NCE
NORTH COAST
ENGINEERING

TECHNICAL MEMORANDUM

DATE: May 31, 2019

TO: San Luis Obispo County Department of Public Works

FROM: Chris Barber, PE

SUBJECT: Sidifoax Cultivation Drainage Analysis

Project Information

This technical memorandum outlines the existing and proposed drainage features for the Sidifoax Cannabis project located at 7575 Carrisa Highway, Santa Margarita, CA. The project is located off State Route 58, just west of the Topaz Solar Farm. Approximately 9 acres of the site's 106 acres will be disturbed. The proposed project includes widening and reconstruction of an existing driveway, two outdoor cannabis grow fields, an indoor cannabis grow structure, and a support building for operations and nursery work. The outdoor grow areas will be constructed with hoop houses. The project will consist of two phases. For the purposes of the analysis in this technical memo, it is assumed that all proposed development is complete and stabilized.

The site consists of rolling terrain with 10% average slopes and contains shrubbery and short grasses. Soils are predominately Hydrologic Soil Group Type C per the NRCS Web Soil Survey. The On-Site watershed is part of a larger 440-acre off-site watershed south of the project (See Watershed Map in Appendix). Because the runoff from the on-site development (11-acre watershed) joins this confluence shortly after leaving the site and due to the significantly smaller size, the on-site development will have an insignificant impact on downstream peak runoff, even though peak flows will increase from the on-site watershed with the development of the project site. No adverse effects from the increase in post-developed water are anticipated.

Existing drainage patterns are maintained to the best extents possible in the proposed site design. A watershed map of the proposed improvements is attached to this memo for reference. Runoff from the west watershed will be captured by a roadside swale, while the east watershed will drain across the site to the north and is collected and

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discharged through the installation of a new culvert. The discharge of the culvert will recombine with the west watershed and spread to sheet flow and continue in its existing condition to State Route 58. Collectively, the east and west watersheds are represented as the "on-site" watershed on the attached exhibit. Once runoff reaches SR58, it flows through the existing drainage ditch along the highway in a westerly direction and then through an existing 24" culvert under the projects existing driveway, continuing westerly. Increase in runoff to this culvert from development is documented in this memo and analysis of the existing culvert will be conducted with final grading plans to ensure the increase in runoff can be accommodated in the existing conditions.

Runoff Calculations

The rational method was selected to determine peak flows for the site given the acreage of the on-site watersheds.

C value: The runoff coefficient was derived from SLO County Standard Detail H-3a, resulting in a value of 0.44. A composite c-value for the west watershed was computed by using the 0.44 value for pervious areas, 0.75 for all developed areas, and 1.0 for buildings.

Time of concentration: T_C was derived from SLO County Standard Detail H-2, with elevation (45-ft) and length (850-ft) determined. This results in a T_C of 4.5 minutes. This value was brought up to the county minimum of 10 minutes.

I value: An intensity was derived based on review of SLO County Standard Detail H-1. The property is located along the 12" annual rainfall contour. With a T_C of 10 minutes, the corresponding table on Detail H-4 prescribes I values of 2.0 and 2.2 for the 25-year and 50-year storm events, respectively.

Areas: The west watershed area (A_W) is 3.5 acres. The east watershed area (A_E) is 4.3 acres. The total on-site watershed area (A_T) does not differ significantly in the pre/post developed conditions and is 11.3 acres.

East Watershed Rational Method Calculations

$Q = kCIA$, where k is the conversion factor for US units, k = 1.008

Composite C = (0.44 * 1.8 + 0.75 * 1.9 + 1.0 * 0.1) / 3.8 = 0.61

I_{25} = 2.0 in/hr I_{50} = 2.2 in/hr A_E = 3.8 acres

$Q_{25} = 1.008 * 0.61 * 2.0 * 3.8 = \mathbf{4.7\ CFS}$

$Q_{50} = 1.008 * 0.61 * 2.2 * 3.8 = \mathbf{5.1\ CFS}$

West Watershed Rational Method Calculations

$Q = kCIA$, where k is the conversion factor for US units, k = 1.008

Composite C = (0.44 * 0.8 + 0.75 * 2.3 + 1.0 * 0.4) / 3.6 = 0.69

I_{25} = 2.0 in/hr I_{50} = 2.2 in/hr A_W = 3.5 acres

$Q_{25} = 1.008 * 0.69 * 2.0 * 3.5 = \mathbf{4.9\ CFS}$

$Q_{50} = 1.008 * 0.69 * 2.2 * 3.5 = \mathbf{5.4\ CFS}$

On-Site Watershed Rational Method Calculations

$Q = kCIA$, where k is the conversion factor for US units, k = 1.008

Pre-developed C-value = 0.44
Post-developed Composite C = (0.44 * 6.4 + 0.75 * 4.2 + 1.0 * 0.7) / 11.3 = 0.59

I_{25} = 2.0 in/hr I_{50} = 2.2 in/hr A_T = 11.3 acres

$Q_{25PRE} = 1.008 * 0.44 * 2.0 * 11.3 = \mathbf{10.0\ CFS}$

$Q_{25POST} = 1.008 * 0.59 * 2.0 * 11.3 = \mathbf{13.4\ CFS}$

$Q_{50PRE} = 1.008 * 0.44 * 2.2 * 11.3 = \mathbf{11.0\ CFS}$

$Q_{50POST} = 1.008 * 0.59 * 2.2 * 11.3 = \mathbf{14.8\ CFS}$

The existing culvert is approximately 24" diameter CMP, installed at approx. 12%. Based on the existing conditions, a maximum flow rate of 25 CFS is accepted by the culvert in ideal conditions before overtopping the road. As a result, the existing culvert can accept the post-developed 50-year flow rate.

