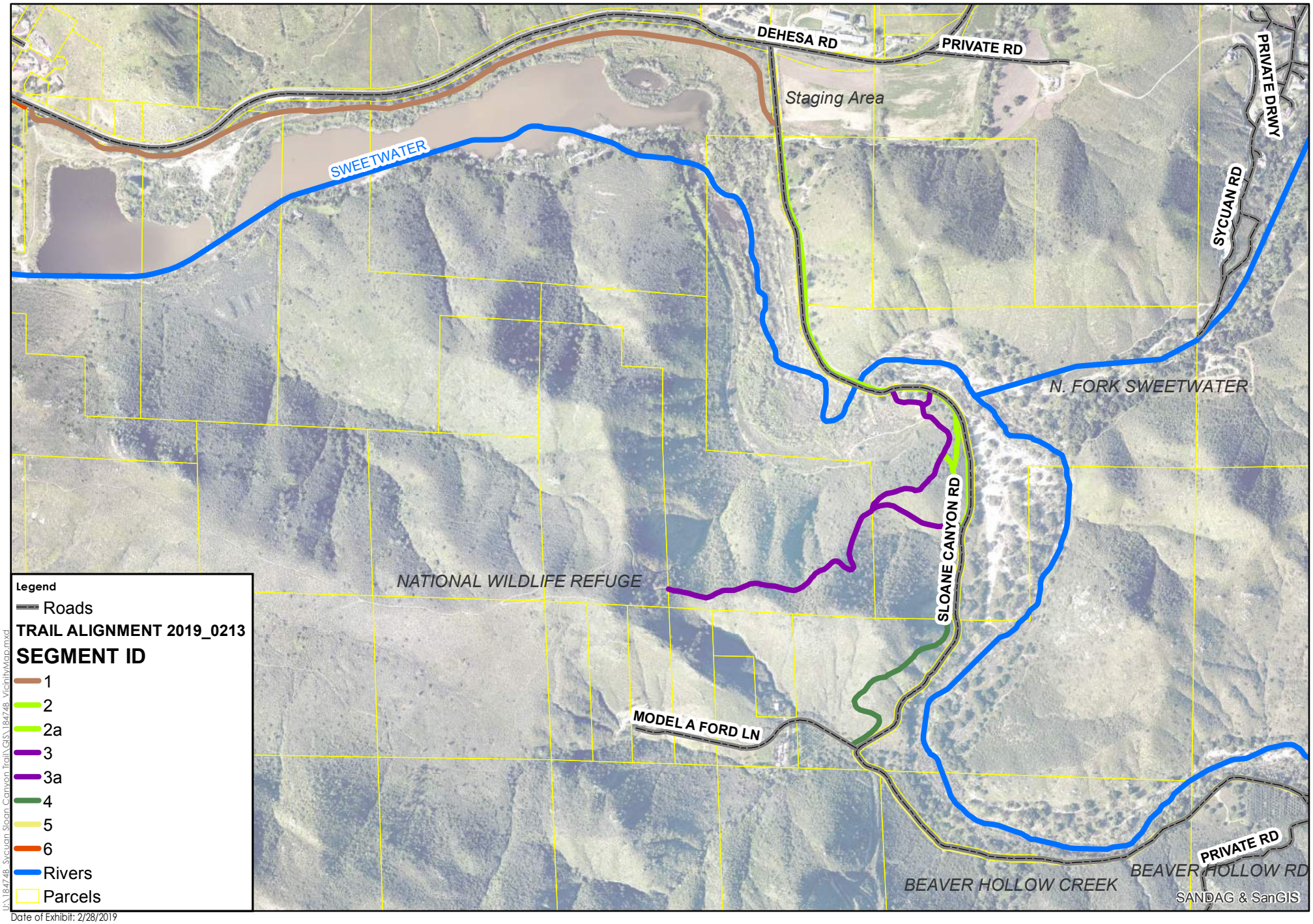
4 CONCLUSION

This Drainage Study presents the hydrologic and hydraulic analyses for Segments 1 through 5 of the Sycuan Sloane Canyon Trail Project. The 100-year 6-hour peak discharge rates were determined using the Rational Method based on the hydrologic methodology and criteria described in the San Diego County Hydrology Manual 2003. The proposed trail segments are intended to maintain the same overall drainage characteristics as compared to the pre-project condition.

Portions of the project are located within the 100-year flood hazard area. Open channel and culvert sizes have been preliminarily calculated based on the 100-year peak flow rates. Analysis and recommendations of drainage crossings are also provided for design purposes.

APPENDIX A

Project Vicinity Map



U:\18474B_Sycuan Sloan Canyon Trail\GIS\18474B_VicinityMap.mxd

Date of Exhibit: 2/28/2019
SANDAG Aerial Image: 2017

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Scale in Feet
0 500 1,000
North

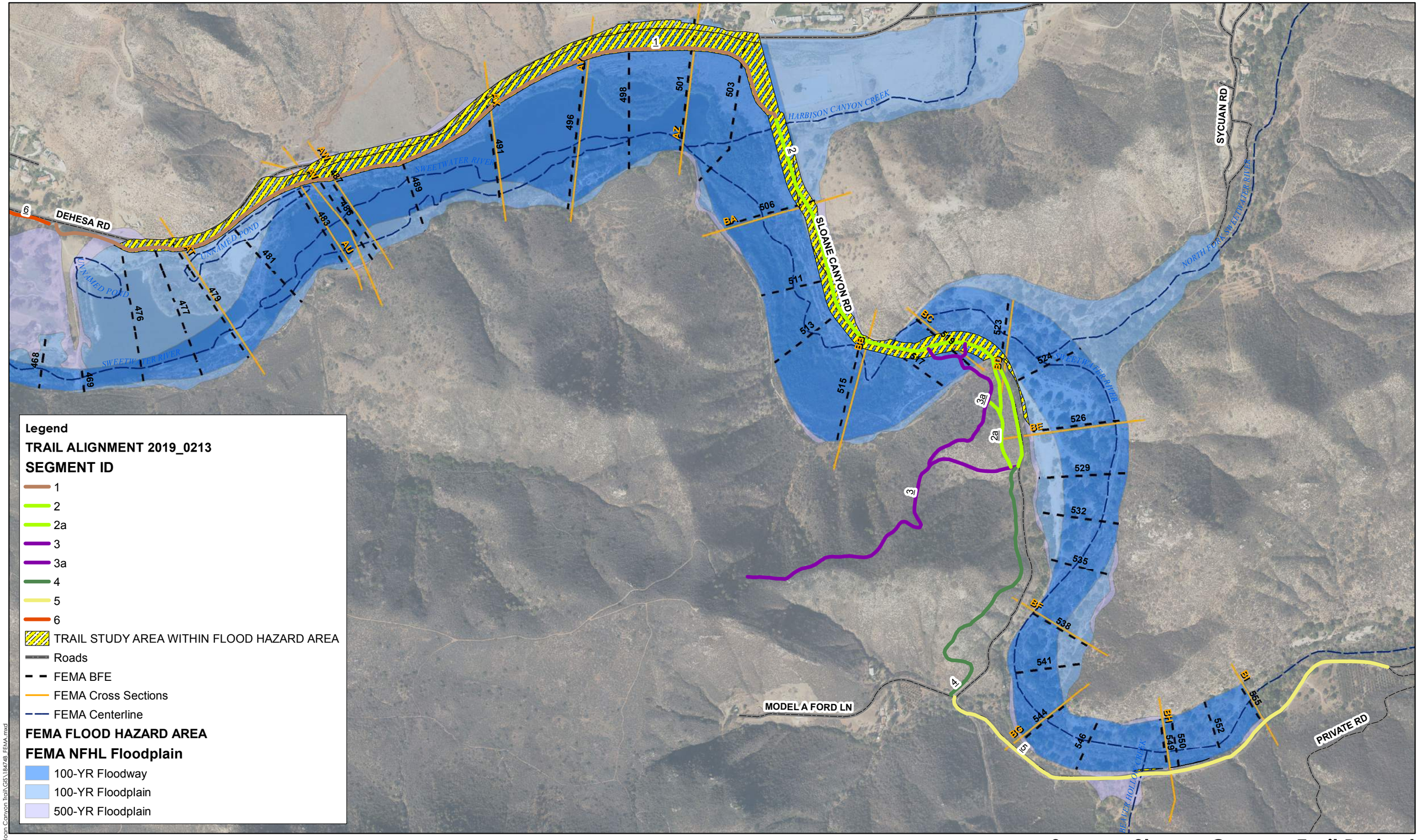
Sycuan Sloane Canyon Trail Improvements

Trail Segment Vicintiy Map

J-18474-B

APPENDIX B

FEMA Map with Project Limits



Legend

TRAIL ALIGNMENT 2019_0213

SEGMENT ID

- 1
- 2
- 2a
- 3
- 3a
- 4
- 5
- 6

TRAIL STUDY AREA WITHIN FLOOD HAZARD AREA

Roads

FEMA BFE

FEMA Cross Sections

FEMA Centerline

FEMA FLOOD HAZARD AREA

FEMA NFHL Floodplain

- 100-YR Floodway
- 100-YR Floodplain
- 500-YR Floodplain

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Scale in Feet

0 700 1,400

North

Date of Exhibit: 2/28/2019
Aerial Image: 2014

Sycuan Sloane Canyon Trail Project

FEMA Flood Hazard Limits

J-18474-B

APPENDIX C

Hydrologic Calculations and Backup

Calculation of Runoff Coeffecients

Soil Group	A		A		A		A		A		A		A		A		A		B		B		B		B		B		B		B		B	
Land Use	Vacant and Undeveloped Land	0.20	Spaced Rural Residential	0.27	Road Right of Way	0.87	Field Crops	0.20	Lake/Reservoir/Large Pond	0.20	Open Space Park or Preserve	0.20	Elementary School	0.80	Other Retail Trade and Strip Commercia	0.80	Single Family Residential Without Units	0.52	Vacant and Undeveloped Land	0.25	Spaced Rural Residential	0.32	Road Right of Way	0.87	Field Crops	0.25	Lake/Reservoir/Large Pond	0.25	Open Space Park or Preserve	0.25	Elementary School	0.80	Other Retail Trade and Strip Commercia	0.80	Single Family Residential Without Units	0.54
		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -

NODE ID	Total Area (Ac)	Weighted C Value (-)	Sub-Area (Ac)																	
10008	21.0	0.34	0.57	0	1.64	3.35	0	0	0	0	0	0	0	1.62	13.86	0	0	0	0	0
11280	37.0	0.31	0.18	0	0.43	0	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0
11378	160.1	0.31	1.85	0	2.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11560	90.6	0.34	0.82	0.02	0.18	0	0	0	0	0	0	0	0	0.36	0.40	0	0	0	0.93	0	0
20080	0.0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20110	3.4	0.24	1.00	0	0	0	0	0	0	0	0	0	2.40	0	0	0	0	0	0	0	0
20120	2.4	0.25	0.09	0	0	0	0	0	0	0	0	0	2.35	0	0	0	0	0	0	0	0
20174	3.0	0.25	0	0	0	0	0	0	0	0	0	0	2.96	0	0	0	0	0	0	0	0
20206	2.6	0.25	0	0	0	0	0	0	0	0	0	0	2.63	0	0	0	0	0	0	0	0
20226	1.7	0.25	0	0	0	0	0	0	0	0	0	0	1.70	0	0	0	0	0	0	0	0
20248	1.2	0.25	0	0	0	0	0	0	0	0	0	0	1.24	0	0	0	0	0	0	0	0
20295	0.0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20356	0.8	0.31	0.16	0	0	0	0	0	0	0	0	0	0.06	0	0	0	0	0	0	0	0
30002	7.0	0.26	0	0	0	0	0	0	0	0	0	0	6.57	0	0	0	0	0.02	0	0	0
30084	4.0	0.25	0	0	0	0	0	0	0	0	0	0	1.46	0	0	0	0	2.50	0	0	0
30370	0.3	0.25	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0
40486	9.7	0.26	0	0	0	0	0	0	0	0	0	0	9.07	0	0	0	0	0	0	0	0
40488	2.2	0.25	0	0	0	0	0	0	0	0	0	0	2.10	0	0	0	0	0	0	0	0
40500	0.7	0.26	0	0	0	0	0	0	0	0	0	0	0.59	0	0	0	0	0	0	0	0
40535	0.7	0.26	0	0	0	0	0	0	0	0	0	0	0.67	0	0	0	0	0	0	0	0
40582	1.1	0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.59	0	0	0
40606	0.5	0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0
40612	0.5	0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.24	0	0	0
40690	30.5	0.31	0	0	0	0	0	0	0	0	0	0	1.38	11.11	0	0	0	8.67	0	0	0
50700	238.3	0.35	0	0	0	0	0	0	0	0	0	0	6.14	0.62	0	0	0	3.00	0	0	0
50710	14.9	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50780	2.0	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50802	21.5	0.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50834	3.1	0.33	0.02	0	0	0	0	0.45	0	0	0	0	0	0	0	0	0	0	0	0	0
50835	2,081.1	0.34	0.09	0	0	0	0	3.18	0	0	0	0	128.92	157.14	0	0	0	21.79	0	0	0
50860	11.2	0.33	0.00	0	0	0	0	1.28	0	0	0	0	0	0	0	0	0	0	0	0	0
50898	69.9	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50918	2.1	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50948	7.4	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50986	41.1	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51034	1.6	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.96	0	0	0

Calculation of Runoff Coeffecients

	C		C		C		C		C		C		C		C		C		D		D		D		D		D		D		D		D	
	Vacant and Undeveloped Land	0.30	Spaced Rural Residential	0.36	Road Right of Way	0.87	Field Crops	0.30	Lake/Reservoir/Large Pond	0.30	Open Space Park or Preserve	0.30	Elementary School	0.81	Other Retail Trade and Strip Commercia	0.81	Single Family Residential Without Units	0.57	Vacant and Undeveloped Land	0.35	Spaced Rural Residential	0.41	Road Right of Way	0.87	Field Crops	0.35	Lake/Reservoir/Large Pond	0.35	Open Space Park or Preserve	0.35	Elementary School	0.82	Other Retail Trade and Strip Commercia	0.82	Single Family Residential Without Units	0.60
		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -		C -
NODE ID	**Sub-Area (Ac)**																																	
10008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11280	30.74	0	0.25	0	0	1.97	0	0	0	3.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11378	60.73	0	0.34	0	0	94.76	0	0	0	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11560	73.84	2.54	2.28	0	0	5.80	0.56	0	1.42	0.83	0	0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20080	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20174	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20206	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20226	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20248	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20295	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20356	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.36	0.01	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0
30084	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30370	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40486	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.53	0	0	0	0	0	0	0	0	0	0.08	0	0	0	0	0	0	0
40488	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0
40500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40535	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40582	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.55	0	0	0	0	0	0	0
40606	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.29	0	0	0	0	0	0	0
40612	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0
40690	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.90	3.54	0	0	0	0	0	0	0	0	3.90	0	0	0	0	0	0	0
50700	0	0	0	0	0	3.02	0	0	0	20.25	6.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198.80	0	0	0	0	0	0	0
50710	0	0	0	0	0	0	0	0	0	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.88	0	0	0	0	0	0	0
50780	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.02	0	0	0	0	0	0	0
50802	0	0	0	0	0	3.78	0	0	0	0.58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.18	0	0	0	0	0	0	0
50834	0	0	0	0	0	0	0	0	0	0.27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.32	0	0	0	0	0	0	0
50835	141.06	264.48	0	0	0	235.05	0	0	0.34	398.57	128.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	601.66	0	0	0.03	0	0	0	0
50860	0	0	0	0	0	0	0	0	0	5.87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.02	0	0	0	0	0	0	0
50898	0	0	0	0	0	0	0	0	0	57.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.11	0	0	0	0	0	0	0
50918	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.13	0	0	0	0	0	0	0
50948	0	0	0	0	0	0	0	0	0	4.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.68	0	0	0	0	0	0	0
50986	0	0	0	0	0	0	0	0	0	6.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34.82	0	0	0	0	0	0	0
51034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.67	0	0	0	0	0	0	0

Calculation of Time of Concentration

					T_i calc				T_t calc			
Drainage Node ID	Flow Path Length (ft)	Max Elevation (ft)	Min. Elevation (ft)	T_c (min)	Initial Slope (%)	Estimated Initial Flow Length (ft)	C	Calculated T_i (min)	Remaining Travel L (miles)	Travel Start Elevation (ft)	E (ft)	Calculated T_c (min)
10008	2,897	526.4	495.8	29.4	5	100	0.34	8.0	0.530	521.4	25.6	21.4
11280	4,232	1,356.8	479.7	14.5	15	100	0.31	5.8	0.783	1341.8	862.1	8.7
11378	4,917	1,769.6	478.2	14.7	15	100	0.31	5.8	0.912	1754.6	1,276.4	8.9
11560	3,077	1,286.9	481.6	12.4	10	100	0.34	6.3	0.564	1276.9	795.3	6.1
20110	920	688.8	502.5	9.7	10	100	0.24	7.2	0.155	678.8	176.3	2.5
20120	781	741.2	502.7	8.9	10	100	0.25	7.1	0.129	731.2	228.5	1.8
20174	719	857.6	514.6	7.6	15	100	0.25	6.2	0.117	842.6	328.0	1.4
20206	668	846.2	514.2	8.4	10	100	0.25	7.1	0.108	836.2	322.0	1.3
20226	586	804.7	515.5	7.3	15	100	0.25	6.2	0.092	789.7	274.2	1.1
20248	671	794.2	513.7	7.6	15	100	0.25	6.2	0.108	779.2	265.5	1.4
20356	580	566.3	527.7	9.3	10	100	0.31	6.6	0.091	556.3	28.6	2.7
30002	2,726	1,018.7	549.6	13.6	10	100	0.26	7.0	0.497	1008.7	459.1	6.6
30084	758	1,088.9	1,000.9	8.9	15	100	0.25	6.2	0.125	1073.9	73.0	2.7
30370	559	694.9	551.6	10.3	5	100	0.25	8.9	0.087	689.9	138.3	1.4
40486	1,349	992.3	542.1	8.9	15	100	0.26	6.1	0.237	977.3	435.2	2.8
40488	867	907.1	543.6	8.0	15	100	0.25	6.2	0.145	892.1	348.5	1.8
40500	703	904.8	558.7	7.5	15	100	0.26	6.1	0.114	889.8	331.1	1.4
40535	517	902.7	571.0	7.0	15	100	0.26	6.1	0.079	887.7	316.7	0.9
40582	579	933.7	635.6	9.5	5	100	0.3	8.4	0.091	928.7	293.1	1.1
40606	323	914.3	725.7	5.2	30	100	0.3	4.6	0.042	884.3	158.6	0.6
40612	316	911.3	730.7	6.3	15	100	0.3	5.8	0.041	896.3	165.6	0.5
40690	2,189	1,243.3	579.1	8.1	60	100	0.31	3.6	0.396	1183.3	604.2	4.5
50710	2,453	1,202.7	569.3	10.7	15	100	0.35	5.5	0.446	1187.7	618.4	5.2
50780	554	734.4	559.9	6.8	15	100	0.35	5.5	0.086	719.4	159.5	1.3
50802	2,771	1,276.2	554.3	11.2	15	100	0.34	5.5	0.506	1261.2	706.9	5.7
50834	1,077	888.4	540.6	8.0	15	100	0.33	5.6	0.185	873.4	332.8	2.4
50860	1,536	985.0	544.9	9.8	10	100	0.33	6.4	0.272	975	430.1	3.4
50898	3,652	1,671.4	554.0	12.1	15	100	0.35	5.5	0.673	1656.4	1,102.4	6.6
50918	589	721.1	568.3	7.0	15	100	0.35	5.5	0.093	706.1	137.8	1.5
50948	2,239	1,010.5	570.1	10.8	15	100	0.35	5.5	0.405	995.5	425.4	5.3
50986	3,288	1,573.6	559.3	11.6	15	100	0.35	5.5	0.604	1558.6	999.3	6.1
51034	606	658.3	558.8	8.6	10	100	0.29	6.8	0.096	648.3	89.5	1.8

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

PROJECT LOCATION

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
SD
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'

33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S

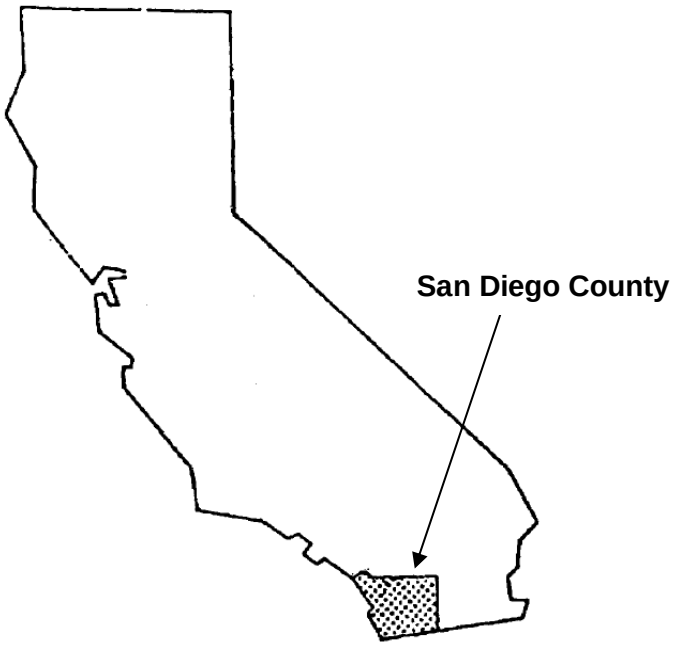
3 0 3 Miles

FLOOD INSURANCE STUDY

SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

VOLUME 1 OF 11

Community Name	Community Number
SAN DIEGO COUNTY, UNINCORPORATED AREAS	060284
CARLSBAD, CITY OF	060285
CHULA VISTA, CITY OF	065021
CORONADO, CITY OF	060287
DEL MAR, CITY OF	060288
EL CAJON, CITY OF	060289
ENCINITAS, CITY OF	060726
ESCONDIDO, CITY OF	060290
IMPERIAL BEACH, CITY OF	060291
LA MESA, CITY OF	060292
LEMON GROVE, CITY OF	060723
NATIONAL CITY, CITY OF	060293
OCEANSIDE, CITY OF	060294
POWAY, CITY OF	060702
SAN DIEGO, CITY OF	060295
SAN MARCOS, CITY OF	060296
SANTEE, CITY OF	060703
SOLANA BEACH, CITY OF	060725
VISTA, CITY OF	060297