Proposed Roadside Swale Sizing

A trapezoidal roadside swale was selected for its efficiency and modeled in FlowMaster with the west watershed peak flow. A cross section was determined using 50-yr flow rates with no freeboard, resulting in the following section (For detailed results, see the Flowmaster results in the appendix):

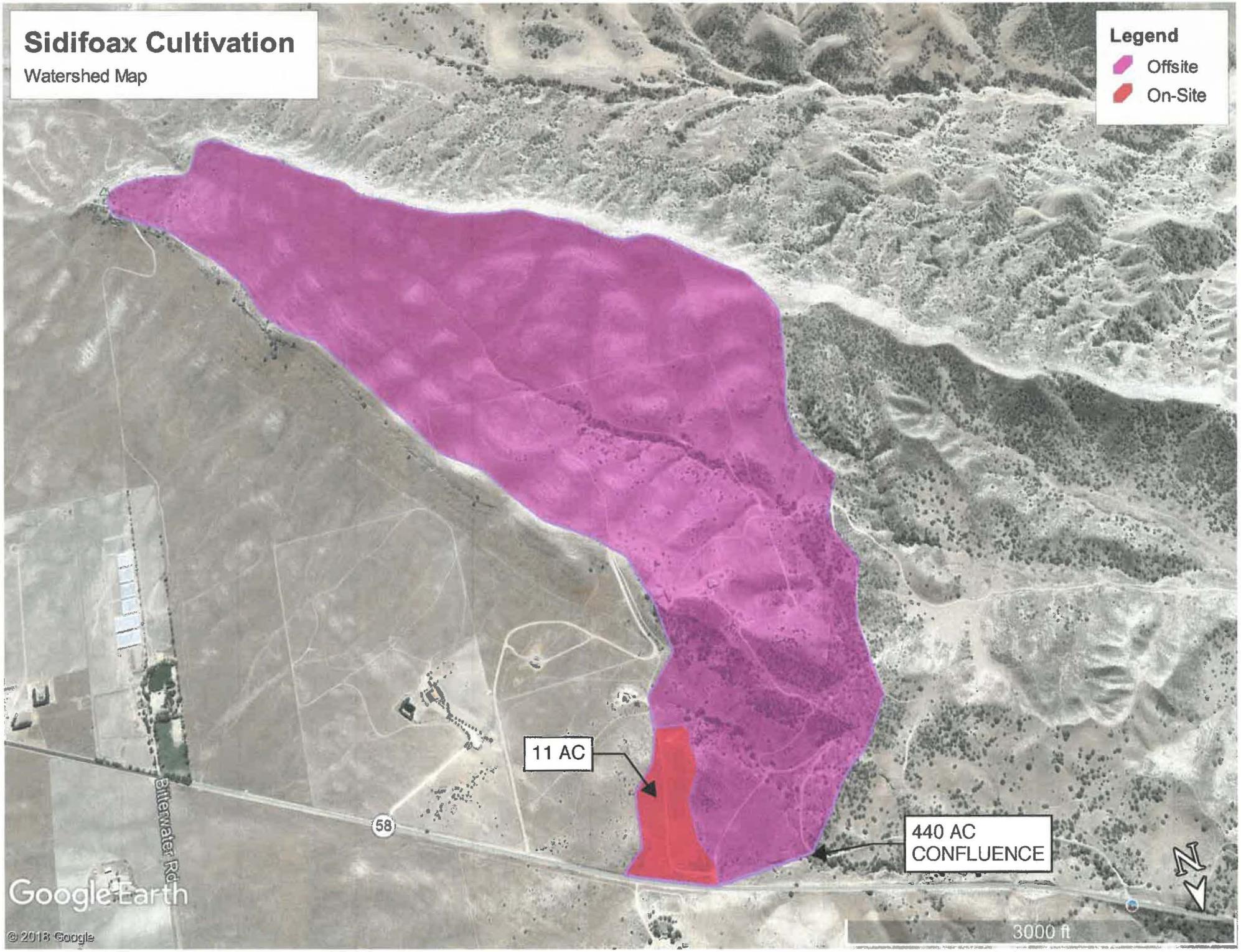
Side Slopes = 4:1
Bottom Width = 2-ft
Depth = 6-in
Total Width = 6-ft

Note: County standards require the primary storm event swale section incorporate 1-ft of freeboard but allow no freeboard in the secondary storm event. Because there is only a 15% increase in peak flows from the primary to secondary storm event, the addition of 1-ft freeboard in the 25-yr event was considered excessive, given the safe overland routes, through the project site, available.

The swale was analyzed at the steepest slope (7.6%) along the swale to determine that velocity in the 25-year storm does not exceed 4.0 ft/s and analyzed along the milder slope at the end of the swale (3.2%) for the 50-year storm to determine sufficient capacity. The results were a velocity of 4.0 ft/s in the 25-year storm and a maximum depth of 0.41-ft in the 50-year storm.

Proposed Culvert Sizing

A proposed culvert will cross the driveway and collect runoff from the east watershed. The culvert was modeled in HY-8 to determine capacity in the 50-year storm. The 18" HDPE pipe selected was found to convey the 50-year storm without spilling over the edge of shoulder. RSP was sized using county drawing H-5. For detailed results, see the HY-8 results in the appendix.