REVISED
4/5/2016

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06073CV001D

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At San Diego River	14.0	2,700	4,500	5,100	6,500
Beaver Hollow Creek					
Approximately 1,200 Feet Downstream of Beaver Hollow Road	5.0	--	--	4,000	--
Beeler Creek					
At U.S. Geological Survey (USGS) Gage on Downstream Side of Pomerado Road	5.5	700	2,400	3,600	9,200
Borrego Palm Canyon					
At Apex of Alluvial Fan	23.3	3,100	7,700	10,650	14,800
Box Canyon					
At Apex of Alluvial Fan	5.9	850	2,600	3,850	4,950
Broadway Creek					
At Mouth	3.8	500	1,200	1,600	4,200
Buena Creek					
At Mouth	6.3	1,880	3,520	4,100	5,420
At Buena Creek Road	1.5	--	--	1,980	--

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Old El Camino Real	2.4	--	--	1,606	--
Green Valley Creek					
At Corporate Limits with City of San Diego	3.2	950	2,050	2,700	4,700
At Orchard Bend Road	1.5	450	925	1,200	2,000
Green Valley Creek Tributary					
At Confluence with Green Valley Creek	0.3	80	200	300	600
Harbison Canyon Creek					
At Noakes Street Crossing	--	500	--	2,100	--
At Warfield Way Crossing	--	750	--	3,000	--
At Collier Way Crossing	--	775	--	3,200	--
At Dehesa Road Crossing	--	1,050	--	4,700	--
Hatfield Creek					
At Mouth	20.8	1,700	7,900	13,700	35,600
Hellhole Canyon					
At Apex of Alluvial Fan	4.8	1,900	4,250	6,450	9,200

-- Data Not Available

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At Mouth	1.2	--	--	900	--
Sunrise Overflow					
At Hollister Street	--[7]	50	435	700	1,800
At Iris Avenue	--[7]	0	300	550	3,000
Sweetwater River (Above Reservoir)					
At Broadway	219.0	1,200	21,000	35,000	60,000
At Intersection of Sweetwater and Bonia Roads	197.0	1,200	21,000	35,000	60,000
Below Confluence with Spring Valley Creek	194.0	1,200	21,000	35,000	60,000
Above Sweetwater Reservoir	174.0	5,600	21,500	29,500	53,600
Below Confluence with Harbison Creek	138.0	5,500	21,000	29,000	53,000
Below Confluence, North Fork	131.0	5,300	20,500	28,000	50,000
Sweetwater River (At National City)					
At Broadway	219.0	1,200	21,000	35,000	60,000
Sweetwater River (Near Descanso)					
At Japatul Valley Road Bridge	41.0	3,800	14,800	20,300	36,800

--[7] This Area is Subject to Overflow Flooding; and therefore, does not have a Defined Contributing Drainage

FLOOD INSURANCE STUDY

SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

VOLUME 3 OF 11

Community Name	Community Number
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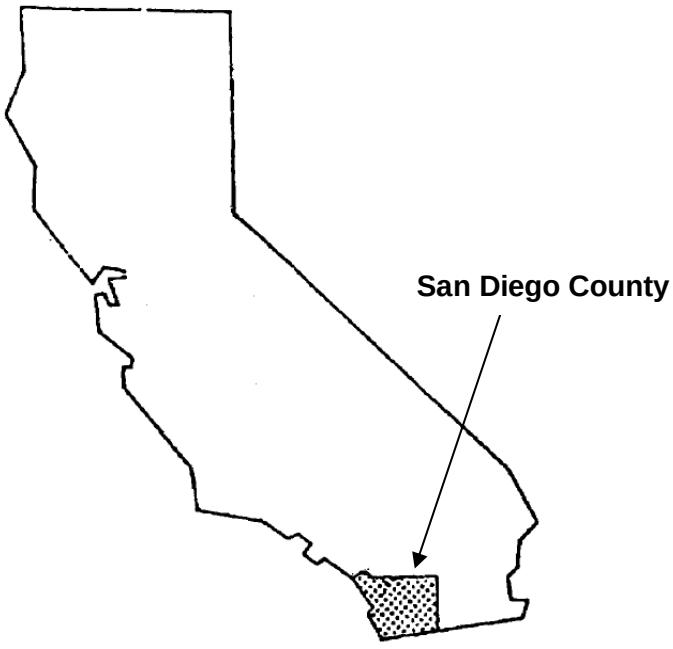
ENCINITAS, CITY OF	060726
ESCONDIDO, CITY OF	060290
IMPERIAL BEACH, CITY OF	060291
LA MESA, CITY OF	060292
LEMON GROVE, CITY OF	060723
NATIONAL CITY, CITY OF	060293
OCEANSIDE, CITY OF	060294
POWAY, CITY OF	060702
SAN DIEGO, CITY OF	060295
SAN MARCOS, CITY OF	060296
SANTEE, CITY OF	060703
SOLANA BEACH, CITY OF	060725
VISTA, CITY OF	060297



REVISED
4/5/2016

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06073CV003D

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Beaver Hollow Creek								
A	2,700	62	414	9.7	1,077.9	1,077.9	1,078.9	1.0
B	3,150	58	361	11.1	1,089.0	1,089.0	1,089.1	0.1
C	3,520	56	361	11.1	1,094.6	1,094.6	1,094.6	0.0
D	3,767	85	399	10.0	1,099.9	1,099.9	1,100.1	0.2
E	3,912	89	633	6.3	1,102.2	1,102.2	1,102.7	0.5
F	3,932	95	604	6.6	1,104.1	1,104.1	1,104.1	0.0
G	4,092	69	363	11.0	1,106.7	1,106.7	1,106.9	0.2
H	4,372	51	310	12.9	1,114.1	1,114.1	1,114.1	0.0
I	4,712	66	353	11.3	1,124.9	1,124.9	1,125.1	0.2
J	5,132	57	339	11.8	1,130.0	1,130.0	1,130.6	0.6
K	5,482	77	380	10.5	1,135.9	1,135.9	1,136.1	0.2
L	5,814	97	416	9.6	1,148.4	1,148.4	1,149.0	0.6
M	6,294	62	362	11.0	1,169.8	1,169.8	1,169.8	0.0
N	6,524	94	616	6.5	1,172.8	1,172.8	1,173.1	0.3
O	6,954	91	405	9.9	1,177.3	1,177.3	1,177.6	0.3
P	7,354	55	322	12.4	1,186.3	1,186.3	1,186.3	0.0
Q	7,704	146	424	9.4	1,199.6	1,199.6	1,199.6	0.0
R	7,934	69	390	10.3	1,203.1	1,203.1	1,203.3	0.2
S	8,364	48	308	13.0	1,213.0	1,213.0	1,213.0	0.0
T	8,698	57	302	13.2	1,225.7	1,225.7	1,225.7	0.0
U	9,098	49	334	12.0	1,235.2	1,235.2	1,235.2	0.0
V	9,416	61	339	11.8	1,249.0	1,249.0	1,249.0	0.0
W	9,836	64	346	10.1	1,270.7	1,270.7	1,270.7	0.0
X	10,216	68	296	11.8	1,293.7	1,293.7	1,293.7	0.0
Y	10,536	46	256	13.7	1,306.6	1,306.6	1,306.6	0.0
Z	10,948	51	315	11.1	1,335.5	1,335.5	1,335.5	0.0

[1] Feet Above Confluence with Sweetwater River

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Harbison Canyon Creek								
A	0	210	599	7.8	572.4	572.4	573.1	0.7
B	446	131	594	7.9	575.1	575.1	575.8	0.7
C	597	95	403	11.7	576.9	576.9	576.9	0.0
D	1,112	102	467	10.1	581.0	581.0	581.4	0.4
E	1,526	106	523	9.1	584.6	584.6	585.4	0.8
F	2,081	74	393	12.0	588.8	588.8	589.1	0.3
G	2,529	79	388	12.1	592.9	592.9	593.1	0.2
H	3,102	142	523	8.6	599.8	599.8	600.2	0.4
I	3,593	201	503	8.9	606.7	606.7	607.0	0.3
J	4,062	219	455	9.9	612.0	612.0	612.4	0.4
K	4,244	195	334	11.7	613.7	613.7	614.4	0.7
L	5,148	185	541	7.2	622.8	622.8	623.4	0.6
M	5,565	85	364	10.7	628.6	628.6	628.7	0.1
N	6,061	91	370	10.5	635.8	635.8	636.0	0.2
O	6,568	65	300	12.3	646.1	-- [2]	-- [2]	-- [2]
P	7,093	67	305	12.1	670.8	670.8	671.2	0.4
Q	7,637	60	274	13.5	699.1	699.1	699.1	0.0
R	8,160	54	283	13.1	725.8	725.8	725.8	0.0
S	8,794	73	370	10.0	751.2	751.2	751.9	0.7
T	9,395	57	255	13.7	776.9	776.9	776.9	0.0
U	9,909	54	259	13.5	789.2	789.2	789.2	0.0
V	10,578	45	262	12.2	809.0	809.0	809.4	0.4
W	10,965	23	200	16.0	814.7	814.7	814.8	0.1
X	11,596	97	447	6.7	829.8	829.8	829.8	0.0
Y	12,611	68	294	10.2	859.2	859.2	859.2	0.0
Z	12,810	80	304	9.9	865.0	865.0	865.0	0.0

[1] Feet Above Limit of Detailed Study

[2] Data Not Available

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

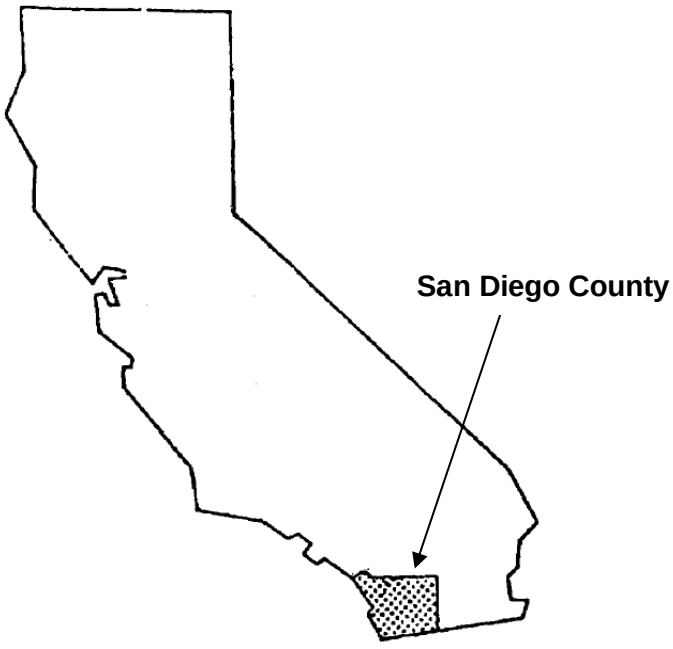
HARBISON CANYON CREEK

FLOOD INSURANCE STUDY

SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

VOLUME 4 OF 11

Community Name	Community Number
SAN DIEGO COUNTY, UNINCORPORATED AREAS	060284
CARLSBAD, CITY OF	060285
CHULA VISTA, CITY OF	065021
CORONADO, CITY OF	060287
DEL MAR, CITY OF	060288
EL CAJON, CITY OF	060289
ENCINITAS, CITY OF	060726
ESCONDIDO, CITY OF	060290
IMPERIAL BEACH, CITY OF	060291
LA MESA, CITY OF	060292
LEMON GROVE, CITY OF	060723
NATIONAL CITY, CITY OF	060293
OCEANSIDE, CITY OF	060294
POWAY, CITY OF	060702
SAN DIEGO, CITY OF	060295
SAN MARCOS, CITY OF	060296
SANTEE, CITY OF	060703
SOLANA BEACH, CITY OF	060725
VISTA, CITY OF	060297



REVISED
4/5/2016

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06073CV004D

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sweetwater River (Above Reservoir)								
A	0	1,133	16,651	1.8	249.7	249.7	250.7	1.0
B	1,520	1,015	7,315	4.0	249.9	249.9	250.8	0.9
C	2,070	1,075	5,696	5.2	250.3	250.3	250.3	0.0
D	3,092	491	3,743	7.9	251.4	251.4	251.4	0.0
E	5,507	247	2,435	12.1	258.3	258.3	258.5	0.2
F	8,097	203	1,406	21.0	268.8	268.8	268.8	0.0
G	8,420	183	1,633	18.1	273.1	273.1	273.1	0.0
H	10,110	243	2,587	11.4	282.7	282.7	282.8	0.1
I	10,970	246	2,074	14.2	289.3	289.3	289.4	0.1
J	12,057	413	2,512	11.7	298.0	298.0	298.0	0.0
K	13,657	720	5,060	5.8	305.9	305.9	306.1	0.2
L	15,520	522	6,012	4.9	318.8	318.8	318.8	0.0
M	15,725	530	5,558	5.3	319.2	319.2	319.2	0.0
N	17,366	664	5,288	5.6	322.3	322.3	322.4	0.1
O	17,869	720	6,617	4.5	323.5	323.5	323.8	0.3
P	19,309	1,025	5,378	5.5	329.2	329.2	329.3	0.1
Q	21,632	960	4,695	6.3	336.7	336.7	336.8	0.1
R	24,273	749	4,140	7.1	345.6	345.6	345.9	0.3
S	25,510	577	3,678	8.0	350.2	350.2	350.2	0.0
T	26,529	1,150	3,209	9.2	353.6	353.6	353.7	0.1
U	27,732	750	3,967	7.4	363.0	363.0	363.2	0.2
V	27,749	750	4,040	7.3	363.1	363.1	363.3	0.2
W	30,221	830	2,937	10.0	375.0	375.0	375.1	0.1
X	30,784	670	1,904	15.5	378.2	378.2	378.2	0.0
Y	30,951	640	4,635	6.4	382.4	382.4	382.6	0.2

[1] Feet Above Sweetwater Reservoir

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

SWEETWATER RIVER (ABOVE RESERVOIR)

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sweetwater River (Above Reservoir) (cont'd)								
Z	33,190	935	2,498	11.8	387.3	387.3	387.3	0.0
AA	33,835	1,036	7,741	3.8	390.2	390.2	390.6	0.4
AB	34,555	833	4,393	6.7	390.5	390.5	390.8	0.3
AC	35,657	440	3,622	8.1	400.0	400.0	400.3	0.3
AD	35,751	455	4,278	6.9	400.9	400.9	401.2	0.3
AE	37,315	561	3,927	7.5	402.6	402.6	403.0	0.4
AF	37,802	572	2,921	10.1	404.2	404.2	404.3	0.1
AG	40,171	405	3,318	8.9	417.2	417.2	417.4	0.2
AH	41,078	668	6,117	4.8	420.8	420.8	421.6	0.8
AI	42,395	344	4,408	6.7	425.1	425.1	425.1	0.0
AJ	43,725	480	3,777	8.8	430.2	430.2	430.4	0.2
AK	44,975	320	4,151	7.8	440.8	440.8	440.9	0.1
AL	45,525	358	3,676	8.9	441.2	441.2	441.3	0.1
AM	46,995	170	3,008	9.8	444.3	444.3	444.3	0.0
AN	47,845	145	1,797	17.1	447.0	447.0	447.0	0.0
AO	48,195	187	2,541	11.6	451.8	451.8	451.8	0.0
AP	48,520	325	3,089	10.3	455.0	454.8	454.8	0.0
AQ	49,120	491	2,562	11.5	455.5	455.5	455.5	0.0
AR	49,920	679	3,414	10.8	459.1	459.1	459.1	0.0
AS	51,340	440	3,798	7.8	463.8	463.8	463.8	0.0
AT	54,209	395	6,427	4.7	479.1	479.1	479.3	0.2
AU	55,346	851	3,171	9.3	483.5	483.5	483.5	0.0
AV	55,481	778	3,306	8.9	484.3	484.3	484.3	0.0
AW	55,645	570	4,232	7.0	487.2	487.2	487.2	0.0

[1] Feet Above Sweetwater Reservoir

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Sweetwater River (Above Reservoir) (cont'd)								
AX	56,845	642	2,635	11.2	491.0	491.0	491.1	0.1
AY	57,545	1,354	4,903	6.0	496.1	496.1	496.2	0.1
AZ	58,515	989	3,822	7.7	500.9	500.9	500.9	0.0
BA	59,445	636	2,740	10.2	506.5	506.5	506.6	0.1
BB	60,775	883	4,576	6.1	515.6	515.6	515.7	0.1
BC	61,325	669	3,196	8.8	519.6	519.6	519.6	0.0
BD	62,085	494	3,240	8.6	523.0	523.0	523.0	0.0
BE	63,235	619	3,295	7.9	526.3	526.3	527.0	0.7
BF	64,755	265	1,837	14.1	538.1	538.1	538.1	0.0
BG	65,655	477	3,344	7.8	543.7	543.7	544.7	1.0
BH	66,705	425	2,266	11.5	549.5	549.5	549.5	0.0
BI	67,625	346	2,273	11.4	555.3	555.3	555.4	0.1

[1] Feet Above Sweetwater Reservoir

APPENDIX D

Hydraulic Calculations

NODE ID	Crossing Flow Regime Type	Total Area (Ac)	Q_100 (cfs)	Channel Name	Estimated Channel Slope at Crossing (%)	Approximate Flow Depth[NOTE 1] (ft)	Approximate Flow Velocity[NOTE 1] (ft/s)	Equivalent Culvert Diameter[NOTE 2] (in)
10008	CONCENTRATED	21.0	18.0		2.0	1.4	3.2	30
11280	CONCENTRATED	37.0	45.7		2.0	2.0	4.1	Dual 30
11378	CONCENTRATED	160.1	195.5		2.0	3.0	5.7	Box Culvert or Bridge
11560	CONCENTRATED	90.6	135.5		2.0	2.6	5.2	Box Culvert or Bridge
20080	MAJOR CROSSING	N/A	4,700	Harbison Canyon Creek	N/A	N/A	N/A	N/A
20110	CONCENTRATED	3.4	4.2		1.0	0.9	1.7	18
20120	CONCENTRATED	2.4	3.3		2.0	0.8	2.1	18
20174	CONCENTRATED	3.0	4.5		5.0	0.7	3.2	18
20206	CONCENTRATED	2.6	3.7		5.0	0.7	3.1	18
20226	CONCENTRATED	1.7	2.6		5.0	0.5	2.7	12
20248	CONCENTRATED	1.2	1.9		5.0	0.5	2.6	12
20295	MAJOR CROSSING	N/A	N/A	North Fork of the Sweetwater River	N/A	N/A	N/A	N/A
20356	CONCENTRATED	0.8	1.3		2.0	0.5	1.7	12
30002	CONVEYANCE	7.0	7.5		10.0	0.7	4.5	24
30084	CONVEYANCE	4.0	5.5		10.0	0.7	4.3	18
30370	CONVEYANCE	0.3	0.4		10.0	0.3	2.4	12
40486	CONCENTRATED	9.7	13.7		5.0	1.2	4.9	30
40488	CONCENTRATED	2.2	3.2		10.0	0.5	3.8	18
40500	CONCENTRATED	0.7	1.1		10.0	0.3	2.8	12
40535	CONCENTRATED	0.7	1.2		10.0	0.4	3.1	12
40582	CONCENTRATED	1.1	1.8		70.0	0.3	7	12
40606	CONCENTRATED	0.5	1.2		90.0	0.2	6.4	12
40612	CONCENTRATED	0.5	1.0		90.0	0.2	6.4	12
40690	CONCENTRATED	30.5	54.7		10.0	1.6	7.5	Dual 36
50700	MAJOR CROSSING	238.3	302.8		5.0	2.6	9.0	Box Culvert or Bridge
50710	CONCENTRATED	14.9	25.3		10.0	1.2	6.6	36
50780	CONCENTRATED	2.0	4.6		10.0	0.6	4.1	18
50802	CONCENTRATED	21.5	34.4		10.0	1.2	6.6	36
50834	CONCENTRATED	3.1	5.9		5.0	0.8	3.4	18
50835	MAJOR CROSSING	N/A	4,000	Beaver Hollow Creek	2.0	5	16	N/A
50860	CONCENTRATED	11.2	18.9		2.0	1.4	3.2	30
50898	CONCENTRATED	69.9	109.4		5.0	2.0	7.0	Box Culvert or Bridge
50918	CONCENTRATED	2.1	4.7		5.0	0.7	3.2	18
50948	CONCENTRATED	7.4	12.5		10.0	0.8	5.0	24
50986	CONCENTRATED	41.1	66.1		5.0	1.9	6.0	Dual 36
51034	CONCENTRATED	1.6	2.6		5.0	0.6	2.7	12

Note 1 - Approximate flow depth and velocity is calculated reflective of the current channel geometry.

Note 2 - Equivalent culvert size is for reference only and not provided as a recommendation. During final design evaluation, selection of the method of crossing will be conducted on a location-specific basis.

Sycuan Sloane Canyon Trail Project
J-18474B
2/28/2019

Preliminary Storm Drain Size

The purpose of this table is to provide an estimated pipe size to convey the 100-year flow rates with a sizing factor.

Manning's n: 0.024

Sizing Factor (%): 30

	Slope at:	0.5%		1.0%		2.0%		3.0%	
Q_{100} (cfs[1])	Q_{100} with Sizing Factor (cfs[1])	Minimum Pipe Size[2] (feet)	Recommended Pipe Size (inches)	Minimum Pipe Size[2] (feet)	Recommended Pipe Size (inches)	Minimum Pipe Size[2] (feet)	Recommended Pipe Size (inches)	Minimum Pipe Size[2] (feet)	Recommended Pipe Size (inches)
1.0	1.3	0.98	12"	0.86	12"	0.76	10"	0.70	10"
2.0	2.6	1.27	18"	1.12	18"	0.98	12"	0.91	12"
5.0	6.5	1.79	24"	1.58	24"	1.38	18"	1.28	18"
10.0	13.0	2.33	30"	2.04	30"	1.79	24"	1.66	24"
15.0	19.5	2.71	36"	2.38	30"	2.09	30"	1.94	24"
20.0	26.0	3.02	42"	2.65	36"	2.33	30"	2.16	30"
25.0	32.5	3.28	42"	2.88	36"	2.53	36"	2.34	30"
30.0	39.0	3.51	48"	3.08	42"	2.71	36"	2.51	36"
35.0	45.5	3.72	48"	3.27	42"	2.87	36"	2.66	36"
40.0	52.0	3.91	48"	3.44	42"	3.02	42"	2.80	36"
50.0	65.0	4.25	54"	3.74	48"	3.28	42"	3.04	42"
60.0	78.0	4.55	60"	4.00	48"	3.51	48"	3.26	42"
70.0	91.0	4.83	60"	4.24	54"	3.72	48"	3.45	42"
80.0	104.0	5.07	72"	4.46	54"	3.91	48"	3.63	48"
90.0	117.0	5.30	72"	4.66	60"	4.09	54"	3.79	48"
110.0	143.0	5.72	72"	5.02	72"	4.41	54"	4.09	54"
145.0	188.5	6.34	84"	5.57	72"	4.89	60"	4.53	60"
170.0	221.0	6.73	84"	5.91	72"	5.19	72"	4.81	60"
240.0	312.0	7.66	96"	6.73	84"	5.91	72"	5.47	72"
350.0	455.0	8.82	108"	7.75	96"	6.80	84"	6.31	84"

Note:

1. "cfs" = cubic feet per second.

2. Minimum pipe sizes are calculated using the Manning's equation and are based on the flow rates with 30% factor.

Worksheet for 11378 - Trapezoidal Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	195.50	ft³/s

Results

Normal Depth	3.05	ft
Flow Area	34.03	ft²
Wetted Perimeter	21.30	ft
Hydraulic Radius	1.60	ft
Top Width	20.31	ft
Critical Depth	2.74	ft
Critical Slope	0.03375	ft/ft
Velocity	5.74	ft/s
Velocity Head	0.51	ft
Specific Energy	3.56	ft
Froude Number	0.78	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.05	ft
Critical Depth	2.74	ft
Channel Slope	0.02000	ft/ft

Worksheet for 11378 - Trapezoidal Channel - 1

GVF Output Data

Critical Slope	0.03375	ft/ft

Worksheet for 11560 - Trapezoidal Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	135.50	ft^3/s

Results

Normal Depth	2.62	ft
Flow Area	25.86	ft^2
Wetted Perimeter	18.58	ft
Hydraulic Radius	1.39	ft
Top Width	17.73	ft
Critical Depth	2.33	ft
Critical Slope	0.03542	ft/ft
Velocity	5.24	ft/s
Velocity Head	0.43	ft
Specific Energy	3.05	ft
Froude Number	0.76	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.62	ft
Critical Depth	2.33	ft
Channel Slope	0.02000	ft/ft

Worksheet for 11560 - Trapezoidal Channel - 1

GVF Output Data

Critical Slope	0.03542	ft/ft

Worksheet for 50700 - Trapezoidal Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.05000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	5.00	ft
Discharge	302.80	ft³/s

Results

Normal Depth	2.63	ft
Flow Area	33.81	ft²
Wetted Perimeter	21.61	ft
Hydraulic Radius	1.56	ft
Top Width	20.75	ft
Critical Depth	2.91	ft
Critical Slope	0.03176	ft/ft
Velocity	8.96	ft/s
Velocity Head	1.25	ft
Specific Energy	3.87	ft
Froude Number	1.24	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.63	ft
Critical Depth	2.91	ft
Channel Slope	0.05000	ft/ft

Worksheet for 50700 - Trapezoidal Channel - 1

GVF Output Data

Critical Slope	0.03176	ft/ft

Worksheet for 50898 - Trapezoidal Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.05000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	109.40	ft³/s

Results

Normal Depth	1.97	ft
Flow Area	15.64	ft²
Wetted Perimeter	14.49	ft
Hydraulic Radius	1.08	ft
Top Width	13.85	ft
Critical Depth	2.11	ft
Critical Slope	0.03643	ft/ft
Velocity	6.99	ft/s
Velocity Head	0.76	ft
Specific Energy	2.73	ft
Froude Number	1.16	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.97	ft
Critical Depth	2.11	ft
Channel Slope	0.05000	ft/ft

Worksheet for 50898 - Trapezoidal Channel - 1

GVF Output Data

Critical Slope	0.03643	ft/ft

Rating Table for Triangular Major Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	1.00	ft³/s

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
10.00	0.02000	1.10	2.73	3.66	6.99	6.63
10.00	0.04000	0.97	3.54	2.82	6.14	5.82
10.00	0.06000	0.90	4.12	2.42	5.69	5.39
10.00	0.08000	0.85	4.59	2.18	5.39	5.11
10.00	0.10000	0.82	4.99	2.00	5.17	4.90
20.00	0.02000	1.43	3.25	6.16	9.06	8.60
20.00	0.04000	1.26	4.21	4.75	7.96	7.55
20.00	0.06000	1.17	4.90	4.08	7.37	7.00
20.00	0.08000	1.10	5.46	3.66	6.99	6.63
20.00	0.10000	1.06	5.94	3.37	6.70	6.36
30.00	0.02000	1.67	3.60	8.34	10.55	10.01
30.00	0.04000	1.46	4.66	6.43	9.26	8.79
30.00	0.06000	1.36	5.43	5.53	8.58	8.14
30.00	0.08000	1.29	6.05	4.96	8.13	7.72
30.00	0.10000	1.23	6.57	4.56	7.80	7.40
40.00	0.02000	1.86	3.86	10.35	11.75	11.15
40.00	0.04000	1.63	5.01	7.99	10.32	9.79
40.00	0.06000	1.51	5.83	6.86	9.56	9.07
40.00	0.08000	1.43	6.50	6.16	9.06	8.60
40.00	0.10000	1.37	7.06	5.66	8.69	8.24
50.00	0.02000	2.02	4.08	12.24	12.78	12.12
50.00	0.04000	1.77	5.30	9.44	11.22	10.64
50.00	0.06000	1.64	6.17	8.11	10.40	9.86
50.00	0.08000	1.56	6.87	7.28	9.85	9.35

Rating Table for Triangular Major Channel - 1

Input Data

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
50.00	0.10000	1.49	7.47	6.69	9.45	8.96
60.00	0.02000	2.16	4.28	14.03	13.68	12.98
60.00	0.04000	1.90	5.54	10.82	12.01	11.40
60.00	0.06000	1.76	6.45	9.30	11.13	10.56
60.00	0.08000	1.67	7.19	8.34	10.55	10.01
60.00	0.10000	1.60	7.82	7.68	10.12	9.60
70.00	0.02000	2.29	4.44	15.76	14.49	13.75
70.00	0.04000	2.01	5.76	12.15	12.73	12.07
70.00	0.06000	1.87	6.71	10.44	11.80	11.19
70.00	0.08000	1.77	7.47	9.37	11.18	10.60
70.00	0.10000	1.69	8.12	8.62	10.72	10.17

Rating Table for Triangular Minor Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	1.00	ft³/s

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.50	0.01000	0.41	1.00	0.50	2.59	2.45
0.50	0.02000	0.36	1.29	0.39	2.27	2.16
0.50	0.03000	0.33	1.50	0.33	2.11	2.00
0.50	0.04000	0.32	1.68	0.30	1.99	1.89
0.50	0.05000	0.30	1.82	0.27	1.91	1.82
0.50	0.06000	0.29	1.95	0.26	1.85	1.75
0.50	0.07000	0.28	2.07	0.24	1.80	1.70
0.50	0.08000	0.28	2.17	0.23	1.75	1.66
0.50	0.09000	0.27	2.27	0.22	1.71	1.63
0.50	0.10000	0.27	2.36	0.21	1.68	1.59
1.00	0.01000	0.53	1.18	0.84	3.35	3.18
1.00	0.02000	0.47	1.54	0.65	2.95	2.80
1.00	0.03000	0.43	1.79	0.56	2.73	2.59
1.00	0.04000	0.41	1.99	0.50	2.59	2.45
1.00	0.05000	0.39	2.17	0.46	2.48	2.35
1.00	0.06000	0.38	2.32	0.43	2.40	2.27
1.00	0.07000	0.37	2.46	0.41	2.33	2.21
1.00	0.08000	0.36	2.58	0.39	2.27	2.16
1.00	0.09000	0.35	2.70	0.37	2.22	2.11
1.00	0.10000	0.34	2.81	0.36	2.18	2.07
1.50	0.01000	0.62	1.31	1.14	3.91	3.71
1.50	0.02000	0.54	1.70	0.88	3.43	3.25
1.50	0.03000	0.50	1.98	0.76	3.18	3.01
1.50	0.04000	0.48	2.21	0.68	3.01	2.86

Rating Table for Triangular Minor Channel - 1

Input Data

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
1.50	0.05000	0.46	2.40	0.63	2.89	2.74
1.50	0.06000	0.44	2.57	0.58	2.79	2.65
1.50	0.07000	0.43	2.72	0.55	2.71	2.57
1.50	0.08000	0.42	2.86	0.52	2.64	2.51
1.50	0.09000	0.41	2.99	0.50	2.59	2.45
1.50	0.10000	0.40	3.11	0.48	2.54	2.41
2.00	0.01000	0.69	1.41	1.42	4.35	4.13
2.00	0.02000	0.60	1.83	1.09	3.82	3.62
2.00	0.03000	0.56	2.13	0.94	3.54	3.36
2.00	0.04000	0.53	2.37	0.84	3.35	3.18
2.00	0.05000	0.51	2.58	0.78	3.22	3.05
2.00	0.06000	0.49	2.76	0.73	3.11	2.95
2.00	0.07000	0.48	2.92	0.68	3.02	2.87
2.00	0.08000	0.47	3.07	0.65	2.95	2.80
2.00	0.09000	0.46	3.21	0.62	2.88	2.73
2.00	0.10000	0.45	3.34	0.60	2.83	2.68
2.50	0.01000	0.75	1.49	1.68	4.73	4.49
2.50	0.02000	0.66	1.93	1.29	4.16	3.94
2.50	0.03000	0.61	2.25	1.11	3.85	3.65
2.50	0.04000	0.58	2.51	1.00	3.65	3.46
2.50	0.05000	0.55	2.73	0.92	3.50	3.32
2.50	0.06000	0.53	2.92	0.86	3.38	3.21
2.50	0.07000	0.52	3.09	0.81	3.28	3.12
2.50	0.08000	0.51	3.25	0.77	3.20	3.04
2.50	0.09000	0.50	3.39	0.74	3.13	2.97
2.50	0.10000	0.49	3.53	0.71	3.07	2.91
3.00	0.01000	0.80	1.56	1.92	5.07	4.81
3.00	0.02000	0.70	2.02	1.48	4.45	4.22
3.00	0.03000	0.65	2.35	1.27	4.12	3.91
3.00	0.04000	0.62	2.62	1.14	3.91	3.71
3.00	0.05000	0.59	2.85	1.05	3.75	3.55
3.00	0.06000	0.57	3.05	0.98	3.62	3.43
3.00	0.07000	0.56	3.23	0.93	3.52	3.34
3.00	0.08000	0.54	3.40	0.88	3.43	3.25
3.00	0.09000	0.53	3.55	0.84	3.35	3.18
3.00	0.10000	0.52	3.70	0.81	3.29	3.12
3.50	0.01000	0.85	1.62	2.16	5.37	5.09

Rating Table for Triangular Minor Channel - 1

Input Data

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
3.50	0.02000	0.75	2.10	1.67	4.71	4.47
3.50	0.03000	0.69	2.45	1.43	4.37	4.14
3.50	0.04000	0.65	2.73	1.28	4.14	3.92
3.50	0.05000	0.63	2.96	1.18	3.97	3.77
3.50	0.06000	0.61	3.17	1.10	3.84	3.64
3.50	0.07000	0.59	3.36	1.04	3.73	3.53
3.50	0.08000	0.57	3.53	0.99	3.63	3.45
3.50	0.09000	0.56	3.69	0.95	3.55	3.37
3.50	0.10000	0.55	3.84	0.91	3.48	3.31
4.00	0.01000	0.89	1.67	2.39	5.64	5.35
4.00	0.02000	0.78	2.17	1.84	4.95	4.70
4.00	0.03000	0.73	2.53	1.58	4.59	4.36
4.00	0.04000	0.69	2.82	1.42	4.35	4.13
4.00	0.05000	0.66	3.06	1.31	4.17	3.96
4.00	0.06000	0.64	3.28	1.22	4.03	3.83
4.00	0.07000	0.62	3.48	1.15	3.92	3.72
4.00	0.08000	0.60	3.66	1.09	3.82	3.62
4.00	0.09000	0.59	3.82	1.05	3.74	3.55
4.00	0.10000	0.58	3.97	1.01	3.66	3.48
4.50	0.01000	0.93	1.73	2.61	5.90	5.59
4.50	0.02000	0.82	2.24	2.01	5.18	4.91
4.50	0.03000	0.76	2.60	1.73	4.80	4.55
4.50	0.04000	0.72	2.90	1.55	4.55	4.31
4.50	0.05000	0.69	3.15	1.43	4.36	4.14
4.50	0.06000	0.67	3.38	1.33	4.21	4.00
4.50	0.07000	0.65	3.58	1.26	4.09	3.88
4.50	0.08000	0.63	3.76	1.20	3.99	3.79
4.50	0.09000	0.62	3.93	1.14	3.91	3.71
4.50	0.10000	0.61	4.09	1.10	3.83	3.63
5.00	0.01000	0.97	1.77	2.82	6.14	5.82
5.00	0.02000	0.85	2.30	2.18	5.39	5.11
5.00	0.03000	0.79	2.67	1.87	4.99	4.74
5.00	0.04000	0.75	2.98	1.68	4.73	4.49
5.00	0.05000	0.72	3.24	1.54	4.54	4.30
5.00	0.06000	0.69	3.47	1.44	4.39	4.16
5.00	0.07000	0.67	3.67	1.36	4.26	4.04
5.00	0.08000	0.66	3.86	1.29	4.16	3.94

Rating Table for Triangular Minor Channel - 1

Input Data

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
5.00	0.09000	0.64	4.04	1.24	4.06	3.86
5.00	0.10000	0.63	4.20	1.19	3.98	3.78
5.50	0.01000	1.01	1.81	3.03	6.36	6.03
5.50	0.02000	0.88	2.35	2.34	5.58	5.30
5.50	0.03000	0.82	2.74	2.01	5.17	4.91
5.50	0.04000	0.78	3.05	1.80	4.90	4.65
5.50	0.05000	0.74	3.32	1.66	4.70	4.46
5.50	0.06000	0.72	3.55	1.55	4.54	4.31
5.50	0.07000	0.70	3.76	1.46	4.41	4.19
5.50	0.08000	0.68	3.96	1.39	4.31	4.08
5.50	0.09000	0.67	4.13	1.33	4.21	4.00
5.50	0.10000	0.65	4.30	1.28	4.13	3.92
6.00	0.01000	1.04	1.85	3.24	6.57	6.23
6.00	0.02000	0.91	2.40	2.50	5.77	5.47
6.00	0.03000	0.85	2.80	2.14	5.34	5.07
6.00	0.04000	0.80	3.12	1.92	5.07	4.81
6.00	0.05000	0.77	3.39	1.77	4.86	4.61
6.00	0.06000	0.74	3.63	1.65	4.70	4.45
6.00	0.07000	0.72	3.85	1.56	4.56	4.33
6.00	0.08000	0.70	4.05	1.48	4.45	4.22
6.00	0.09000	0.69	4.23	1.42	4.35	4.13
6.00	0.10000	0.67	4.40	1.36	4.27	4.05
6.50	0.01000	1.07	1.89	3.44	6.77	6.42
6.50	0.02000	0.94	2.45	2.65	5.95	5.64
6.50	0.03000	0.87	2.86	2.28	5.51	5.23
6.50	0.04000	0.83	3.18	2.04	5.22	4.95
6.50	0.05000	0.79	3.46	1.88	5.01	4.75
6.50	0.06000	0.76	3.70	1.76	4.84	4.59
6.50	0.07000	0.74	3.92	1.66	4.70	4.46
6.50	0.08000	0.72	4.12	1.58	4.58	4.35
6.50	0.09000	0.71	4.31	1.51	4.48	4.25
6.50	0.10000	0.70	4.48	1.45	4.40	4.17
7.00	0.01000	1.10	1.93	3.63	6.96	6.60
7.00	0.02000	0.97	2.50	2.80	6.11	5.80
7.00	0.03000	0.90	2.91	2.41	5.66	5.37
7.00	0.04000	0.85	3.24	2.16	5.37	5.09
7.00	0.05000	0.81	3.52	1.99	5.15	4.88

Rating Table for Triangular Minor Channel - 1

Input Data

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
7.00	0.06000	0.79	3.77	1.86	4.97	4.72
7.00	0.07000	0.76	4.00	1.75	4.83	4.58
7.00	0.08000	0.75	4.20	1.67	4.71	4.47
7.00	0.09000	0.73	4.39	1.59	4.61	4.37
7.00	0.10000	0.71	4.57	1.53	4.52	4.29
7.50	0.01000	1.13	1.96	3.83	7.14	6.78
7.50	0.02000	0.99	2.54	2.95	6.27	5.95
7.50	0.03000	0.92	2.96	2.53	5.81	5.51
7.50	0.04000	0.87	3.30	2.28	5.51	5.22
7.50	0.05000	0.84	3.58	2.09	5.28	5.01
7.50	0.06000	0.81	3.84	1.96	5.11	4.84
7.50	0.07000	0.78	4.07	1.84	4.96	4.70
7.50	0.08000	0.76	4.28	1.75	4.84	4.59
7.50	0.09000	0.75	4.47	1.68	4.73	4.49
7.50	0.10000	0.73	4.65	1.61	4.64	4.40
8.00	0.01000	1.16	1.99	4.01	7.32	6.94
8.00	0.02000	1.02	2.58	3.10	6.43	6.10
8.00	0.03000	0.94	3.01	2.66	5.96	5.65
8.00	0.04000	0.89	3.35	2.39	5.64	5.35
8.00	0.05000	0.86	3.64	2.19	5.41	5.13
8.00	0.06000	0.83	3.90	2.05	5.23	4.96
8.00	0.07000	0.80	4.13	1.94	5.08	4.82
8.00	0.08000	0.78	4.34	1.84	4.95	4.70
8.00	0.09000	0.77	4.54	1.76	4.85	4.60
8.00	0.10000	0.75	4.72	1.69	4.75	4.51

Rating Table for Steep Triangular Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.70000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	1.00	ft³/s

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
1.00	0.70000	0.24	5.83	0.17	1.51	1.43
1.00	0.80000	0.23	6.13	0.16	1.47	1.40
1.00	0.90000	0.23	6.41	0.16	1.44	1.37
1.00	1.00000	0.22	6.66	0.15	1.42	1.34
1.00	1.10000	0.22	6.90	0.14	1.39	1.32
1.00	1.20000	0.22	7.13	0.14	1.37	1.30
1.00	1.30000	0.21	7.35	0.14	1.35	1.28
1.00	1.40000	0.21	7.56	0.13	1.33	1.26
1.00	1.50000	0.21	7.75	0.13	1.31	1.24
2.00	0.70000	0.31	6.93	0.29	1.96	1.86
2.00	0.80000	0.30	7.28	0.27	1.91	1.82
2.00	0.90000	0.30	7.61	0.26	1.87	1.78
2.00	1.00000	0.29	7.92	0.25	1.83	1.74
2.00	1.10000	0.28	8.21	0.24	1.80	1.71
2.00	1.20000	0.28	8.49	0.24	1.77	1.68
2.00	1.30000	0.28	8.74	0.23	1.75	1.66
2.00	1.40000	0.27	8.99	0.22	1.72	1.63
2.00	1.50000	0.27	9.22	0.22	1.70	1.61
3.00	0.70000	0.36	7.67	0.39	2.28	2.17
3.00	0.80000	0.35	8.07	0.37	2.23	2.11
3.00	0.90000	0.34	8.43	0.36	2.18	2.07
3.00	1.00000	0.34	8.77	0.34	2.14	2.03
3.00	1.10000	0.33	9.09	0.33	2.10	1.99
3.00	1.20000	0.33	9.39	0.32	2.06	1.96

Rating Table for Steep Triangular Channel - 1

Input Data

Discharge (ft³/s)	Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
3.00	1.30000	0.32	9.67	0.31	2.03	1.93
3.00	1.40000	0.32	9.94	0.30	2.01	1.90
3.00	1.50000	0.31	10.21	0.29	1.98	1.88
4.00	0.70000	0.40	8.25	0.48	2.54	2.41
4.00	0.80000	0.39	8.66	0.46	2.48	2.35
4.00	0.90000	0.38	9.06	0.44	2.43	2.30
4.00	1.00000	0.38	9.42	0.42	2.38	2.26
4.00	1.10000	0.37	9.76	0.41	2.34	2.22
4.00	1.20000	0.36	10.09	0.40	2.30	2.18
4.00	1.30000	0.36	10.39	0.38	2.27	2.15
4.00	1.40000	0.35	10.68	0.37	2.24	2.12
4.00	1.50000	0.35	10.98	0.36	2.20	2.09
5.00	0.70000	0.44	8.71	0.57	2.77	2.62
5.00	0.80000	0.43	9.16	0.55	2.70	2.56
5.00	0.90000	0.42	9.57	0.52	2.64	2.50
5.00	1.00000	0.41	9.96	0.50	2.59	2.45
5.00	1.10000	0.40	10.33	0.48	2.54	2.41
5.00	1.20000	0.40	10.66	0.47	2.50	2.37
5.00	1.30000	0.39	10.99	0.45	2.46	2.34
5.00	1.40000	0.38	11.30	0.44	2.43	2.30
5.00	1.50000	0.38	11.60	0.43	2.40	2.27