Sidifoax Cultivation
Watershed Map
Legend
Offsite
On-Site
11 AC
440 AC
CONFLUENCE
Bitterwater Rd
58
Google Earth
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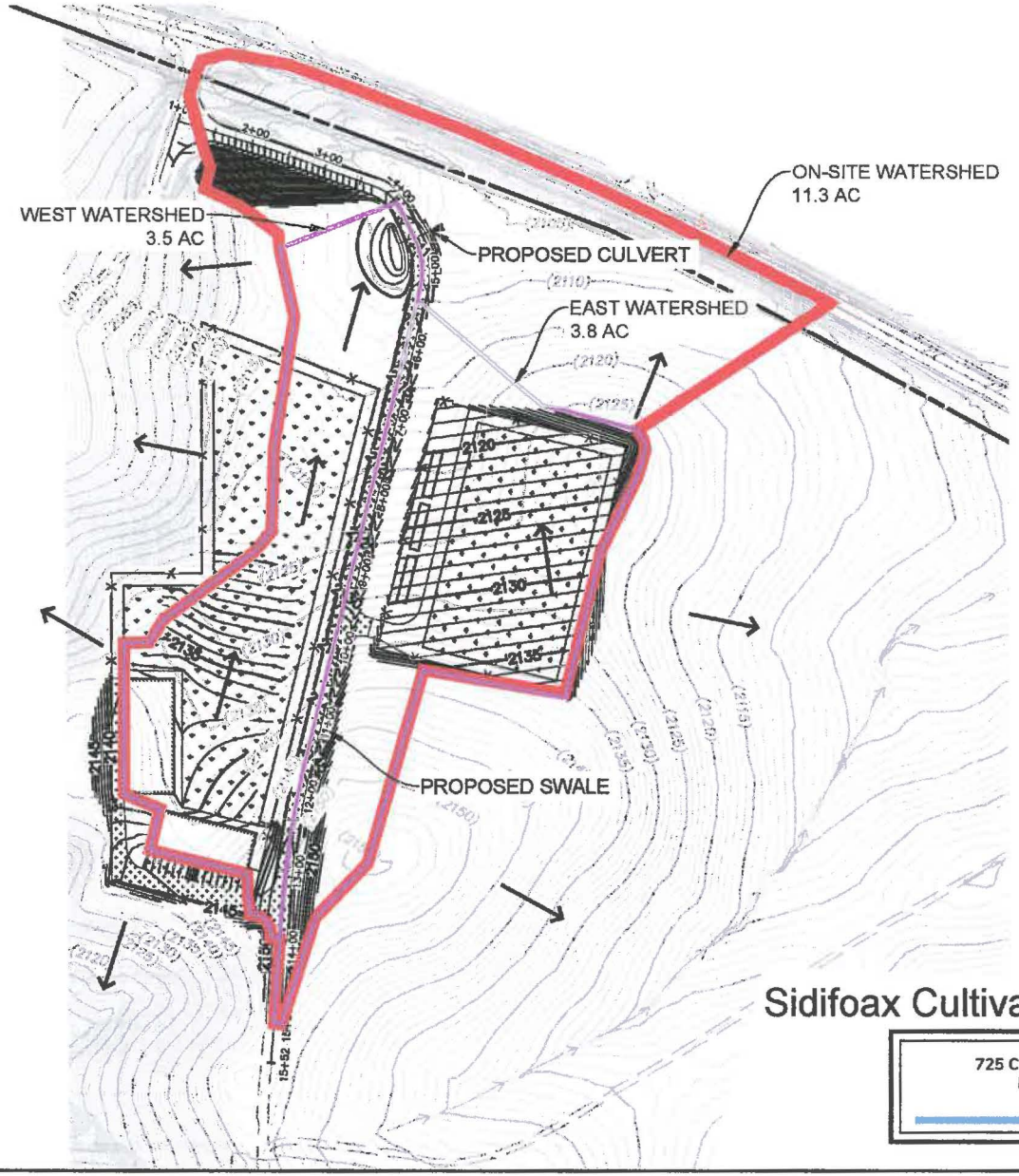
3000 ft
N



NCE

0 75' 150' 300'

SCALE: 1"=150'

Sidifoax Cultivation Watershed Exhibit

725 CRESTON ROAD, SUITE B
PASO ROBLES, CA
805.239.3127

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  - AASHTO Group Index
  - Depth to a Selected Soil Restrictive Layer
  - Depth to Any Soil Restrictive Layer
  - Drainage Class
  - Frost Action
  - Frost-Free Days
  - Hydrologic Soil Group

View Description | View Rating

View Options

Map ✓

Table ✓

Description of Rating ✓

Rating Options

Detailed Description

Advanced Options

Aggregation Method: Dominant Condition

Component Percent Cutoff:

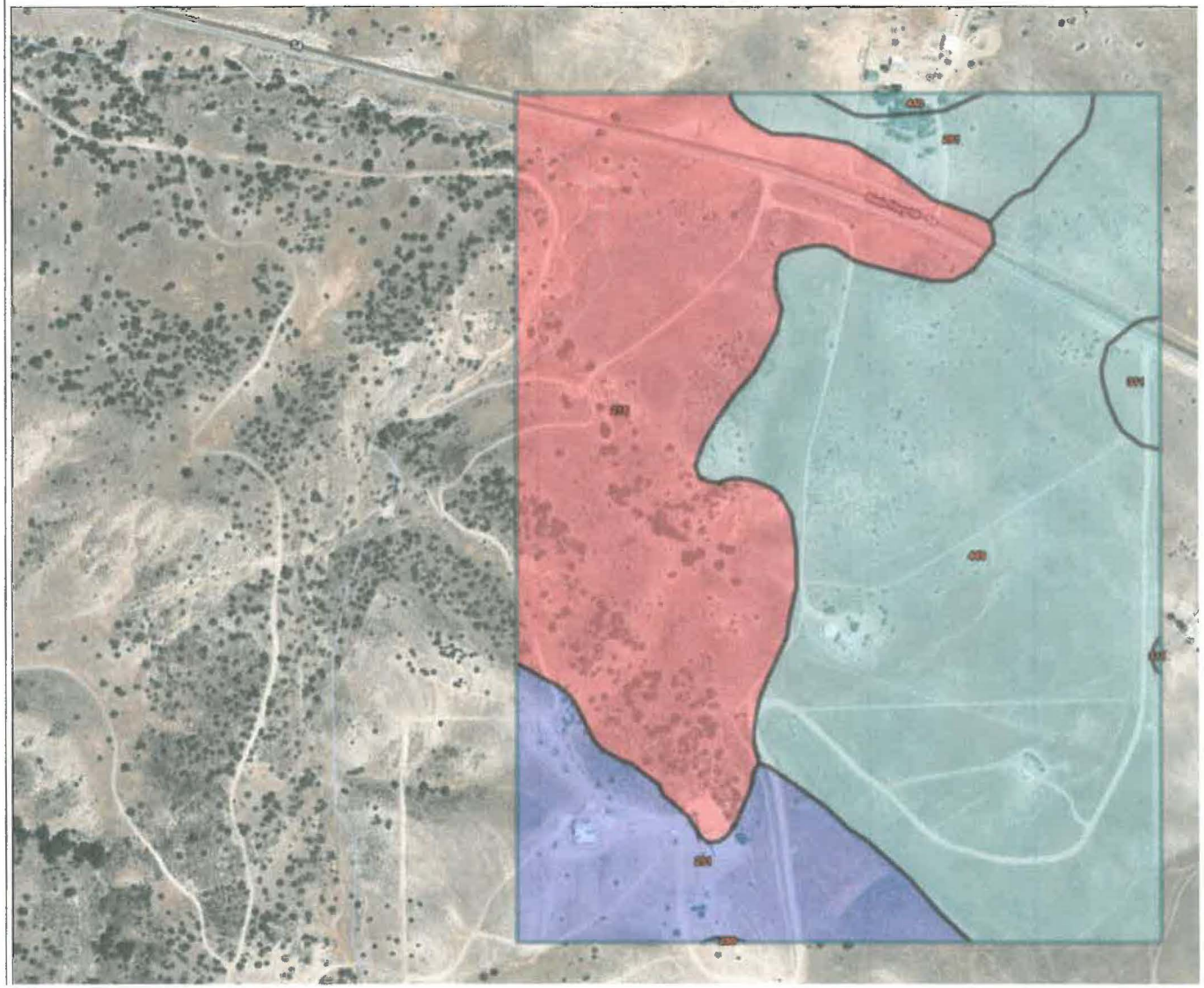
Tie-break Rule: Lower / Higher

View Description | View Rating

- Map Unit Name
- Parent Material Name
- Representative Slope
- Soil Slippage Potential

Map – Hydrologic Soil Group

Scale (not to scale)



Unified Soil Classification (Surface)
Water Features

Warning: Soil Ratings Map may not be valid at this scale.

You have zoomed in beyond the scale at which the soil map for this area is intended to be used. Mapping of soils is done at a particular scale. The soil surv design of map units and the level of detail shown in the resulting soil map are dependent on that map scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do been shown at a more detailed scale.

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — San Luis Obispo County, California, Carrizo Plain Area (CA667)

Summary by Map Unit — San Luis Obispo County, California, Carrizo Plain Area (CA667)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
218	Seaback-Calleguas-Panoza complex, 30 to 50 percent slopes	D	52.5	34.1%
281	Seaback-Panoza-Jenks complex, 15 to 30 percent slopes	C	6.5	4.2%
290	San Timoteo-San Andreas-Bellyspring complex, 15 to 30 percent slopes	B	0.0	0.0%
291	San Timoteo-San Andreas-Bellyspring complex, 30 to 50 percent slopes	B	18.3	11.9%
311	Yeguas-Pinspring complex, 2 to 5 percent slopes	C	1.7	1.1%
440	Bellyspring-Panoza complex, 9 to 15 percent slopes	C	74.8	48.6%
Totals for Area of Interest			**153.8**	**100.0%**