APPENDIX E

Typical Details of Drainage Crossings

DRAINGE CROSSING METHOD A - FORD/LOW FLOW

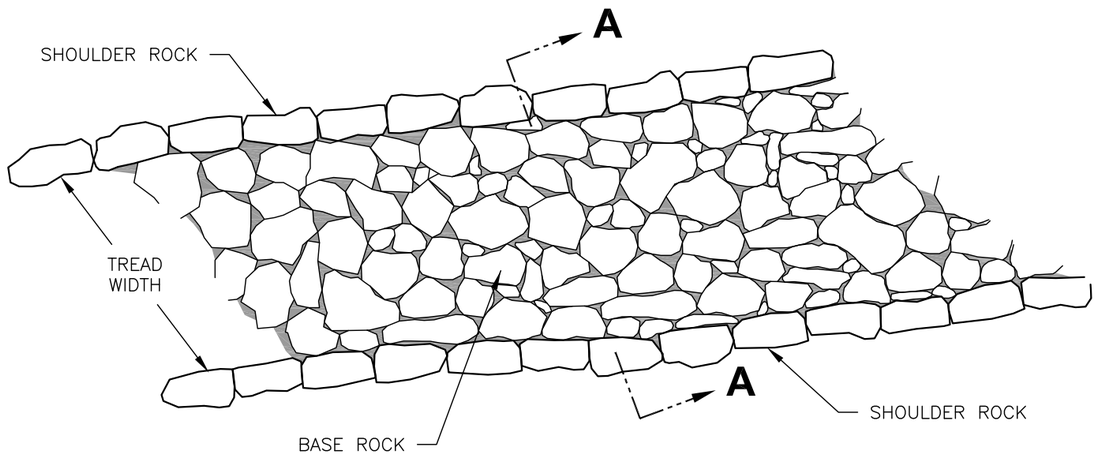
RIPRAP SURFACING

TYPICAL ID	TREAD WIDTH	GEOTEXTILE TYPE	LEVELING COURSE TYPE	MINIMUM ROCK SIZE: SHOULDER ROCK (LBS)	MINIMUM ROCK SIZE: BASE ROCK (LBS)	COMMENTS
RRS–1			L			

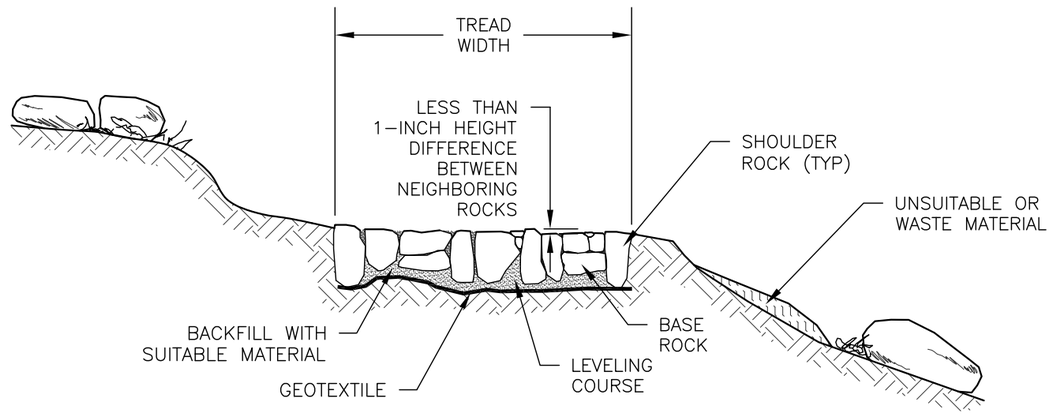
N/A WHEN NOT SPECIFIED

LEVELING COURSE MATERIAL

TYPE	MATERIAL	GRADATION	COMMENTS
L1	PITRUN		
L2	AGGREGATE		
L3			



PLAN VIEW



SECTION **A-A**

NOTES:

1. REMOVE AND DISPOSE OF DUFF AND TOP ORGANIC LAYERS DOWN TO MINERAL SOIL.
2. PROVIDE ORGANIC–FREE BACKFILL MATERIAL WHERE SHOWN ON DRAWINGS FOR LEVELING AND SUPPORT OF BASE ROCK.
3. LAY ROCK WITH A MINIMUM OF 3 POINTS OF CONTACT WITH ADJACENT ROCKS.
4. LAY ROCKS IN A RANDOM ARRANGEMENT.
5. FILL VOIDS WITH BROKEN ROCK OR SUITABLE BACKFILL.

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME: **RIPRAP SURFACING**
SECTION: **913 - SURFACING**
TYPICAL ID: **RRS**

REVISION DATE: **XX/XX/XX**
NO SCALE

DRAWING NO.: **STD_913-50-01**
SHEET OF

NATURAL FORD STRUCTURE

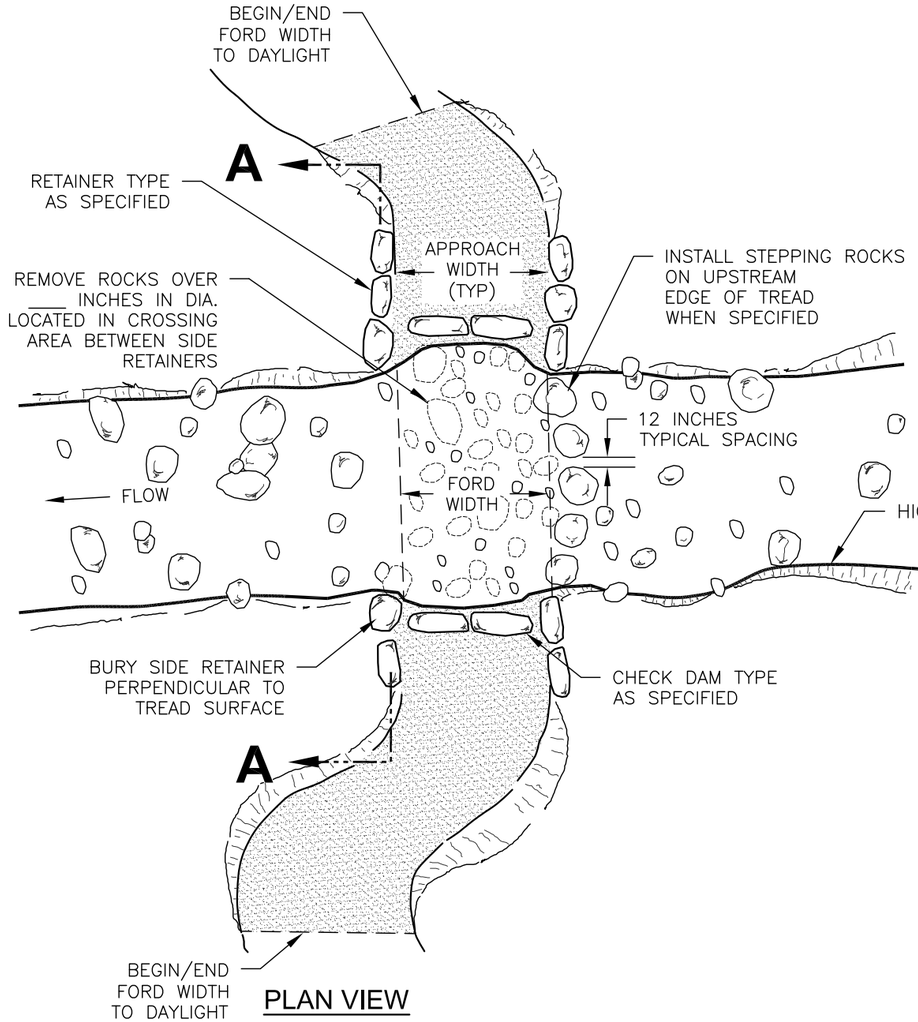
DRAINGE CROSSING METHOD A - FORD/LOW FLOW

		APPROACHES				SIDE RETAINERS*		MINIMUM ROCK SIZE			
TYPICAL ID	FORD WIDTH	WIDTH	GRADE	SURFACE TYPE	SURFACE DEPTH	TYPE	SIZE	CHECK DAM**** TYPE	STEPPING ROCK (LBS)	RETAINER ROCK (LBS)	COMMENTS
NFD–1				S		R					

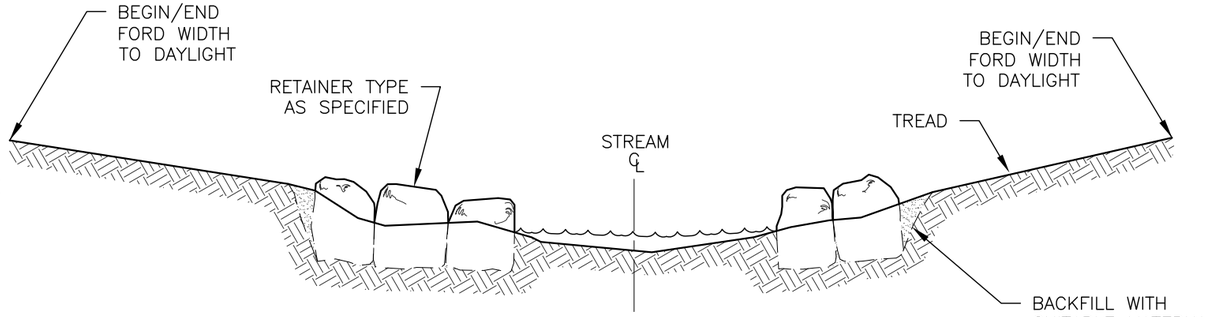
N/A WHEN NOT APPLICABLE
*FOR TYPICAL RETAINERS SEE SHEET STD_911–03
****FOR CHECK DAM SEE SHEET STD_928–01

SURFACE COURSE MATERIAL TYPE

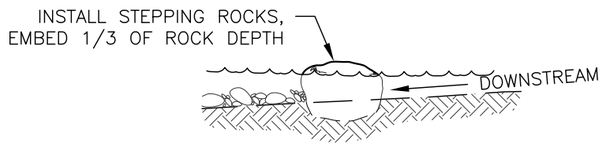
TYPE	MATERIAL	GRADATION	COMMENTS
S1	PITRUN		
S2	AGGREGATE		
S3	CLAY		
S4	WOODCHIPS		
S5			



PLAN VIEW



SECTION **A-A**



STEPPING ROCK DETAIL

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME: **NATURAL FORD**
SECTION: **917 - FORDS**
TYPICAL ID: **NFD**

REVISION DATE: **XX/XX/XX**
NO SCALE

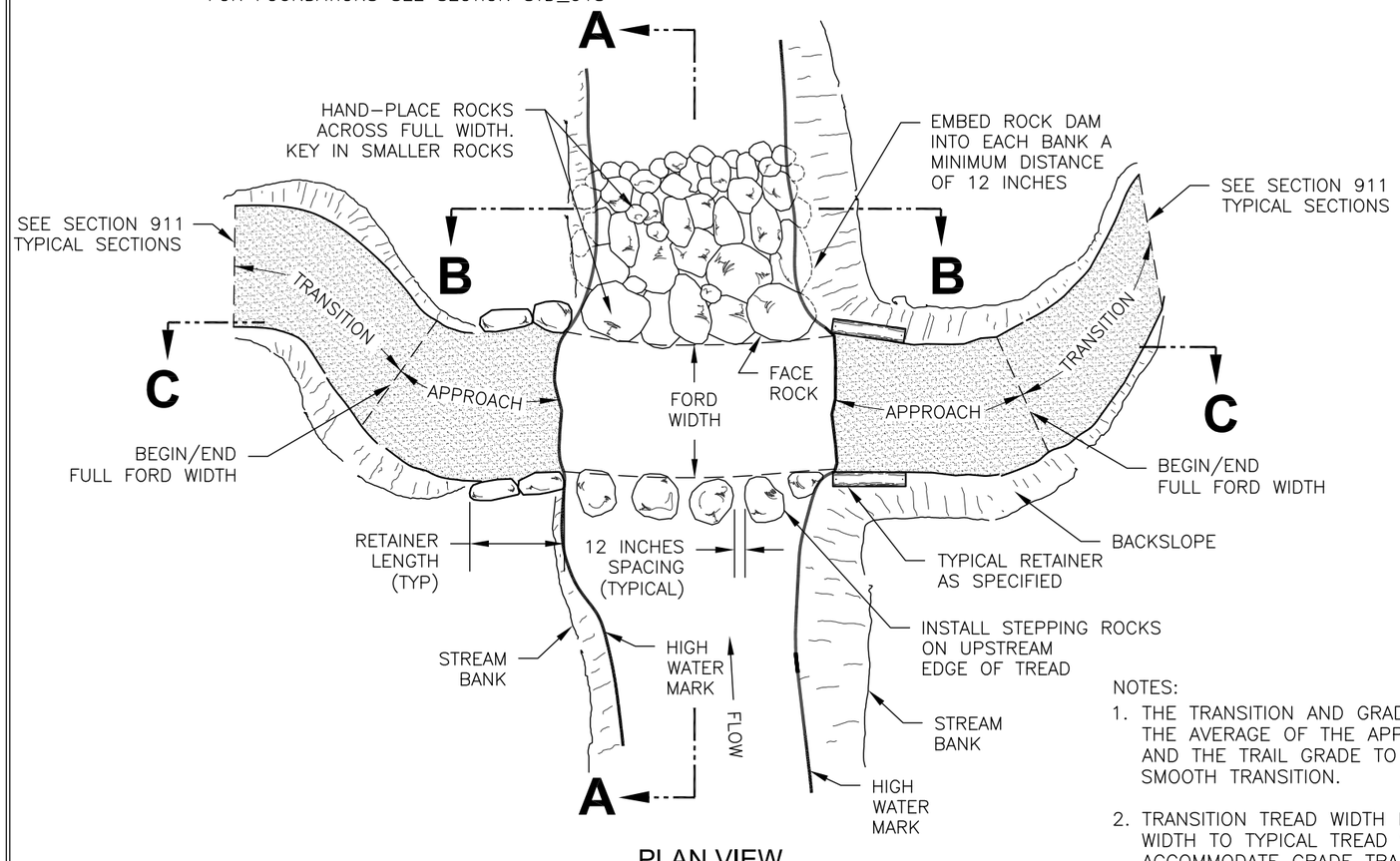
DRAWING NO.: **STD_917-10-01**
SHEET | OF

CONSTRUCTED FORD - ROCK STRUCTURE

DRAINGE CROSSING METHOD A - FORD/LOW FLOW

		APPROACHES		RETAINERS*		FOUNDATION**				SURFACE COURSE			ROCK DAM			
TYPICAL ID	FORD LENGTH	% GRADE NEAR	% GRADE FAR	TYPE	LENGTH	TYPE	DEPTH	LENGTH	GEOTEXTILE TYPE	TYPE	DEPTH	LENGTH	MINIMUM LENGTH	MINIMUM FACE ROCK SIZE (LBS)	STEPPING ROCK MINIMUM SIZE (LBS)	COMMENTS
RF1–1		%	%	R		F			G	S						

N/A WHEN NOT REQUIRED
*FOR TYPICAL RETAINERS SEE SHEET STD_911–03
**FOR FOUNDATIONS SEE SECTION STD_918



PLAN VIEW

NOTES:
1. THE TRANSITION AND GRADE SHALL BE THE AVERAGE OF THE APPROACH GRADE AND THE TRAIL GRADE TO CREATE A SMOOTH TRANSITION.
2. TRANSITION TREAD WIDTH FROM FORD WIDTH TO TYPICAL TREAD WIDTH TO ACCOMMODATE GRADE TRANSITION.

GEOTEXTILE TYPE

TYPE	MATERIAL	COMMENTS
G1	NON–WOVEN	
G2	WOVEN	
G3	GEOGRID	
G4		
G5		
G6		

FOUNDATION MATERIAL TYPE

TYPE	MATERIAL	COMMENTS
F1	GRAVEL	SMALL ROCKS LESS THAN 3 INCHES
F2	PAVING BLOCK	
F3	GEOCELL	
F4		

SURFACE COURSE MATERIAL TYPE

TYPE	MATERIAL	GRADATION	COMMENTS
S1	PITRUN		
S2	AGGREGATE		
S3	CLAY		
S4	WOODCHIPS		
S5			

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

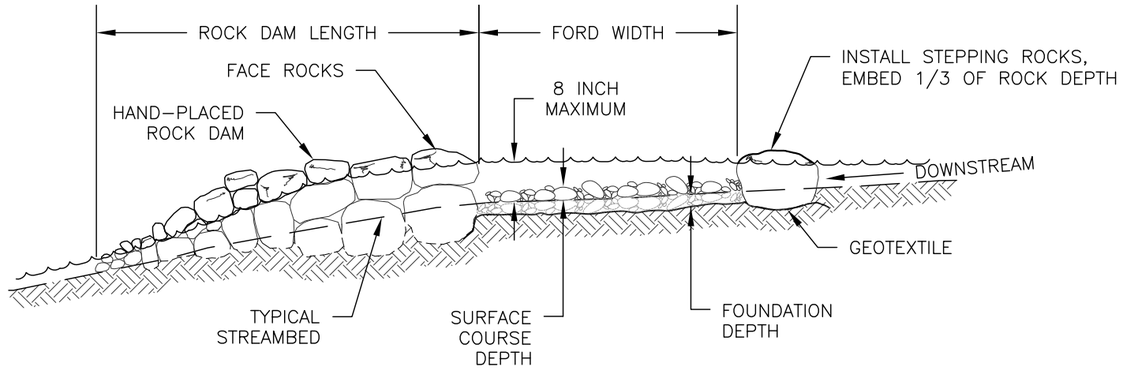
PROJECT NAME & LOCATION

DRAWING NAME **CONSTRUCTED FORD ROCK STRUCTURE**
SECTION **917 - FORDS**
TYPICAL ID **RF1**

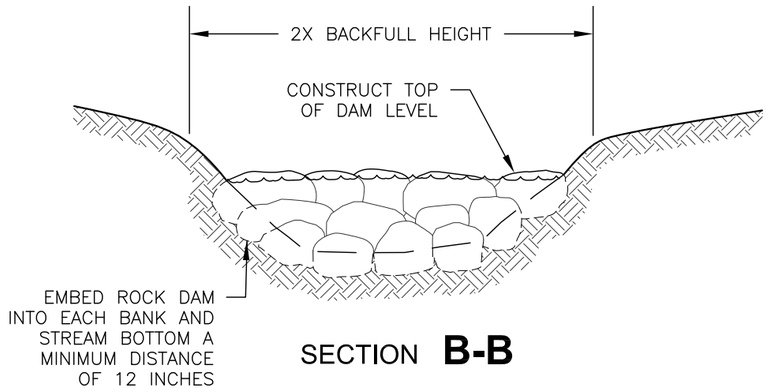
REVISION DATE **XX/XX/XX**
NO SCALE

DRAWING NO. **STD_917-20-01**
SHEET OF

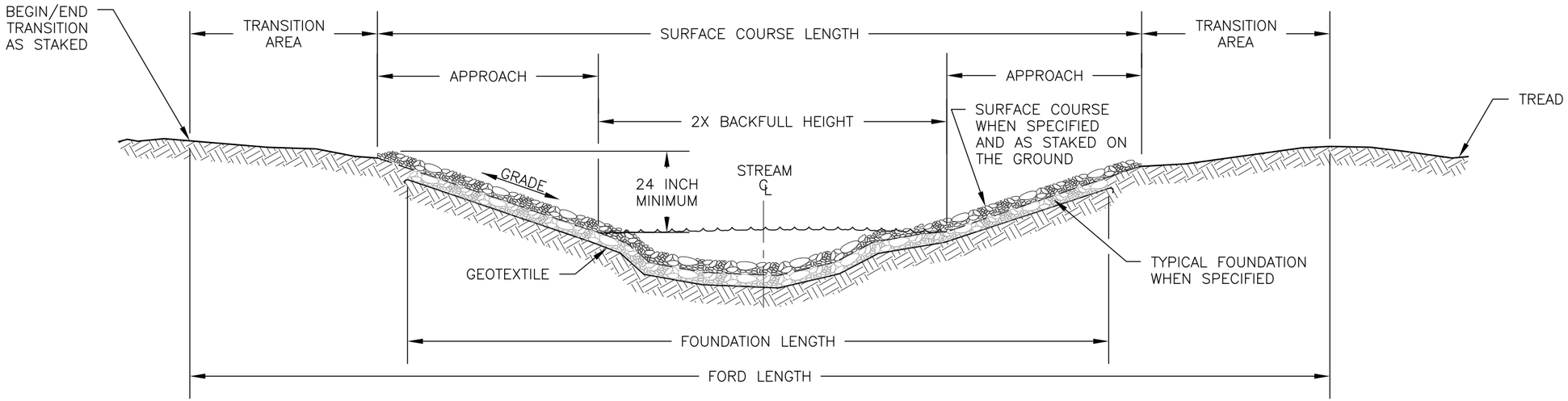
DRAINGE CROSSING METHOD A - FORD/LOW FLOW



SECTION **A-A**



SECTION **B-B**



SECTION **C-C**

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME **CONSTRUCTED FORD ROCK STRUCTURE**