Description — Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

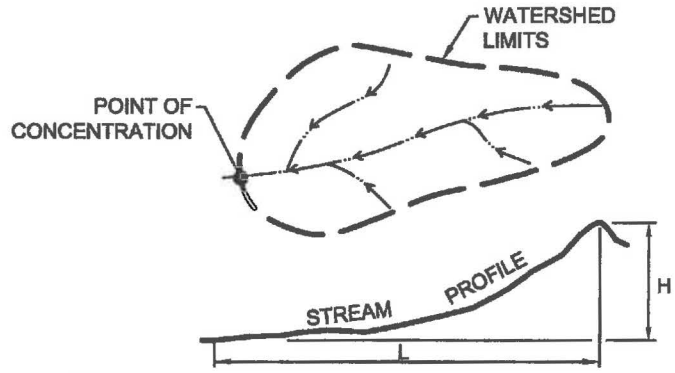
Rating Options — Hydrologic Soil Group

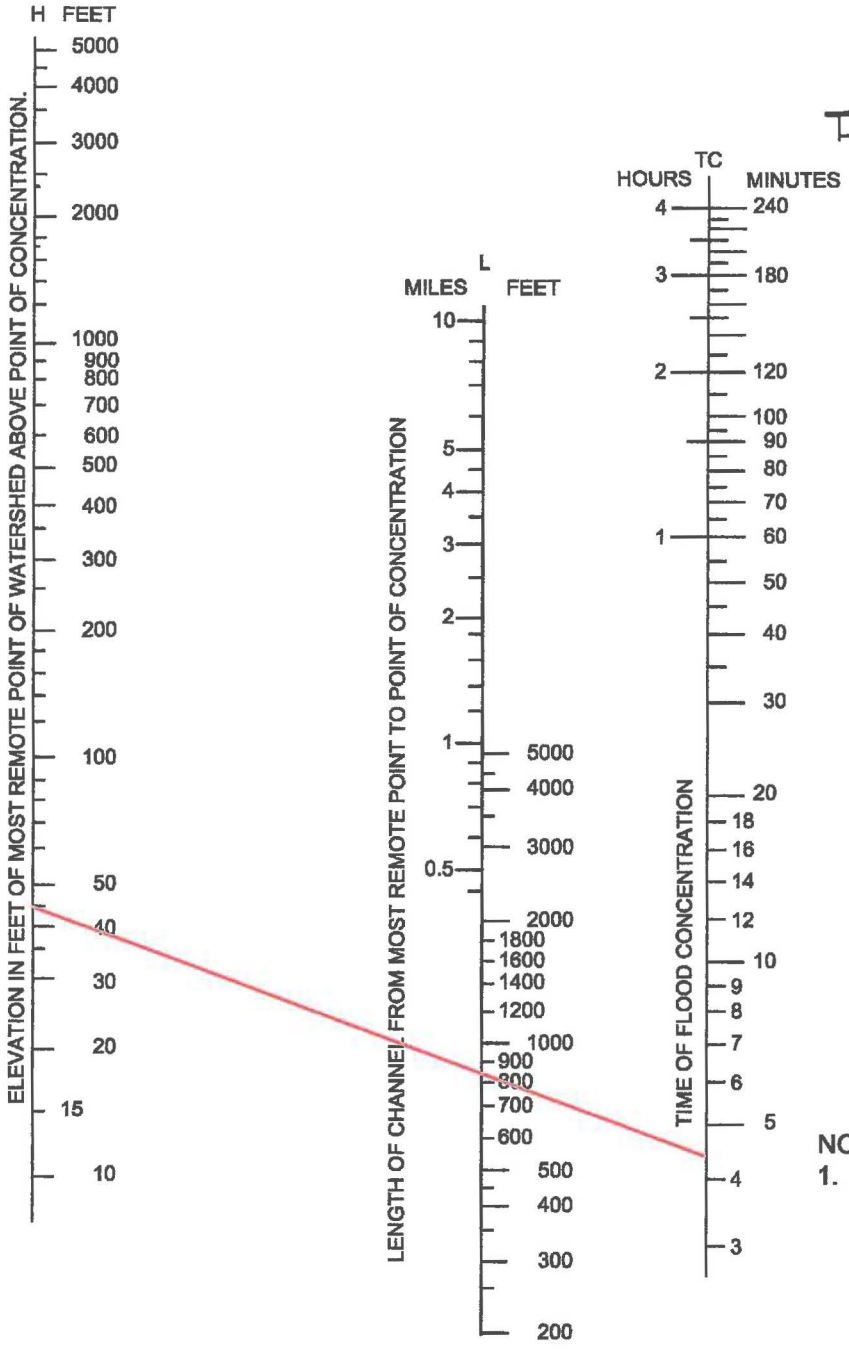
Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Revisions					
Description	Approved	Date	Description	Approved	Date
ADD REF.	GDM	NOV 08			





EQUATIONS FOR ESTIMATED "TIME OF CONCENTRATION"

$$Tc = \left(\frac{11.9L^3}{H}\right)^{0.385}$$

LEGEND:
Tc = TIME OF CONCENTRATION IN HOURS.
L = LENGTH OF CHANNEL IN MILES.
H = DIFFERENCE IN ELEVATION BETWEEN MOST REMOTE POINT AND THE POINT OF CONCENTRATION IN FEET.

Tc Calculation
L = 840 ft
H = 160 ft

Tc = 4.5 min -> 10 min Tc
Minimum selected

NOTES:
1. THIS NOMOGRAPH IS TO BE LIMITED TO WATERSHED AREAS OF 200 ACRES OR LESS. FOR LARGER WATERSHEDS REFER TO THE DESIGN STANDARDS.

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TIME OF CONCENTRATION
FOR WATERSHEDS LESS THAN 200 ACRES

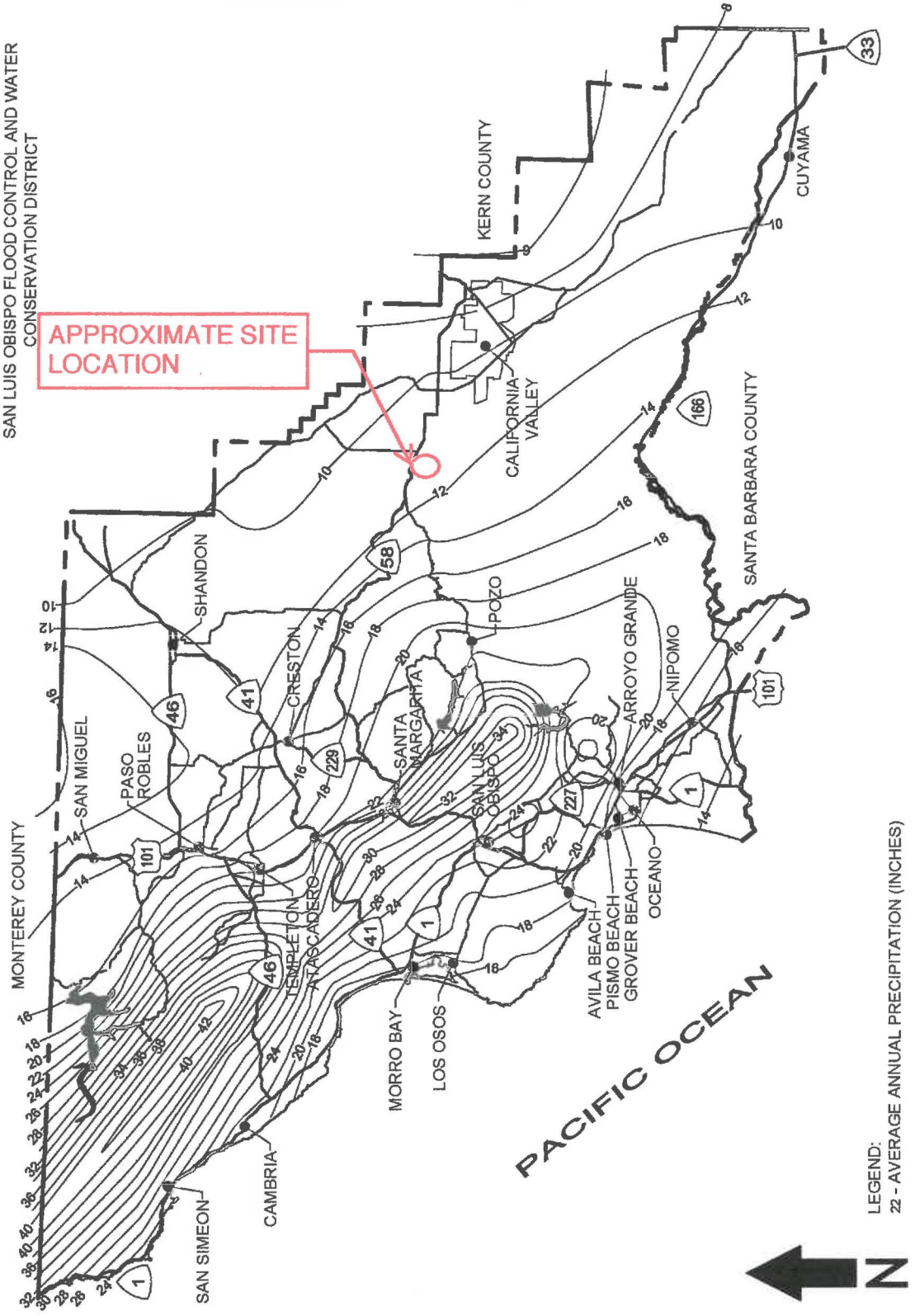
Scale:	Adopted: 2011
Drawing No:	H-2
Sheet No:	1 OF 1

Revisions					
Description	Approved	Date	Description	Approved	Date

SAN LUIS OBISPO COUNTY AVERAGE ANNUAL PRECIPITATION

(JULY 1 THROUGH JUNE 30) FOR 42 YEAR PERIOD FROM 1955-56 THROUGH 1997-98)

SAN LUIS OBISPO FLOOD CONTROL AND WATER CONSERVATION DISTRICT



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AVERAGE ANNUAL RAINFALL

Scale:	Adopted:
NTS	2011
Drawing No:	H-1
Sheet No:	1 OF 1

Revisions					
Description	Approved	Date	Description	Approved	Date

TABLE 1: ANNUAL RAINFALL < 14":

Recurrence Interval (Years)	Duration							
	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	10 Hr
2	1.00	0.90	0.60	0.40	0.26	0.22	0.18	0.14
5	1.40	1.20	0.80	0.50	0.37	0.32	0.25	0.20
10	1.70	1.40	1.00	0.60	0.44	0.38	0.30	0.23
25	2.00	1.70	1.10	0.70	0.54	0.47	0.37	0.28
50	2.20	1.90	1.30	0.80	0.60	0.53	0.44	0.34
100	2.40	2.10	1.40	0.90	0.65	0.59	0.48	0.36

TABLE 2: ANNUAL RAINFALL 14" TO 17":

Recurrence Interval (Years)	Duration							
	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	10 Hr
2	1.30	1.10	0.80	0.50	0.35	0.30	0.23	0.18
5	1.90	1.60	1.10	0.70	0.49	0.42	0.33	0.26
10	2.30	1.90	1.30	0.80	0.60	0.51	0.40	0.30
25	2.60	2.20	1.50	1.00	0.71	0.63	0.50	0.38
50	3.00	2.50	1.70	1.10	0.81	0.74	0.60	0.47
100	3.20	2.70	1.90	1.20	0.90	0.80	0.65	0.49