SECTION **917 - FORDS**

TYPICAL ID **RF2**

REVISION DATE **XX/XX/XX**

NO SCALE

DRAWING NO. **STD_917-20-02**

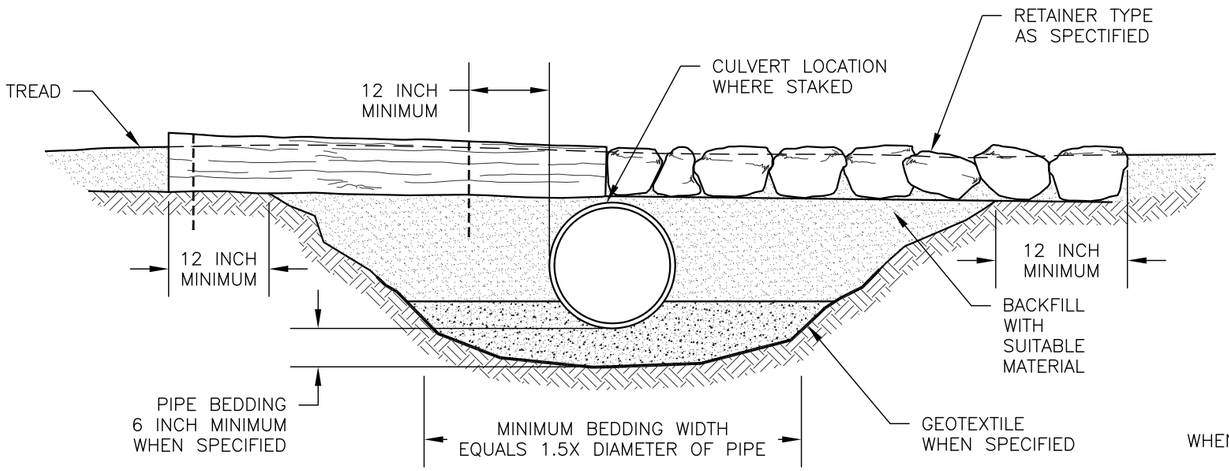
SHEET OF

STANDARD CULVERT

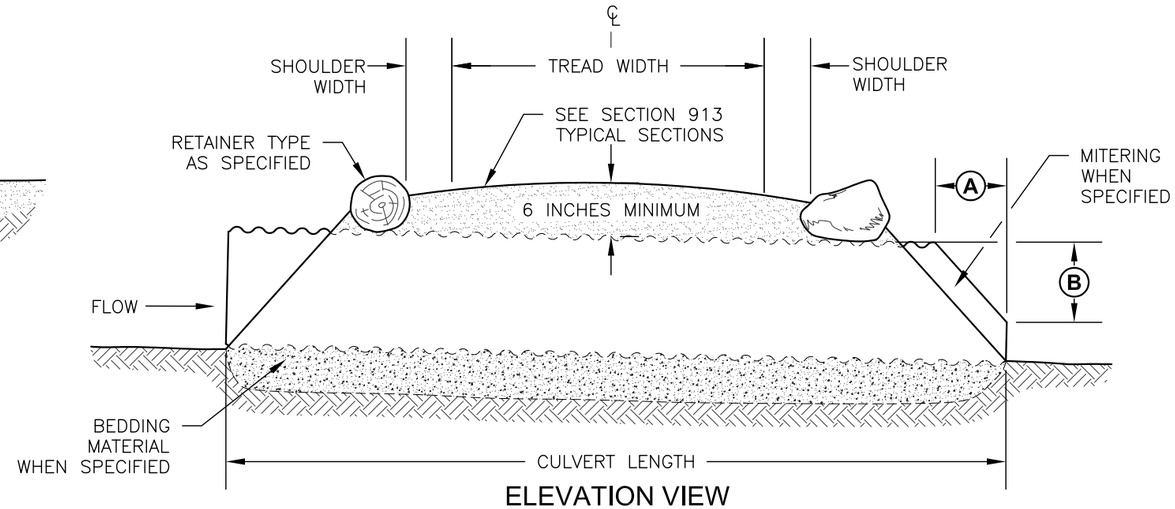
DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT

TYPICAL ID	GEOTEXTILE TYPE	BEDDING	CULVERT			RETAINER*	COMMENTS
		TYPE	TYPE	MITERING Ⓐ	MITERING Ⓑ	TYPE	
SCV–1		B	C			R	

N/A WHEN NOT APPLICABLE
*FOR TYPICAL RETAINERS SEE SHEET STD_911–03



END VIEW



ELEVATION VIEW

CULVERT TYPE

TYPE	MATERIAL	COMMENTS
C1	CMP – GALV	
C2	HDPE	
C3	PLASTIC	
C4	ALUMINUM	
C5	CONCRETE	
C6		

NOTE:
1. COMPACT BACKFILL IN 6 INCH LIFTS UNTIL NO VISUAL DISPLACEMENT.
2. NO ROCKS LARGER THAN 1 1/2 INCHES WITHIN 12 INCHES OF PIPE.

BEDDING MATERIAL TYPE

TYPE	MATERIAL	GRADATION	COMMENTS
B1	PITRUN		
B2	AGGREGATE		
B3			

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME **STANDARD CULVERT**
SECTION **921 - CULVERTS**
TYPICAL ID **SCV**

REVISION DATE **XX/XX/XX**
NO SCALE

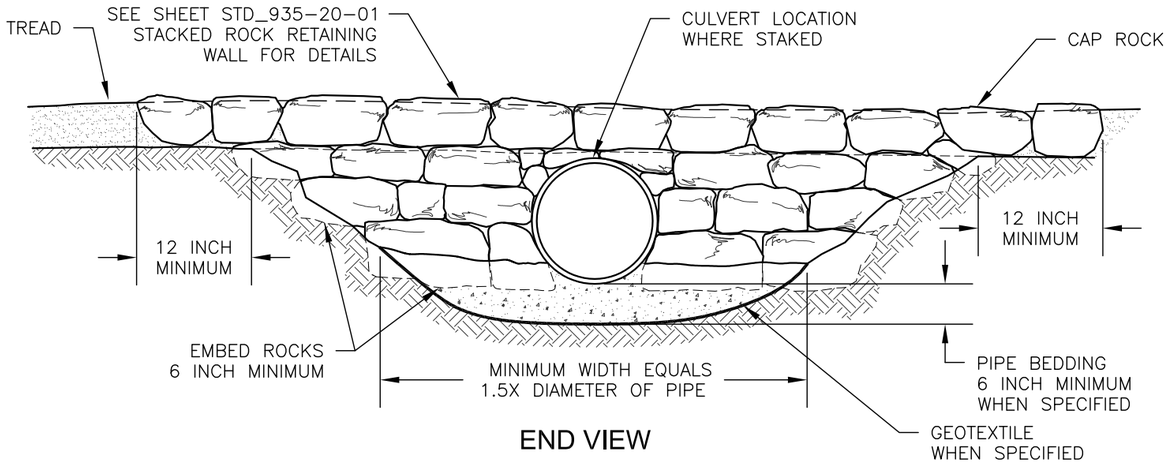
DRAWING NO. **STD_921-10-01**
SHEET
OF

STANDARD CULVERT WITH HEADWALLS

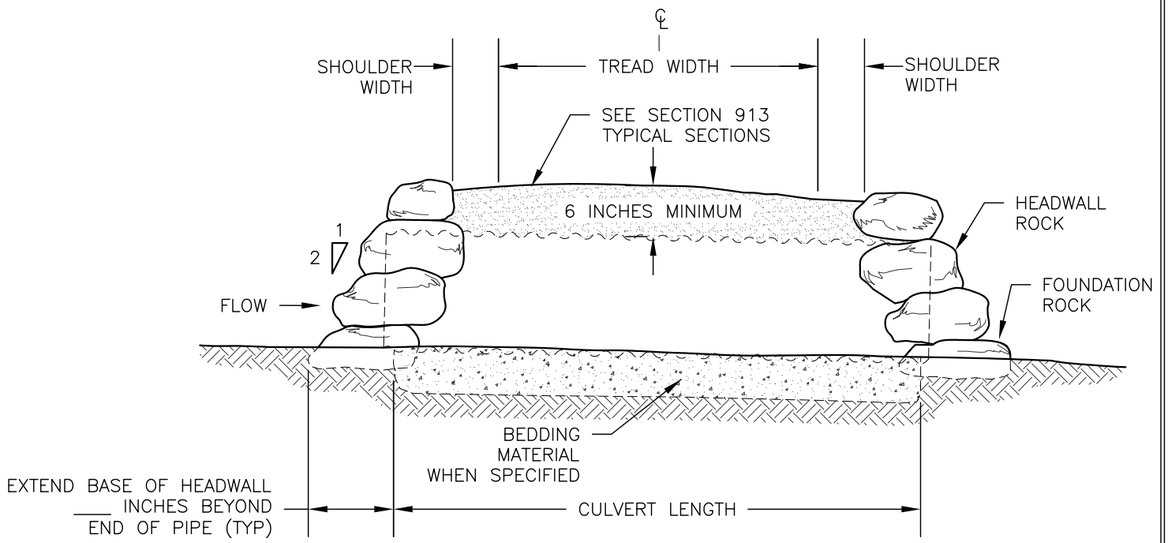
DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT

TYPICAL ID	GEOTEXTILE TYPE	BEDDING TYPE	CULVERT TYPE	HEADWALL MINIMUM ROCK SIZE	HEADWALL MAXIMUM ROCK SIZE	COMMENTS
CVH–1		B	C			

N/A WHEN NOT APPLICABLE



END VIEW



ELEVATION VIEW

CULVERT TYPE

TYPE	MATERIAL	COMMENTS
C1	CMP – GALV	
C2	HDPE	
C3	PLASTIC	
C4	ALUMINUM	
C5	CONCRETE	
C6		

NOTE:
1. COMPACT BACKFILL IN 6 INCH LIFTS UNTIL NO VISUAL DISPLACEMENT.
2. NO ROCKS LARGER THAN 1 1/2 INCHES WITHIN 12 INCHES OF PIPE.

BEDDING MATERIAL TYPE

TYPE	MATERIAL	GRADATION	COMMENTS
B1	PITRUN		
B2	AGGREGATE		
B3			

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME **STANDARD CULVERT WITH HEADWALLS**
SECTION **921 - CULVERTS**
TYPICAL ID **CVH**

REVISION DATE **XX/XX/XX**
NO SCALE

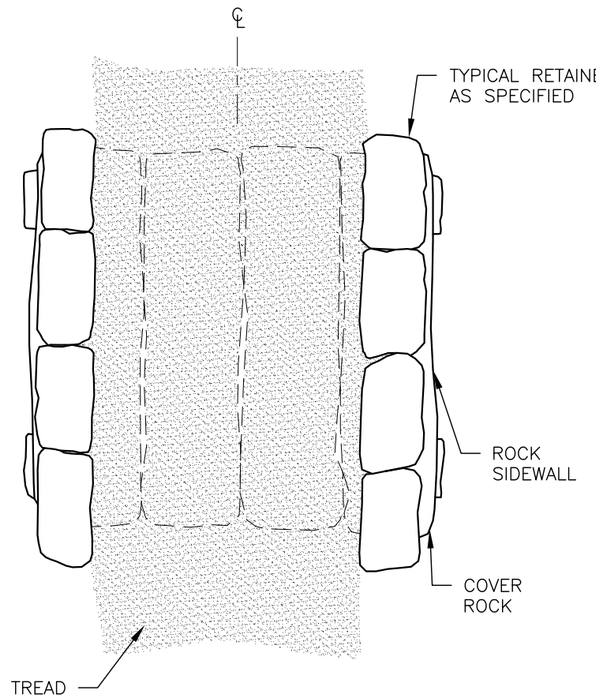
DRAWING NO. **STD_921-20-01**
SHEET
OF

DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT

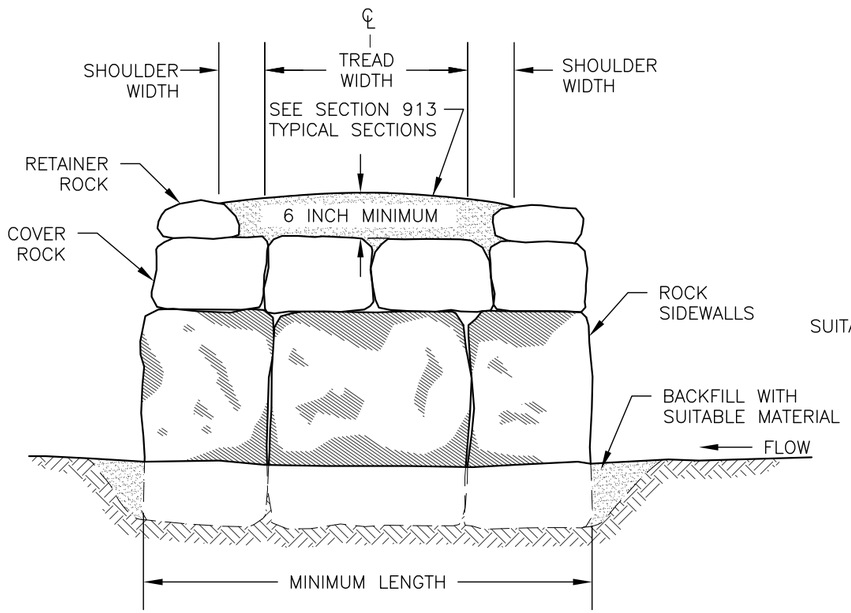
ROCK CULVERT

	ROCK CULVERT			ROCK SIDEWALL		COVER ROCK (FLAT)		RETAINER ROCK*		
TYPICAL ID	OPENING WIDTH	OPENING HEIGHT	MINIMUM LENGTH	MINIMUM WEIGHT (LBS)	MINIMUM THICKNESS (INCHES)	MINIMUM WEIGHT (LBS)	MINIMUM THICKNESS (INCHES)	MINIMUM WEIGHT (LBS)	MAXIMUM WEIGHT (LBS)	COMMENTS
RCV–1										

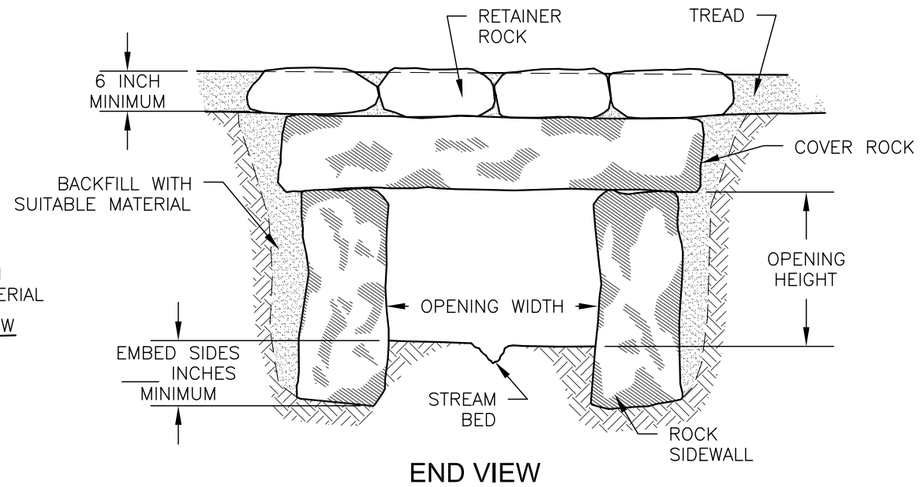
N/A WHEN NOT APPLICABLE
*FOR TYPICAL RETAINERS SEE SHEET STD_911–03



PLAN VIEW



ELEVATION VIEW



END VIEW

NOTE:
1. COMPACT BACKFILL IN 6 INCH LIFTS UNTIL NO VISUAL DISPLACEMENT.

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME: **ROCK CULVERT**
SECTION: **921 - CULVERTS**
TYPICAL ID: **RCV**

REVISION DATE: **XX/XX/XX**
NO SCALE

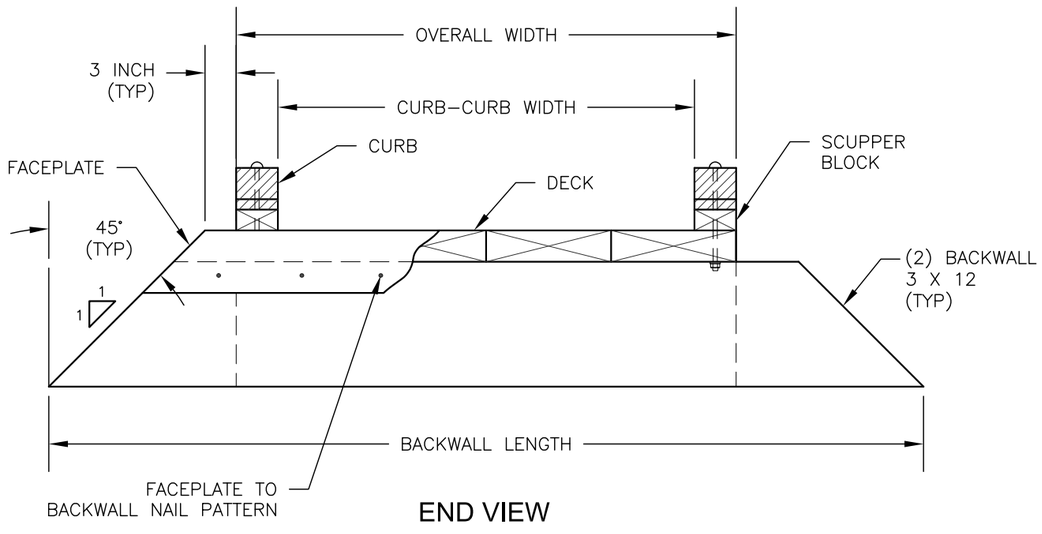
DRAWING NO.: **STD_921-30-01**
SHEET OF

TREATED TIMEBER BOX CULVERT & CURB

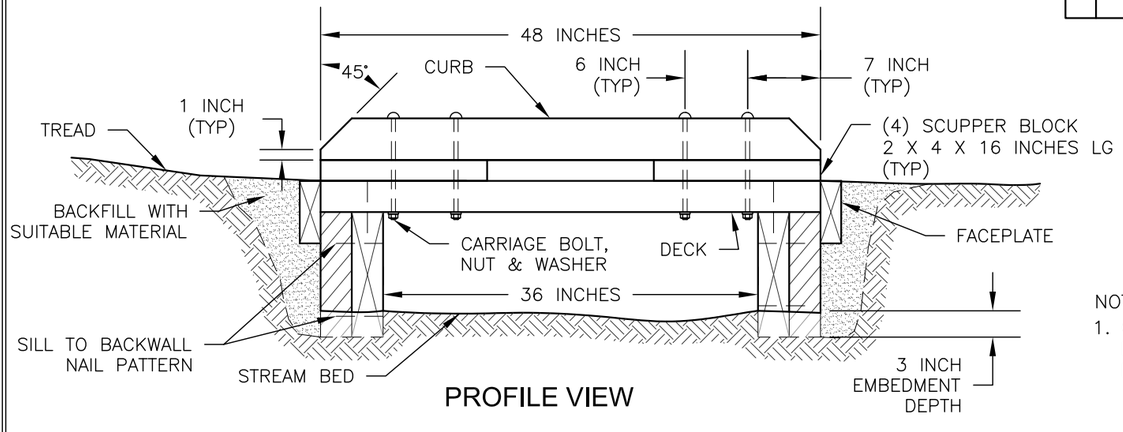
DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT

TYPICAL ID	CURB–CURB WIDTH	OVERALL WIDTH	BACKWALL/SILL/FACEPLATE LENGTH	BACKWALL/SILL/FACEPLATE SPECIES	BACKWALL/SILL/FACEPLATE PRESERV. TYPE	DECK SPECIES	DECK PRESERV. TYPE	CURBS/SCUPPER BLOCKS SPECIES	CURBS/SCUPPER BLOCKS PRESERV. TYPE	COMMENTS
TCV–1					P		P		P	

N/A WHEN NOT APPLICABLE



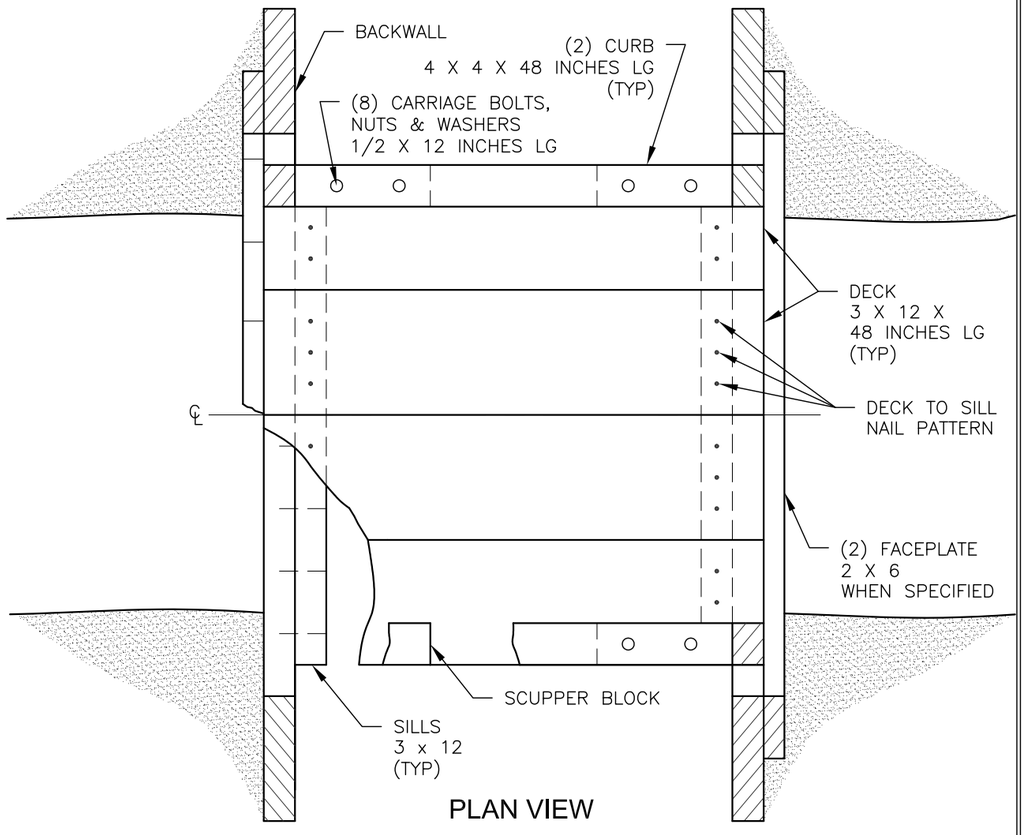
END VIEW



PROFILE VIEW

NAIL PATTERN		
	FACEPLATE TO BACKWALL	30d NAILS @ 12 INCHES ON CENTER.
	SILL TO BACKWALL	30d NAILS IN TWO 6 INCH STAGGERED ROWS, 2 INCH MINIMUM FROM EDGE OF SILL.
	DECK TO SILL	(3) 60d NAILS THROUGH EACH END OF DECK PLANK INTO SILL, 6 INCHES FROM EDGE OF DECK PLANK.