TABLE 3: ANNUAL RAINFALL 18" TO 21":

Recurrence Interval (Years)	Duration							
	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	10 Hr
2	1.70	1.40	1.00	0.65	0.44	0.37	0.29	0.22
5	2.30	1.90	1.30	0.85	0.60	0.52	0.41	0.33
10	2.80	2.40	1.60	1.03	0.74	0.64	0.50	0.38
25	3.20	2.70	1.90	1.20	0.92	0.80	0.64	0.50
50	3.70	3.10	2.10	1.40	1.05	0.92	0.74	0.58
100	4.00	3.40	2.30	1.50	1.13	1.00	0.80	0.62

TABLE 4: ANNUAL RAINFALL 22" TO 28":

Recurrence Interval (Years)	Duration							
	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	10 Hr
2	2.10	1.80	1.20	0.77	0.55	0.47	0.36	0.28
5	2.80	2.50	1.70	1.05	0.76	0.64	0.52	0.42
10	3.60	3.00	2.10	1.30	0.92	0.81	0.64	0.48
25	3.90	3.50	2.40	1.50	1.10	0.98	0.78	0.60
50	4.50	3.90	2.60	1.70	1.28	1.15	0.94	0.72
100	5.00	4.30	2.90	1.85	1.40	1.25	0.98	0.76

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RAINFALL INTENSITY DATA

Scale:	Adopted: 2011
Drawing No: H-4	
Sheet No: 1 OF 1	

Cross Section for Roadside Swale Q25

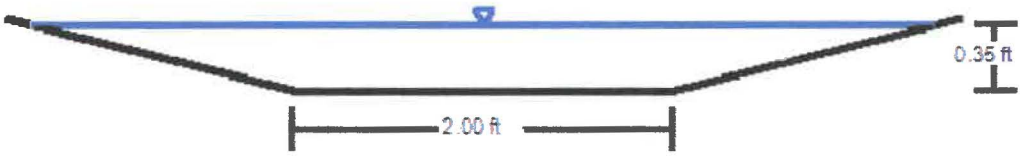
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	7.60000	%
Normal Depth	0.35	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	4.70	ft³/s

Cross Section Image



Worksheet for Roadside Swale Q25

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	7.60000	%
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	4.70	ft^3/s

Results

Normal Depth	0.35	ft
Flow Area	1.18	ft^2
Wetted Perimeter	4.87	ft
Hydraulic Radius	0.24	ft
Top Width	4.78	ft
Critical Depth	0.42	ft
Critical Slope	0.03621	ft/ft
Velocity	3.98	ft/s
Velocity Head	0.25	ft
Specific Energy	0.59	ft
Froude Number	1.41	
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	0.35	ft
Critical Depth	0.42	ft
Channel Slope	7.60000	%
Critical Slope	0.03621	ft/ft

Cross Section for Roadside Swale Q50

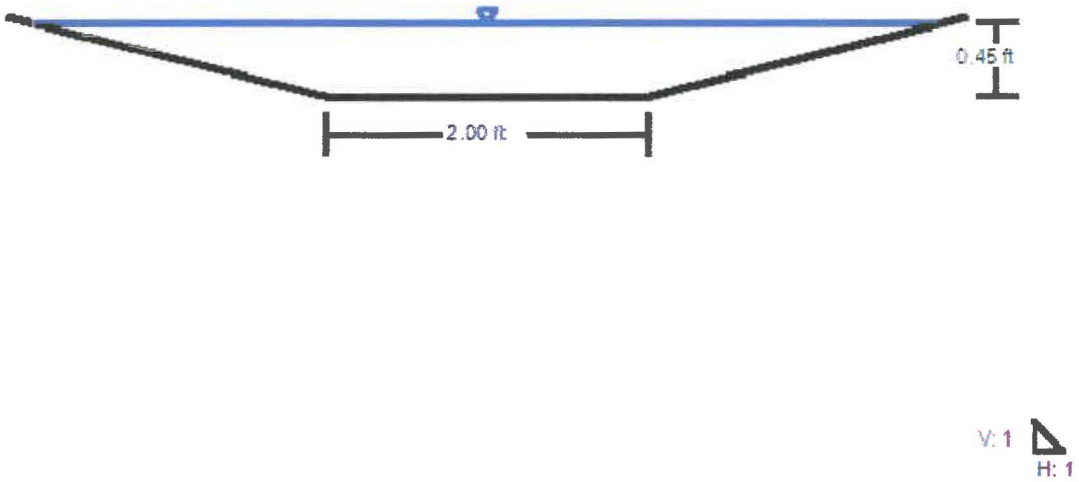
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	3.20000	%
Normal Depth	0.45	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	5.10	ft³/s

Cross Section Image



Worksheet for Roadside Swale Q50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	3.20000	%
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	2.00	ft
Discharge	5.10	ft^3/s

Results

Normal Depth	0.45	ft
Flow Area	1.71	ft^2
Wetted Perimeter	5.72	ft
Hydraulic Radius	0.30	ft
Top Width	5.60	ft
Critical Depth	0.44	ft
Critical Slope	0.03579	ft/ft
Velocity	2.98	ft/s
Velocity Head	0.14	ft
Specific Energy	0.59	ft
Froude Number	0.95	
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	0.45	ft
Critical Depth	0.44	ft
Channel Slope	3.20000	%
Critical Slope	0.03579	ft/ft

HY-8 Culvert Analysis Report

Culvert Data Summary - Driveway Culvert

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0100

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

****

Straight Culvert

Inlet Elevation (invert): 2107.00 ft, Outlet Elevation (invert): 2106.10 ft

Culvert Length: 50.01 ft, Culvert Slope: 0.0180

****

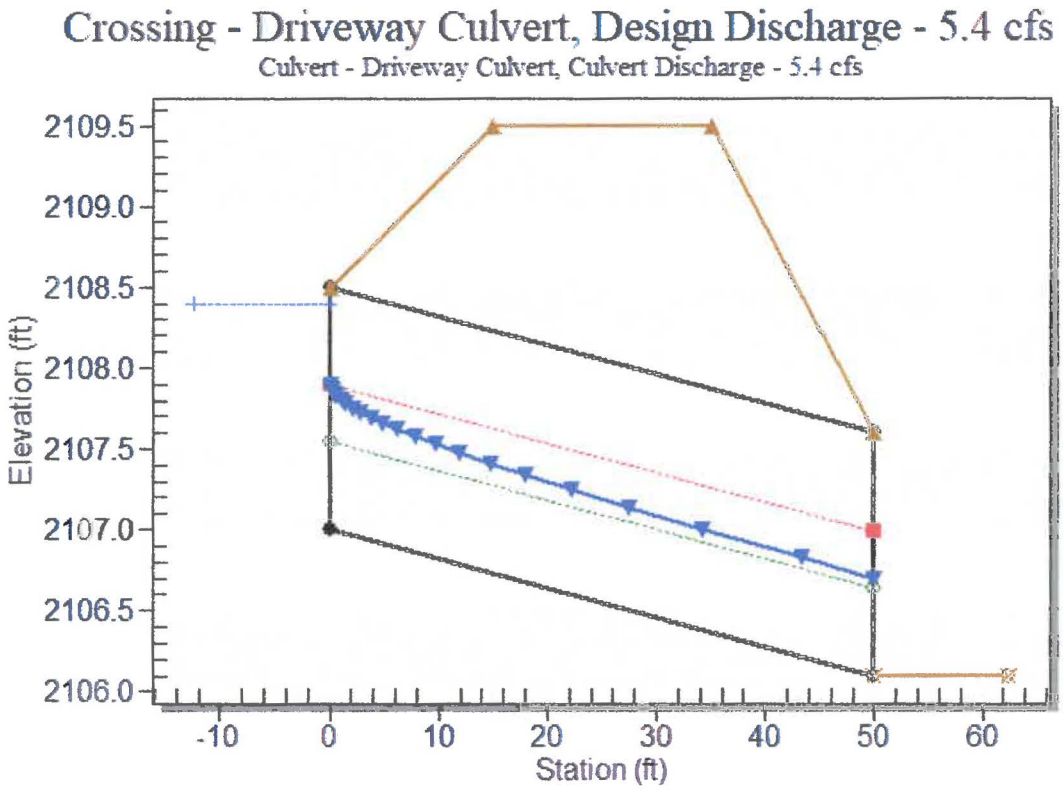
Table 1 - Culvert Summary Table: Driveway Culvert

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	2107.00	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.00	1.00	2107.54	0.541	0.0*	1-S2n	0.232	0.369	0.242	0.000	5.367	0.000
2.00	2.00	2107.78	0.783	0.0*	1-S2n	0.325	0.530	0.344	0.000	6.352	0.000
3.00	3.00	2107.98	0.981	0.0*	1-S2n	0.399	0.658	0.428	0.000	6.991	0.000
4.00	4.00	2108.15	1.154	0.043	1-S2n	0.463	0.765	0.502	0.000	7.454	0.000
5.00	5.00	2108.32	1.324	0.234	1-S2n	0.521	0.856	0.571	0.000	7.828	0.000
5.40	5.40	2108.40	1.396	0.317	1-S2n	0.543	0.893	0.598	0.000	7.946	0.000
7.00	7.00	2108.72	1.721	0.666	5-S2n	0.626	1.021	0.697	0.000	8.423	0.000
8.00	8.00	2108.96	1.964	0.904	5-S2n	0.675	1.092	0.756	0.000	8.673	0.000
9.00	9.00	2109.24	2.243	1.329	5-S2n	0.722	1.156	0.813	0.000	8.910	0.000
10.00	9.88	2109.52	2.515	1.540	5-S2n	0.763	1.211	0.862	0.000	9.112	0.000

Table 2 - Summary of Culvert Flows at Crossing: Driveway Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Driveway Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
2107.00	0.00	0.00	0.00	1
2107.54	1.00	1.00	0.00	1
2107.78	2.00	2.00	0.00	1
2107.98	3.00	3.00	0.00	1
2108.15	4.00	4.00	0.00	1
2108.32	5.00	5.00	0.00	1
2108.40	5.40	5.40	0.00	1
2108.72	7.00	7.00	0.00	1
2108.96	8.00	8.00	0.00	1
2109.24	9.00	9.00	0.00	1
2109.52	10.00	9.88	0.09	20
2109.50	9.83	9.83	0.00	Overtopping

Water Surface Profile Plot for Culvert: Driveway Culvert



Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 5.4 cfs

Maximum Flow: 10 cfs