NOTES:
1. COMPACT BACKFILL IN 6 INCH LIFTS UNTIL NO VISUAL DISPLACEMENT.



PLAN VIEW

PRESERVATIVE TREATMENT – (REFER TO AWPA USE CATEGORY SYSTEM)			
PRESERVATIVE TYPE	TREATMENT TYPE	USE CATEGORY	COMMENTS
P1	WB	UC4A	
P2	WB	UC3B	
P3			

TREATMENT TYPE
WB = WATERBORNE
OT = OIL–BORNE

USE CATEGORY
UC3B = ABOVE GROUND – EXPOSED
UC4A = GROUND CONTACT – GENERAL USE
UC4B = GROUND CONTACT – HEAVY DUTY

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME
TREATED TIMBER BOX CULVERT
SECTION **921 - CULVERTS**
TYPICAL ID **TCV**

REVISION DATE **XX/XX/XX**

NO SCALE

DRAWING NO. **STD_921-40-01**
SHEET
OF

DRAIN DIP SECTION

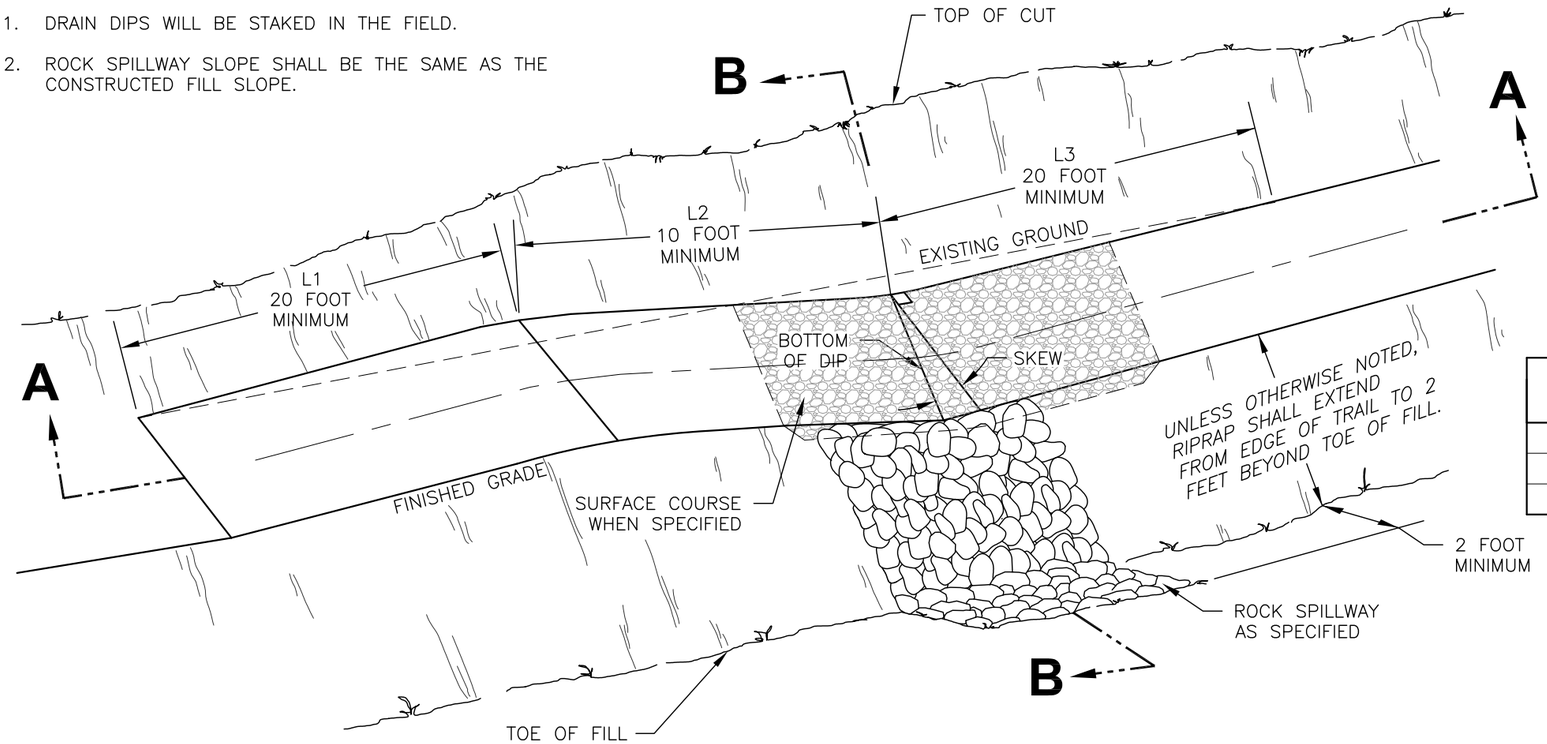
DRAINGE CROSSING METHOD A - FORD/LOW FLOW

TYPICAL ID	DRAIN DIP TYPE	GEOTEXTILE TYPE	SKEW	SURFACE COURSE TYPE	SURFACE COURSE DEPTH	ROCK SPILLWAY***	COMMENTS
DD1–1	DD	G		S			

N/A WHEN NOT APPLICABLE
***FOR ROCK SPILLWAY SEE SHEET STD_923–10–01

NOTES:

1. DRAIN DIPS WILL BE STAKED IN THE FIELD.
2. ROCK SPILLWAY SLOPE SHALL BE THE SAME AS THE CONSTRUCTED FILL SLOPE.



GEOTEXTILE TYPE

TYPE	MATERIAL	COMMENTS
G1	NON–WOVEN	
G2	WOVEN	
G3		

SURFACE COURSE MATERIAL TYPE

TYPE	MATERIAL	GRADATION	COMMENTS
S1	PITRUN		
S2	AGGREGATE		
S3			

DRAIN DIP CONSTRUCTION DIMENSIONS

DRAIN DIP TYPE	% PROFILE GRADE	L1	L2	L3	(H)	(E)
DD1	0 TO 4					
DD2	5 TO 6					
DD3	7 TO 8					
DD4	9 TO 10					
DD5						

OVER 10% NOT RECOMMENDED
H = $\mathcal{L}$ OF TREAD

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

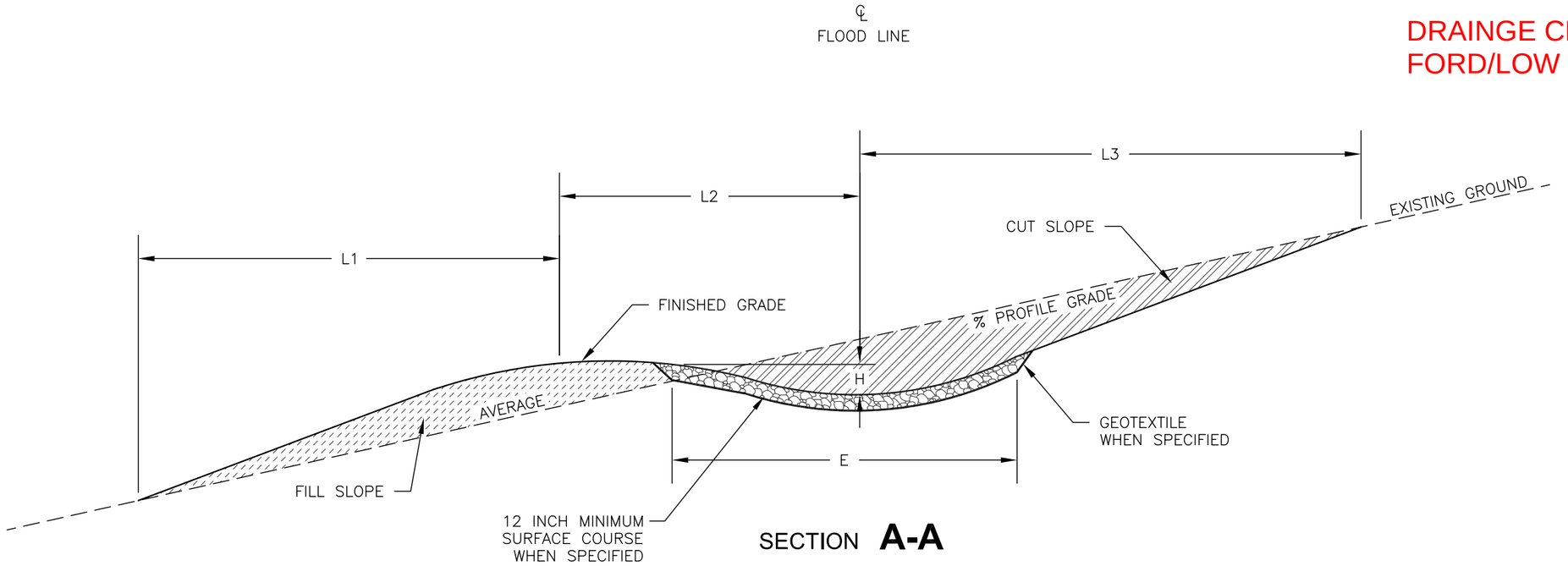
PROJECT NAME & LOCATION

DRAWING NAME: **DRAIN DIP**
SECTION: **927 - DRAIN DIPS**
TYPICAL ID: **DD1**

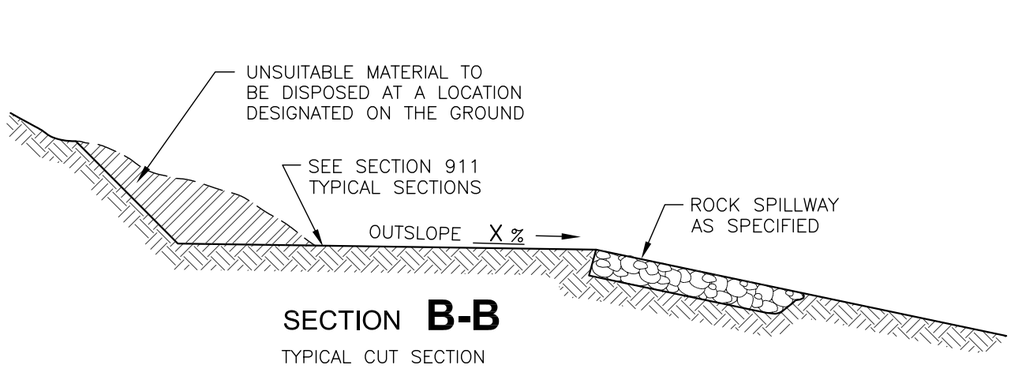
REVISION DATE: **XX/XX/XX**
NO SCALE

DRAWING NO.: **STD_927-10-01**
SHEET OF

DRAINGE CROSSING METHOD A - FORD/LOW FLOW

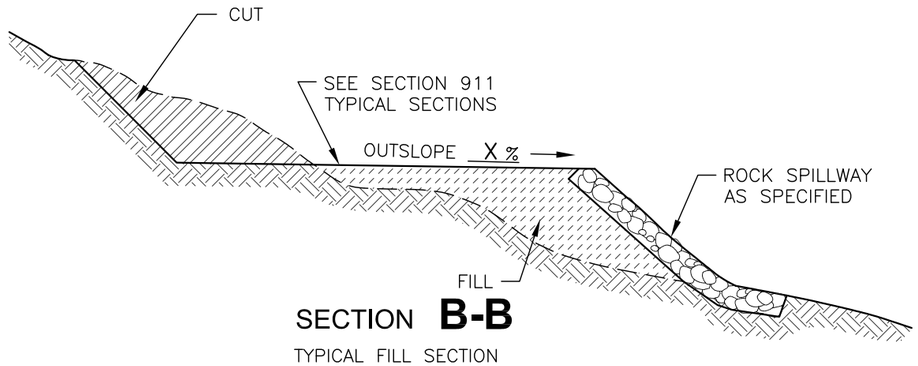


SECTION **A-A**



SECTION **B-B**

TYPICAL CUT SECTION



SECTION **B-B**

TYPICAL FILL SECTION

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME: **DRAIN DIP DETAILS**

SECTION: **927 - DRAIN DIPS**

TYPICAL ID: **DD2**

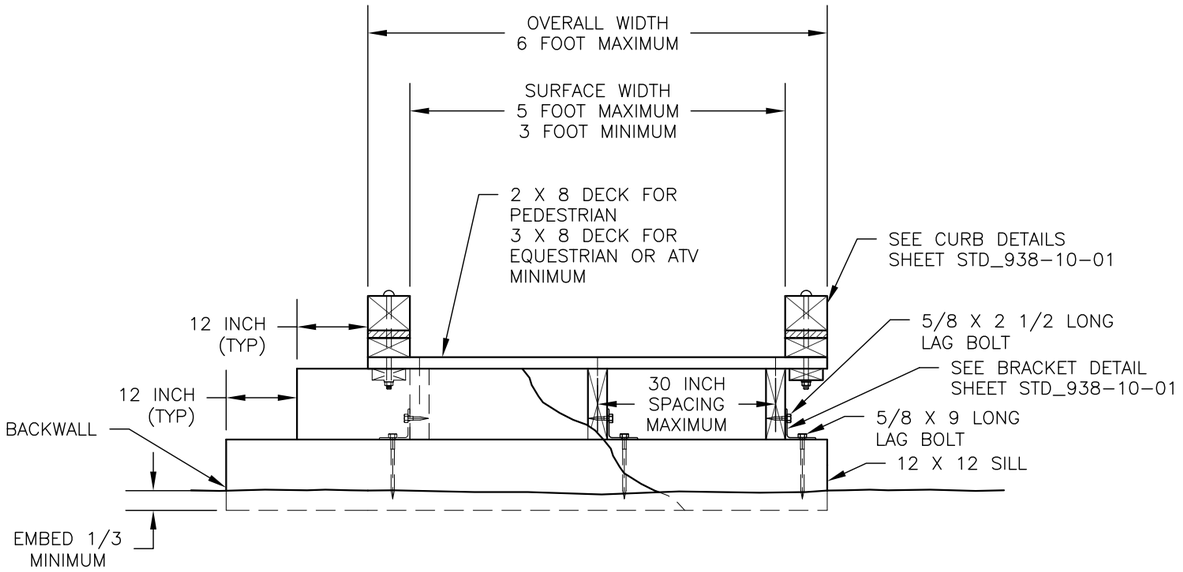
REVISION DATE: **XX/XX/XX**

NO SCALE

DRAWING NO.: **STD_927-10-02**

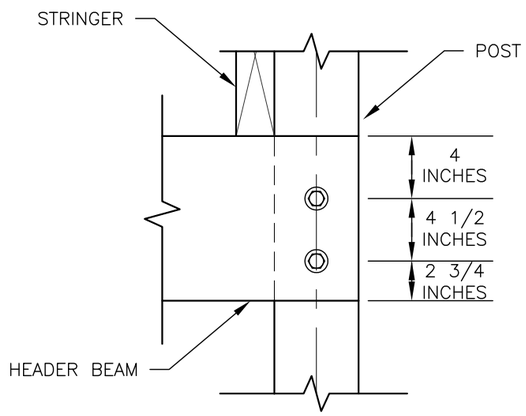
SHEET | OF

DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT

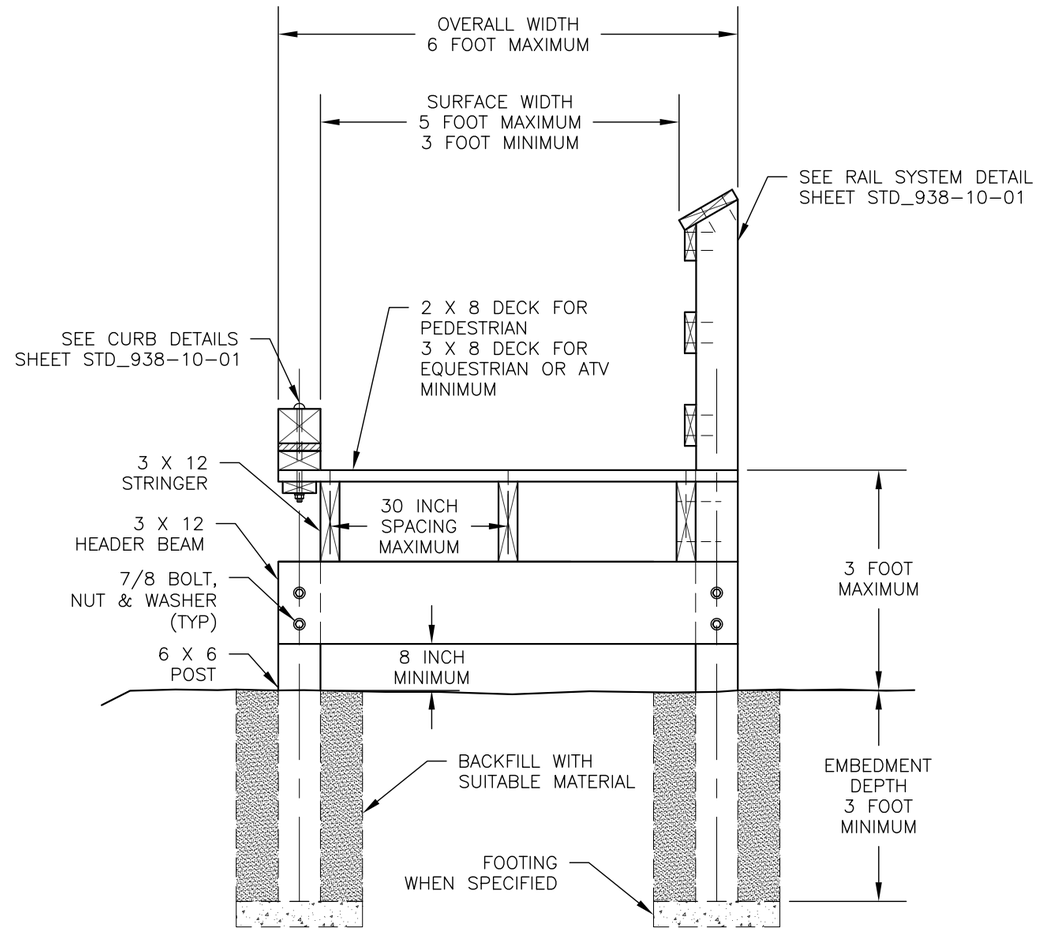


A TYPICAL GROUND SECTION

BLOCKING REQUIRED AT EVERY SUPPORT NOT SHOWN FOR CLARITY



BOLT DETAIL



B TYPICAL ELEVATED SECTION

LESS THAN 3 FEET WITH CURB
BLOCKING REQUIRED AT EVERY SUPPORT
NOT SHOWN FOR CLARITY

C TYPICAL ELEVATED SECTION

LESS THAN 3 FEET WITH CURB
BLOCKING REQUIRED AT EVERY SUPPORT
NOT SHOWN FOR CLARITY

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME
STANDARD BOARDWALK

SECTION
938 - BOARDWALKS

TYPICAL ID
SB2

REVISION DATE
XX/XX/XX

NO SCALE

DRAWING NO.
STD_938-10-02

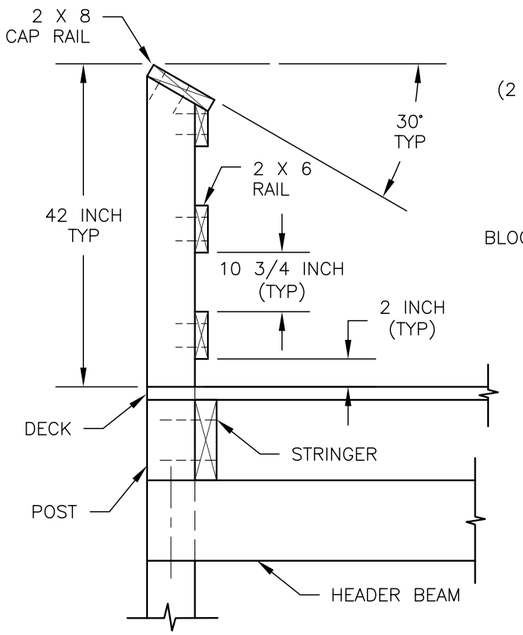
SHEET
OF

ELEVATED BOARDWALK

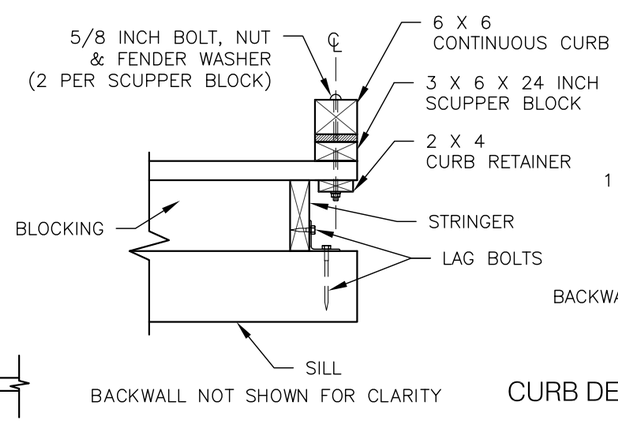
DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT

TYPICAL ID	SECTION TYPE	OVERALL WIDTH	SURFACE WIDTH	FOOTING MATERIAL			POST/SILLS/BACKWALLS				HEADER BEAM/STRINGERS/ DECK/CURB/RAILING SYSTEM			COMMENTS
				TYPE	DEPTH	WIDTH	POST HEIGHT	POST EMBEDMENT DEPTH	SPECIES	PRESERV. TYPE	DECK SIZE	SPECIES	PRESERV. TYPE	
SBW–1				F						P			P	

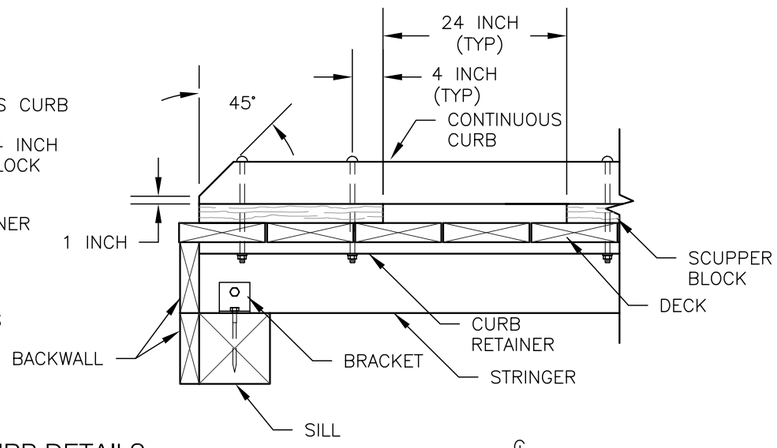
N/A WHEN NOT APPLICABLE



RAIL SYSTEM DETAIL



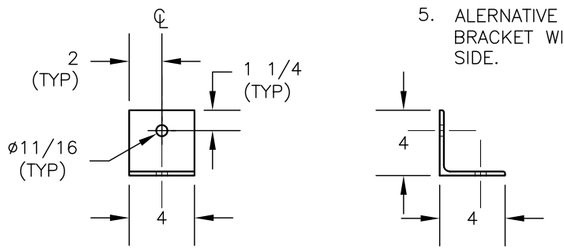
BACKWALL NOT SHOWN FOR CLARITY



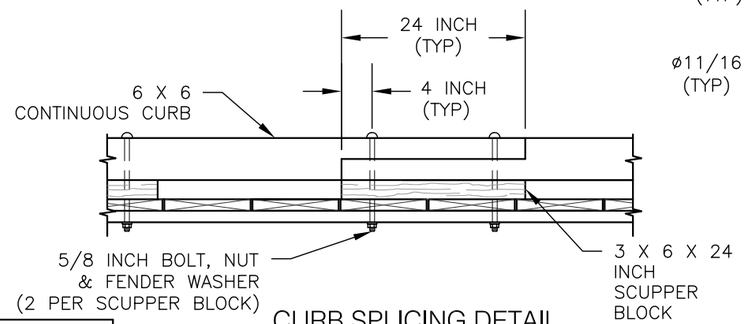
CURB DETAILS

NOTES:

1. DESIGN LOAD: 100 PSF PEDESTRIAN LOAD.
2. ALL MATERIAL TYPE SHALL BE DOUGLAS FIR OR SOUTHERN PINE NO. 2 OR BETTER AS SPECIFIED IN THE ABOVE TABLE.
3. ALL FASTENERS SHALL BE GALVANIZED.
4. FASTENERS:
   - DECKING: 60d 6 INCH RING SHANK NAILS OR DECK SCREWS 2 PER DECK STRINGER CONNECTION.
   - RAILING: NO. 10 X 4 INCH LONG WOOD SCREWS 2 PER RAIL POST CONNECTION.
   - STRINGERS & BACKWALLS: 40d 5 INCH LONG RING SHANK NAILS.
5. ALERNATIVE FOR 7/8 BOLTS FOR HEADER BEAM IS BRACKET WITH AN ALLOWABLE LOAD OF 1100 LBS EACH SIDE.



BRACKET DETAIL



CURB SPLICING DETAIL

FOOTING MATERIAL

TYPE	MATERIAL	GRADATION	COMMENTS
FT1	CONCRETE		
FT2	AGGREGATE		
FT3			

PRESERVATIVE TREATMENT – (REFER TO AWPA USE CATEGORY SYSTEM)			
PRESERVATIVE TYPE	TREATMENT TYPE	USE CATEGORY	COMMENTS
P1	WB	UC4A	
P2	WB	UC3B	
P3			

TREATMENT TYPE

WB = WATERBORNE
OT = OIL–BORNE

USE CATEGORY

UC3B = ABOVE GROUND – EXPOSED
UC4A = GROUND CONTACT – GENERAL USE
UC4B = GROUND CONTACT – HEAVY DUTY

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

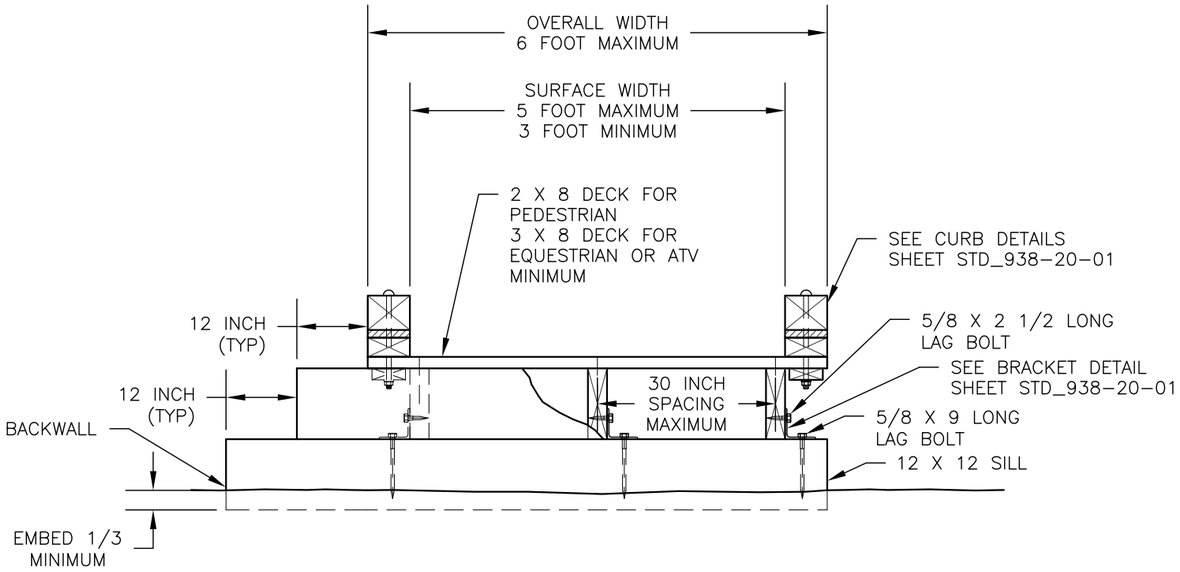
PROJECT NAME & LOCATION

DRAWING NAME: **ELEVATED BOARDWALK**
SECTION: **938 - BOARDWALKS**
TYPICAL ID: **EB1**

REVISION DATE: **XX/XX/XX**
NO SCALE

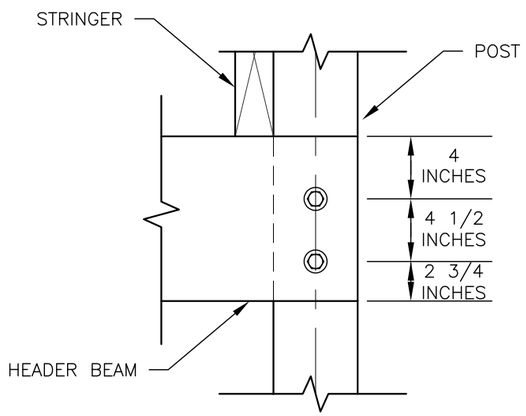
DRAWING NO.: **STD_938-20-01**
SHEET OF

DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT

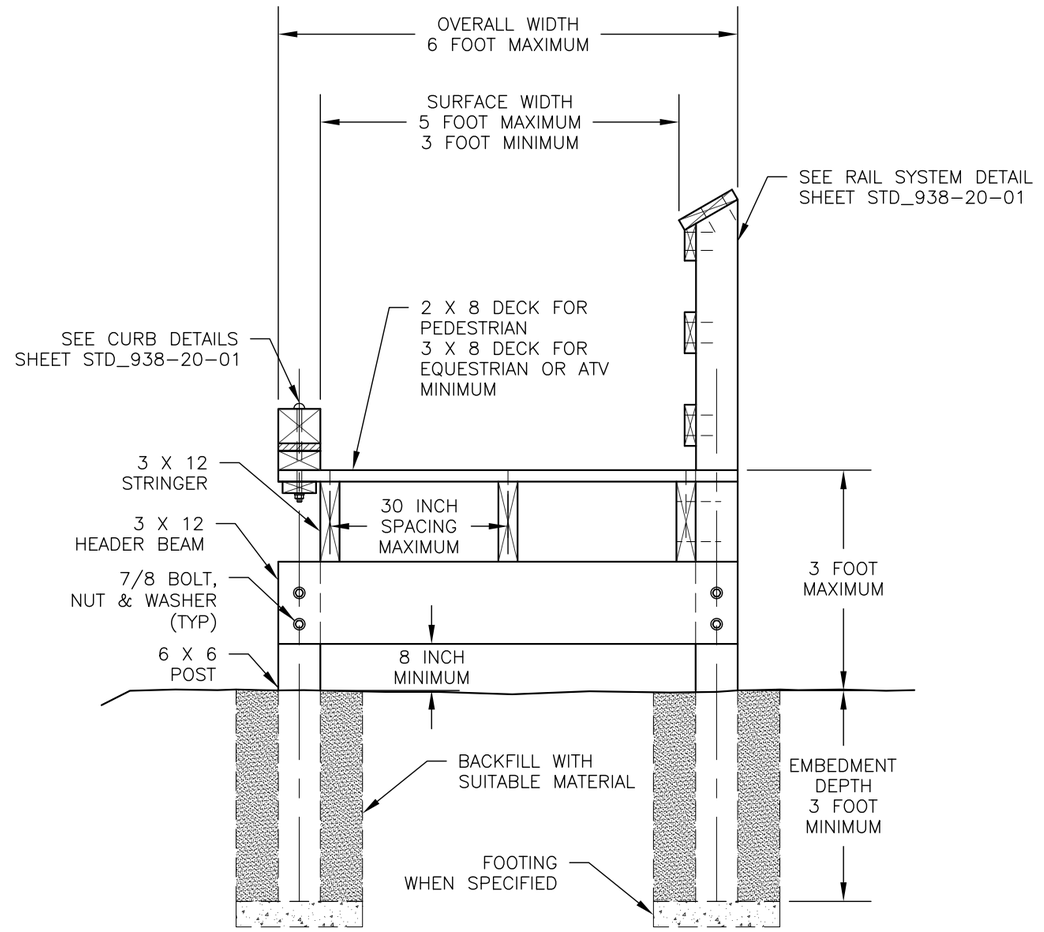


A TYPICAL GROUND SECTION

BLOCKING REQUIRED AT EVERY SUPPORT NOT SHOWN FOR CLARITY



BOLT DETAIL



B TYPICAL ELEVATED SECTION

LESS THAN 3 FEET WITH CURB
BLOCKING REQUIRED AT EVERY SUPPORT
NOT SHOWN FOR CLARITY

C TYPICAL ELEVATED SECTION

LESS THAN 3 FEET WITH CURB
BLOCKING REQUIRED AT EVERY SUPPORT
NOT SHOWN FOR CLARITY

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME
ELEVATED BOARDWALK

SECTION
938 - BOARDWALKS

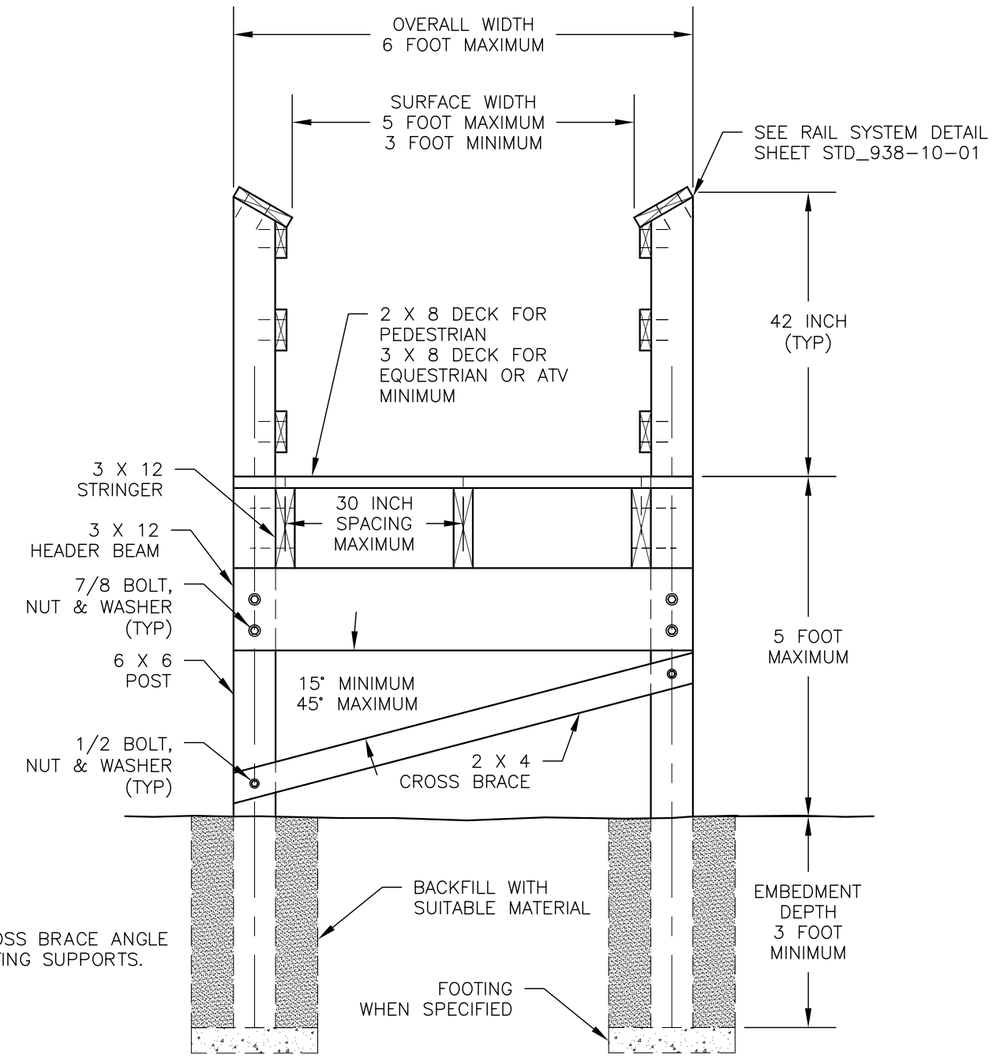
TYPICAL ID
EB2

REVISION DATE
XX/XX/XX

NO SCALE

DRAWING NO.
STD_938-20-02

SHEET
OF

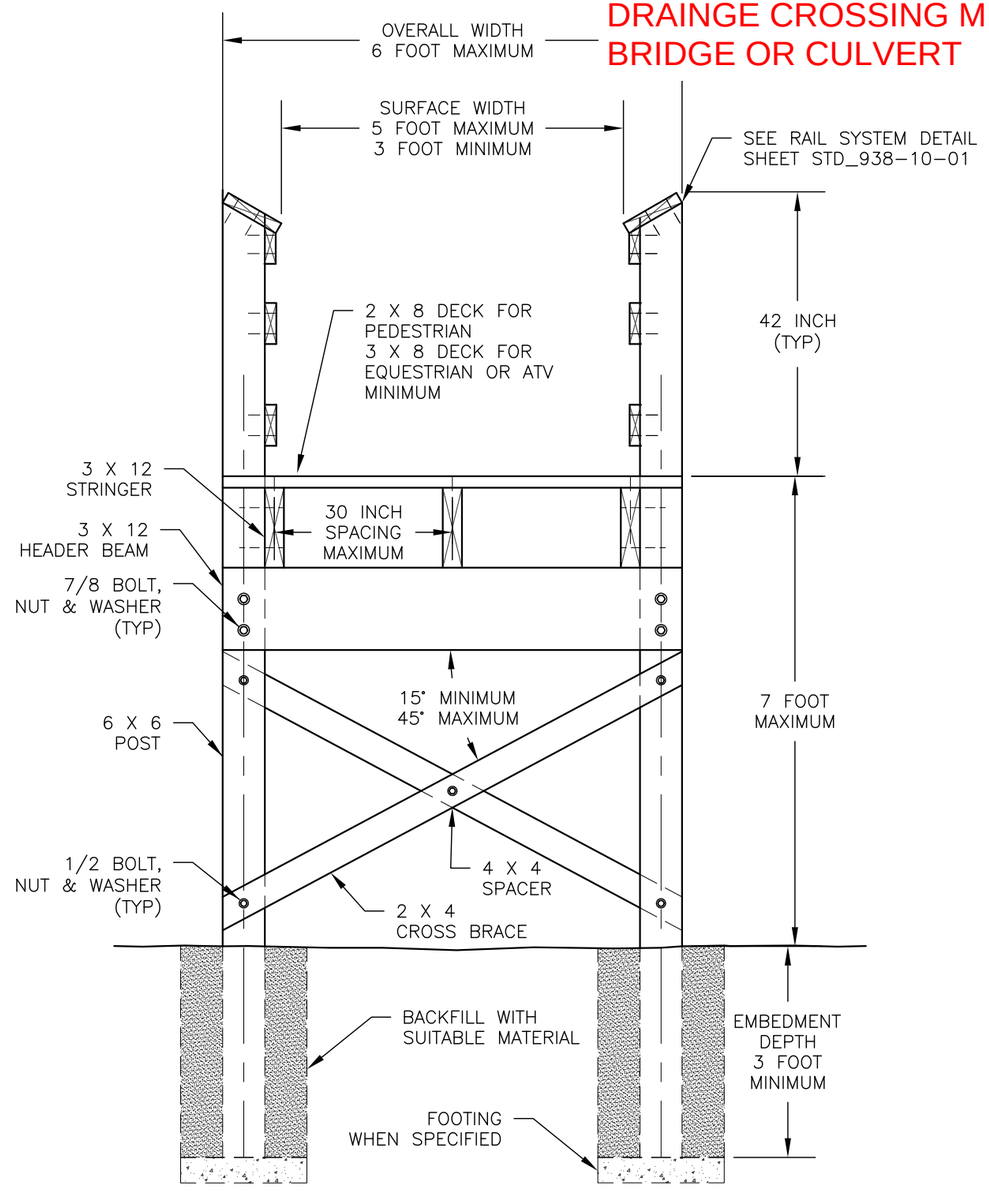


NOTE:
REVERSE CROSS BRACE ANGLE AT ALTERNATING SUPPORTS.

D TYPICAL ELEVATED SECTION

GREATER THAN 3 FEET LESS THAN 5 FEET BLOCKING REQUIRED AT EVERY SUPPORT NOT SHOWN FOR CLARITY

DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT



E TYPICAL ELEVATED SECTION

GREATER THAN 5 FEET LESS THAN 7 FEET BLOCKING REQUIRED AT EVERY SUPPORT NOT SHOWN FOR CLARITY

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME
ELEVATED BOARDWALK

SECTION
938 - BOARDWALKS

TYPICAL ID
EB3

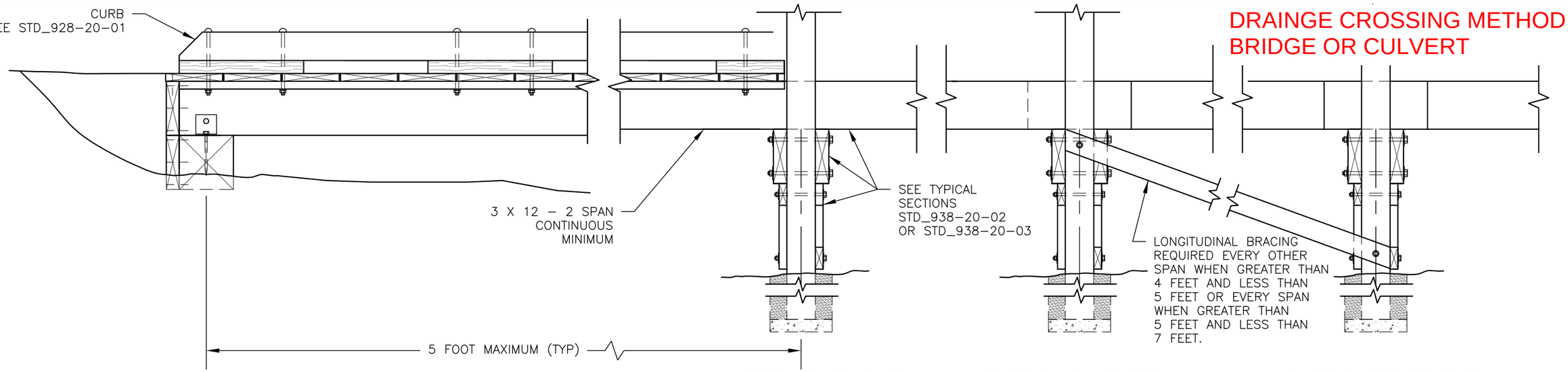
REVISION DATE
XX/XX/XX

NO SCALE

DRAWING NO.
STD_938-20-03

SHEET
OF

DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT

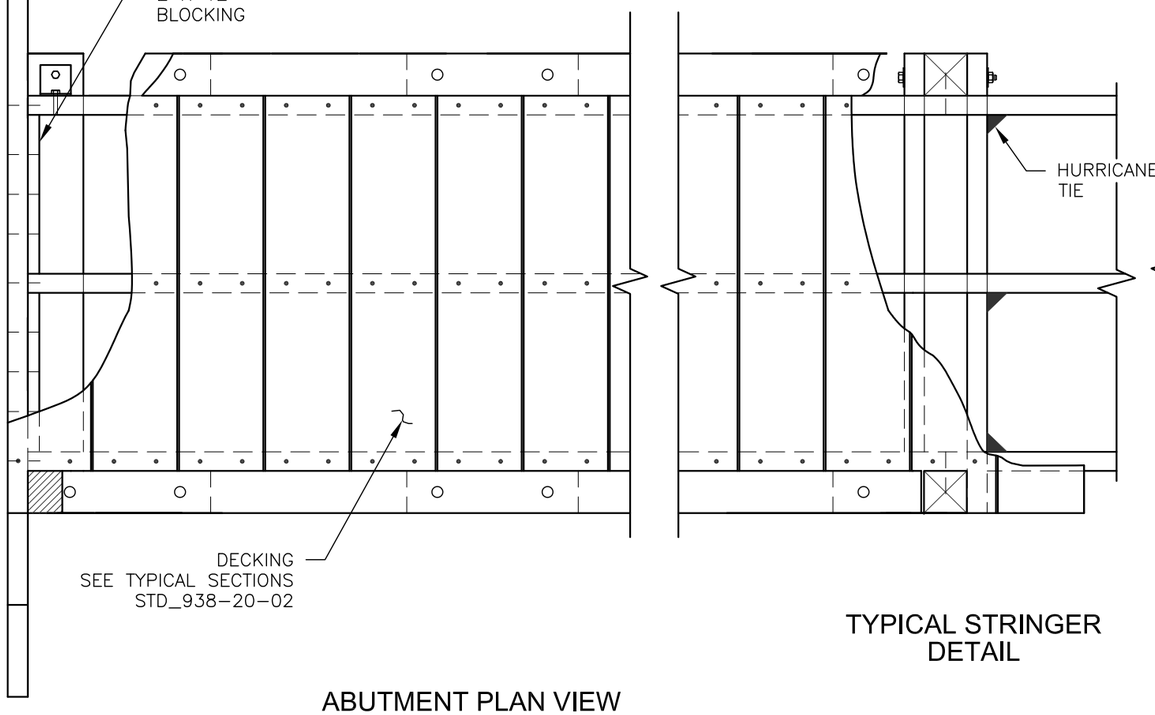


TYPICAL STRINGER DETAIL

STRINGER LAP JOINT DETAIL

STRINGER BLOCKING DETAIL

ABUTMENT PROFILE VIEW



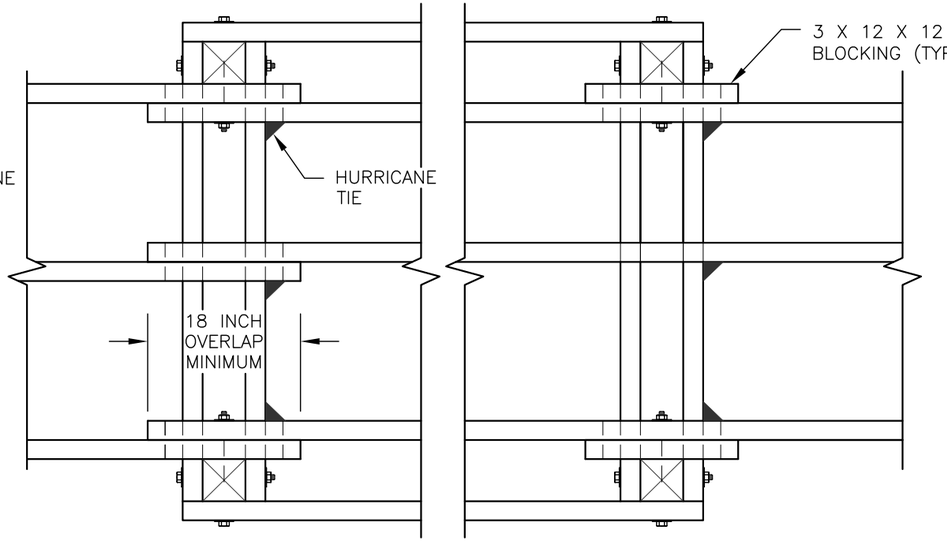
TYPICAL STRINGER DETAIL

ABUTMENT PLAN VIEW

CROSS BRACING NOT SHOWN FOR CLARITY

PIER PROFILE VIEW

BLOCKING, DECKING AND RAIL SYSTEM NOT SHOWN FOR CLARITY



STRINGER LAP JOINT DETAIL

STRINGER BLOCKING DETAIL

PIER PLAN VIEW

BLOCKING, CROSS BRACING, DECKING AND RAIL SYSTEM NOT SHOWN FOR CLARITY

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME
ELEVATED BOARDWALK

SECTION
938 - BOARDWALKS

TYPICAL ID
EB4

REVISION DATE
XX/XX/XX

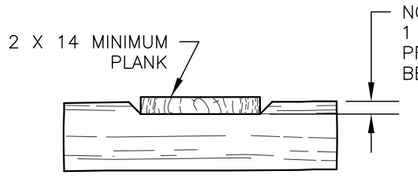
NO SCALE

DRAWING NO.
STD_938-20-04

SHEET
OF

STEP AND RUN

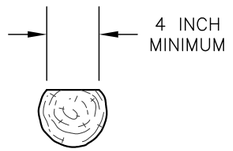
DRAINGE CROSSING METHOD B - BRIDGE OR CULVERT



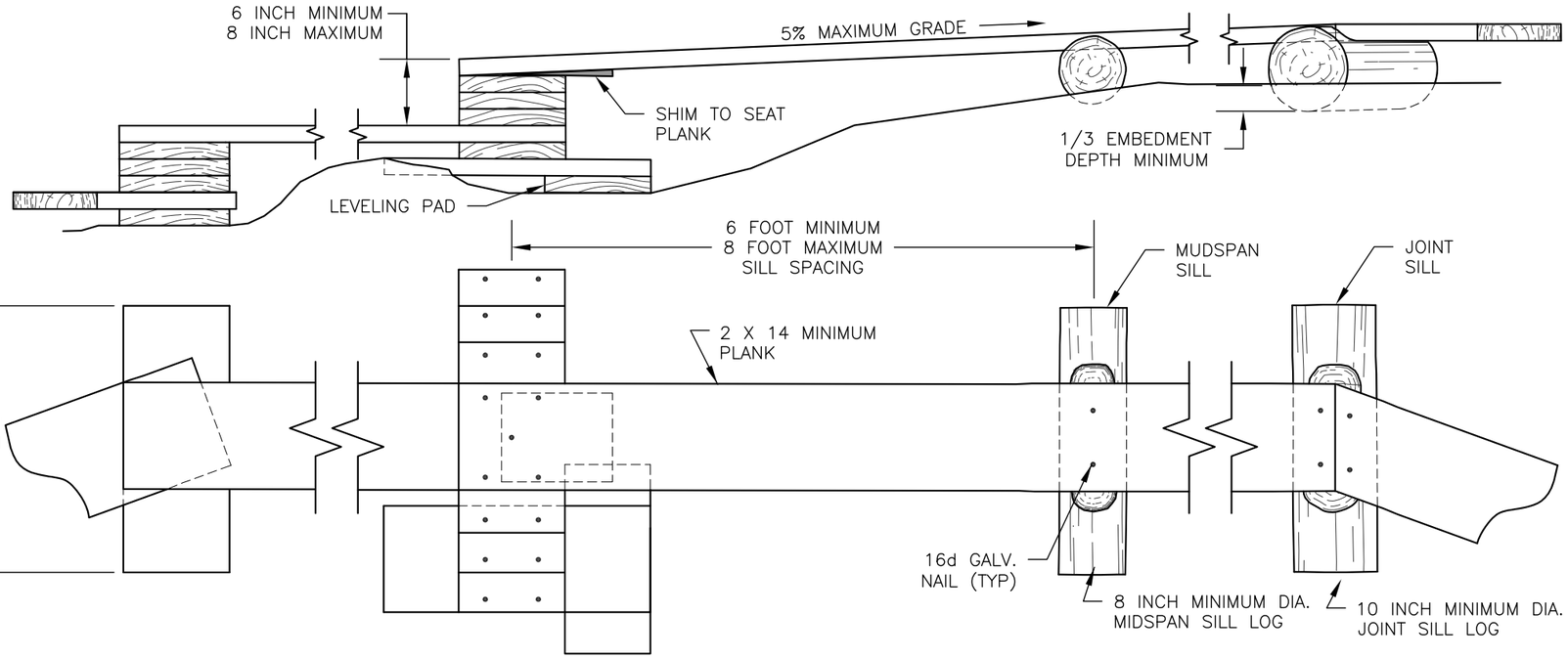
SILL LOG JOINT DETAIL

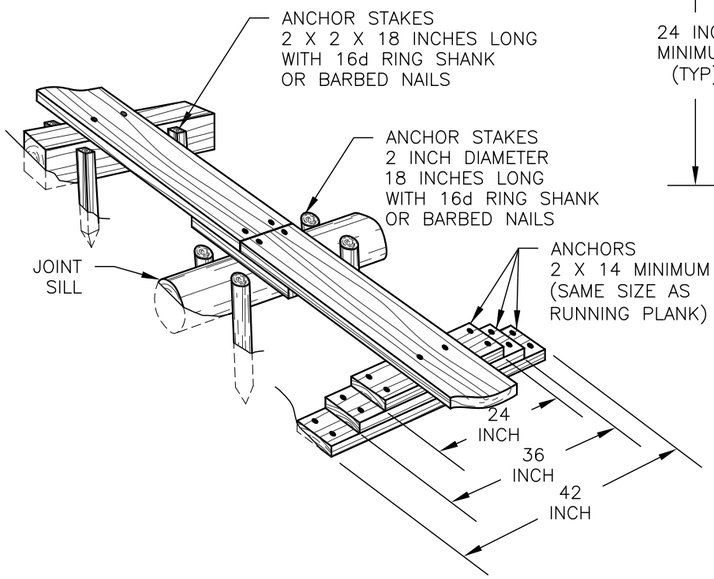
TYPICAL ID	SILL TYPE	SILL SIZE	SILL SPECIES	SILL PRESERV. TYPE	PLANK SIZE	PLANK SPECIES	PLANK PRESERV. TYPE	COMMENTS
SNR–1				P			P	

N/A WHEN NOT APPLICABLE



LOG DETAIL





NOTES:

1. KEEP PLANKS LOW TO THE GROUND. FOLLOW TOPOGRAPHY THROUGH SMALL DIPS.
2. AVOID STACKING PLANKS FOR SILL ON SIDE HILLS. DIG THE SILL INTO THE BANK.

PRESERVATIVE TREATMENT – (REFER TO AWPA USE CATEGORY SYSTEM)			
PRESERVATIVE TYPE	TREATMENT TYPE	USE CATEGORY	COMMENTS
P1	WB	UC4A	
P2	WB	UC3B	
P3			

TREATMENT TYPE

WB = WATERBORNE
OT = OIL–BORNE

USE CATEGORY

UC3B = ABOVE GROUND – EXPOSED
UC4A = GROUND CONTACT – GENERAL USE
UC4B = GROUND CONTACT – HEAVY DUTY

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

STANDARD TRAIL PLAN

PROJECT NAME & LOCATION

DRAWING NAME: **STEP AND RUN**

SECTION: **938 - BOARDWALKS**

TYPICAL ID: **SNR**

REVISION DATE: **XX/XX/XX**

NO SCALE

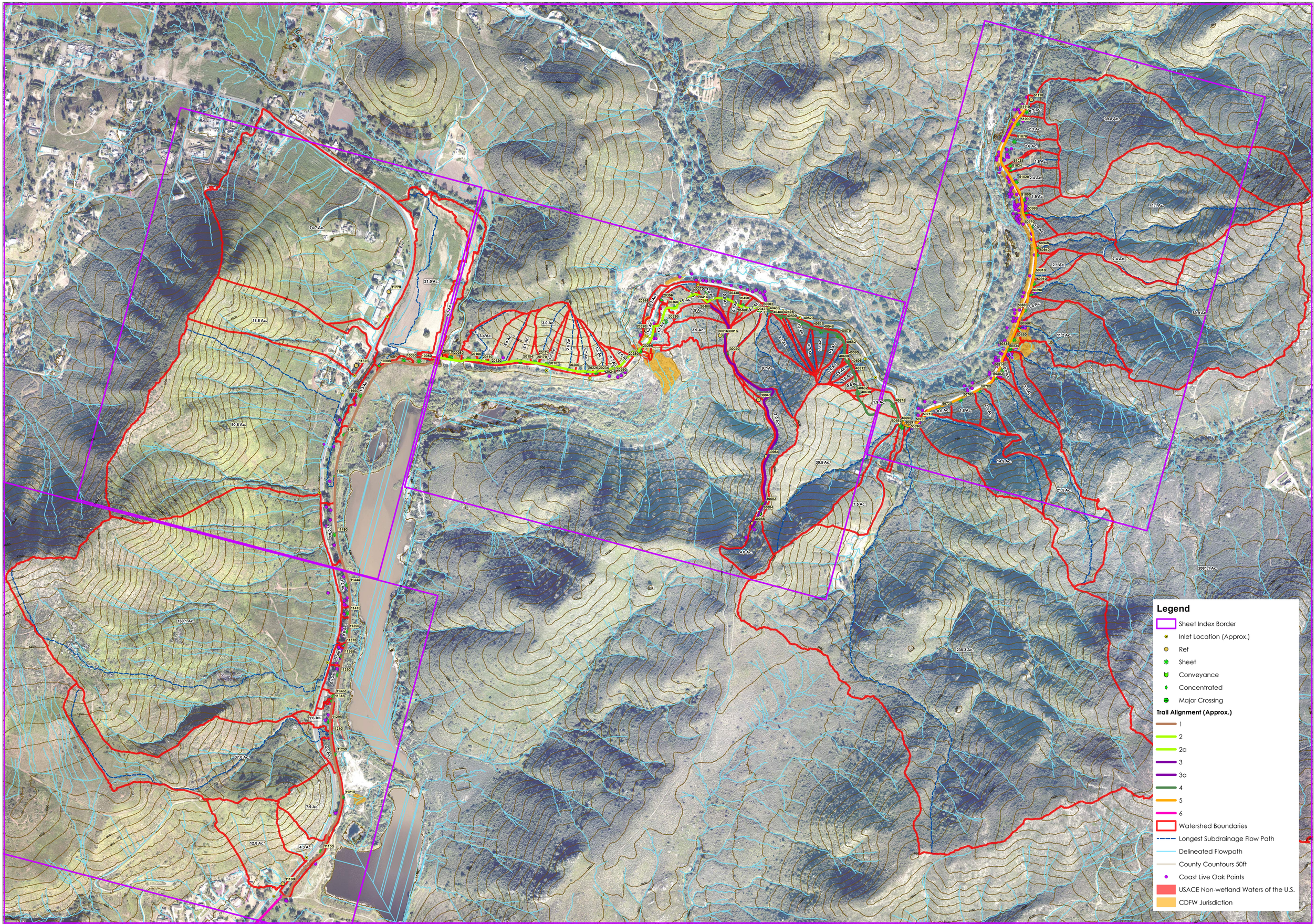
DRAWING NO.: **STD_938-30-01**

SHEET

OF

MAP POCKET

Drainage Study Maps



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8/30/2019 9:47:58 AM

RICK ENGINEERING COMPANY
www.rickengineering.com

Scale in Feet
0 300 600 900
North

Date of Trail Alignments: 06.06.2019
Date of Exhibit: 08.30.2019
Aerial Image: 2017
Topographic Source: 2017 (SanGIS)

Sycuan Sloane Canyon Trail Project

Page 1 of 5 - DRAINAGE STUDY INDEX MAP

J-18474-B

Legend

- Sheet Index Border
- Inlet Location (Approx.)
- Ref
- Sheet
- Conveyance
- Concentrated
- Major Crossing

Trail Alignment (Approx.)

- 1
- 2
- 2a
- 3
- 3a
- 4
- 5
- 6

- Watershed Boundaries
- Longest Subdrainage Flow Path
- Delineated Flowpath
- Major 20' Contour
- Minor 4' Contour
- Coast Live Oak Points
- USACE Non-wetland Waters of the U.S.
- CDFW Jurisdiction

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RICK ENGINEERING COMPANY
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Scale in Feet
0 100 200 300
North

Date of Trail Alignments: 06.06.2019
Date of Exhibit: 08.30.2019
Aerial Image: 2017
Topographic Source: 2017 (SanGIS)

Sycuan Sloane Canyon Trail Project

Page 2 of 5 - DRAINAGE STUDY MAP

J-18474-B

Legend

- Sheet Index Border
- Inlet Location (Approx.)
- Ref
- Sheet
- Conveyance
- Concentrated
- Major Crossing

Trail Alignment (Approx.)

- 1
- 2
- 2a
- 3
- 3a
- 4
- 5
- 6

- Watershed Boundaries
- Longest Subdrainage Flow Path
- Delineated Flowpath
- Major 20' Contour
- Minor 4' Contour
- Coast Live Oak Points
- USACE Non-wetland Waters of the U.S.
- CDFW Jurisdiction

90.6 Ac.
18.6 Ac.
74.7 Ac.
160.1 Ac.
0.3 Ac.
1.3 Ac.
2.0 Ac.
1.2 Ac.
21.0 Ac.
5.7 Ac.
5.7 Ac.
11676
11560
11610
11660
11490
11770
11644
10008
10030
10050
10040

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Scale in Feet
0 100 200 300
North

Date of Trail Alignments: 06.06.2019
Date of Exhibit: 08.30.2019
Aerial Image: 2017
Topographic Source: 2017 (SanGIS)

Sycuan Sloane Canyon Trail Project

Page 3 of 5 - DRAINAGE STUDY MAP

J-18474-B

Legend

- Sheet Index Border
- Inlet Location (Approx.)
- Ref
- Sheet
- Conveyance
- Concentrated
- Major Crossing

Trail Alignment (Approx.)

- 1
- 2
- 2a
- 3
- 3a
- 4
- 5
- 6

- Watershed Boundaries
- Longest Subdrainage Flow Path
- Delineated Flowpath
- Major 20' Contour
- Minor 4' Contour
- Coast Live Oak Points
- USACE Non-wetland Waters of the U.S.
- CDFW Jurisdiction

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RICK ENGINEERING COMPANY
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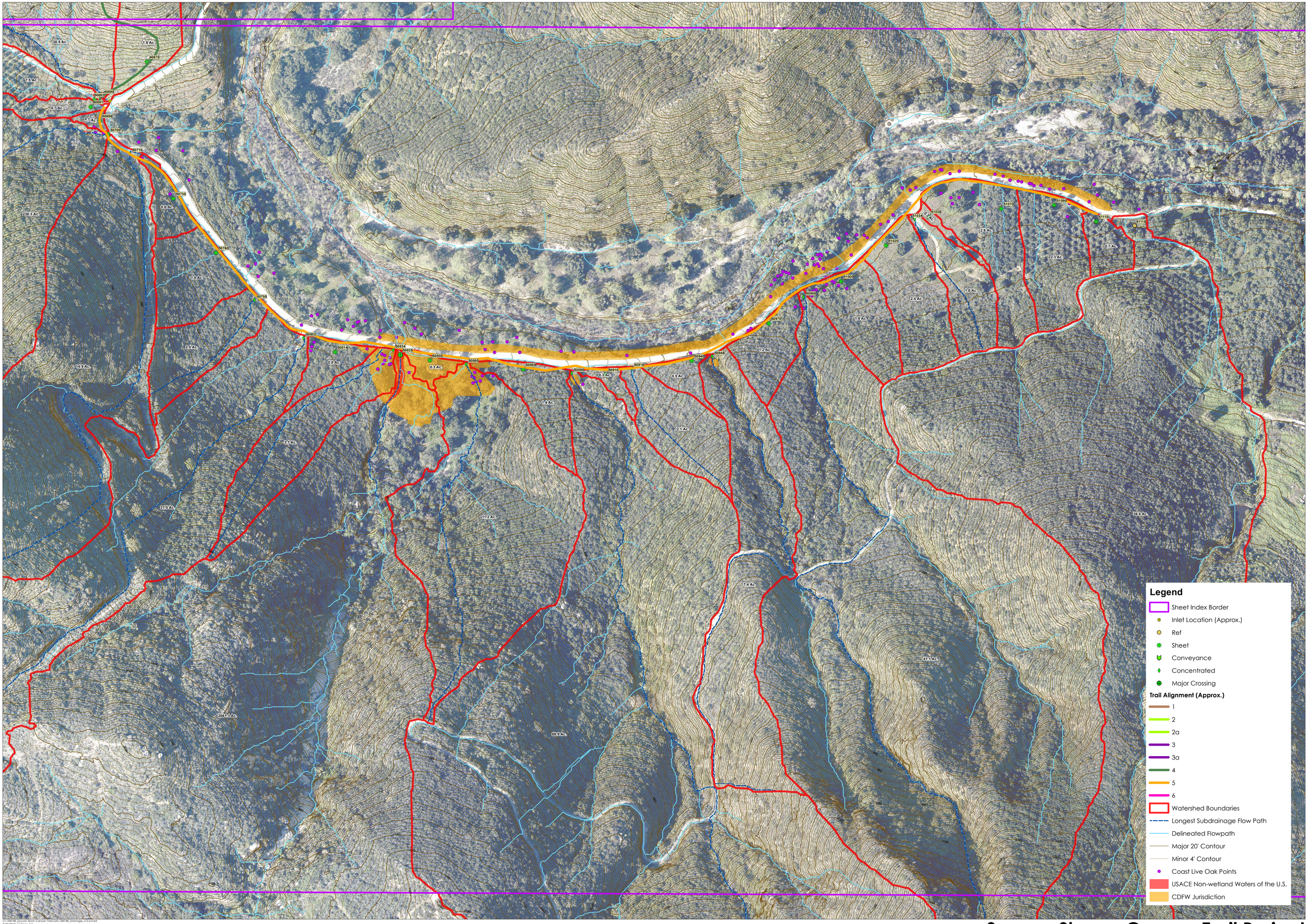
Scale in Feet
0 100 200 300
North

Date of Trail Alignments: 06.06.2019
Date of Exhibit: 08.30.2019
Aerial Image: 2017
Topographic Source: 2017 (SanGIS)

Sycuan Sloane Canyon Trail Project

Page 4 of 5 - DRAINAGE STUDY MAP

J-18474-B



Legend

- Sheet Index Border
- Inlet Location (Approx.)
- Ref
- Sheet
- Conveyance
- Concentrated
- Major Crossing

Trail Alignment (Approx.)

- 1
- 2
- 2a
- 3
- 3a
- 4
- 5
- 6

- Watershed Boundaries
- Longest Subdrainage Flow Path
- Delineated Flowpath
- Major 20' Contour
- Minor 4' Contour
- Coast Live Oak Points
- USACE Non-wetland Waters of the U.S.
- CDFW Jurisdiction

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RICK ENGINEERING COMPANY
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Scale in Feet
0 100 200 300
North

Date of Trail Alignments: 06.06.2019
Date of Exhibit: 08.30.2019
Aerial Image: 2017
Topographic Source: 2017 (SanGIS)

Sycuan Sloane Canyon Trail Project

Page 5 of 5 - DRAINAGE STUDY MAP

J-18474-B