



Subject Sunrise Mountain-

Hydraulic Design

Calculations

Made by JDP

Checked by MAB

Approved by RW

Job No 093-97436

Date 06/15/11

Sheet No 1 of 8

## **OBJECTIVE:**

Utilize the results of the HEC-RAS and HydroCAD analysis to design appropriate erosion control features for all surface water structures as well as to demonstrate freeboard requirements are met.

## **DESIGN CRITERIA AND ASSUMPTIONS:**

1. Structures will convey run-off from the Design Storm Event without overflow.
2. Structures were evaluated with the computer modeling programs, HEC-RAS and HydroCAD.
3. Minimum freeboard requirements are taken into account in the design of the channels and diversion berms as stipulated in the SOW and the Manual. Where the computed channel flow is in excess of 300 cfs, the freeboard will be a minimum of 2.0 feet.
4. Freeboard requirements are calculated using the bulk flow from the Design Storm Event for the Rockfall Channel network and the clear flow for the remainder of the diversion berms and channels.
5. All structures conveying 300 cfs or more (clear flow) will have a continuous parallel maintenance road on one side of the channel. The Rockfall Channel is exempt from this requirement.
6. Additional conveyance depth for channels was computed to carry water through bends, curved sections, and where hydraulic jumps occur in the channel sections.
7. Structure labels are shown on the Construction Drawings.

## **CALCULATIONS:**

HEC-RAS modeled multiple reaches for each channel. Each reach was analyzed to insure the appropriate erosion protection and freeboard was designed for all surface water structures. Attachment 1 contains a summary of the hydraulic data obtained from HEC-RAS and the corresponding freeboard calculations used in this analysis.

HydroCAD modeled the berms or secondary channels as a single reach. Each was analyzed to insure the appropriate erosion protection and freeboard was designed. Attachment 2 contains a summary of the hydraulic data from HydroCAD. A range of slopes were applied to the diversion berms to define the required freeboard and erosion protection.

The following Manning's n values were used in the design:

- Concrete = 0.015
- Grouted Riprap = 0.028 – 0.03 (reference: US DOT HEC-15, Design of Roadside Channels with Flexible Linings)



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- Loose Riprap = 0.035

The lower grouted riprap n value was only applied to demonstrate that stable flow conditions will remain in berm B-E1 and channel C-123. The construction drawings note that rock protrusions in these areas may not exceed 1-inch to insure smooth flow conditions.

## Freeboard

The minimum freeboard is computed with the following equation from the SOW and the Clark County Manual for super-critical channel flow (Froude Number >1.0):

$$(1) \quad Fb = 1.0 + 0.025 V(d)^{1/3}$$

Where:

Fb = Freeboard (ft)

V = Velocity (fps)

d = depth of flow (ft)

Section 700 of the Manual provides the following equation for calculating the minimum freeboard where the channel flow is sub-critical (Froude Number <1.0):

$$(2) \quad Fb = 0.5 + V^2 / 2g$$

Where:

Fb = Freeboard (ft)

V = Velocity (ft)

g = Acceleration of Gravity (32.2 ft/sec<sup>2</sup>)

Where the actual design freeboard was within 0.10 feet of the required freeboard the section was considered adequate for this design. This is considered acceptable as the design storm is a 200-year event compared to the 100-year event required by the Manual.



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## Transitions

Contracting and expanding transitions were designed according to Clark County. Expanding supercritical transition lengths were calculated as:

$$L > 1.5 (Tw)Fr$$

Where:

L = minimum transition length (ft)

Tw = Difference in top width of flow

Fr = Upstream Froude Number

Contracting supercritical transitions were calculated using Clark County Methods and the spreadsheets provided by EPA. These typically occurred at the exit of the concrete box culverts and the analyses are provided in Attachment 6. The spreadsheets provided by EPA were utilized for determining the transition length for the supercritical berm to channel transition as well (Berm B-E1 to C-E1). Note that Berm B-W1 to Channel C-1 was a subcritical transition.

## Stable Channel Flow

To maintain stable flow the Froude Number was designed to be below 0.86 for subcritical flow or above 1.13 for supercritical flow.

The Froude Number ( $F_r$ ) is calculated with the following equation:

$$F_r = V / (gD)^{1/2}$$

Where:

$F_r$  = Froude Number

V = Velocity (fps)

g = Acceleration of Gravity (32.2 ft/sec<sup>2</sup>)

D = Hydraulic Depth (ft)



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## Junctions

Five primary channel junctions along the Rockfall Channel network have been designed to specific design criteria as defined by the EPA. Typically for combined junction flows in the Rockfall network in excess of 375 cfs (bulked) the junctions were designed to closely meet junction condition #1 as provided in the design criteria table in Attachment 3. Junction criteria for condition #1 include the following:

- Combined flow  $\geq 375$  cfs (bulked);
- Maximum angle of intersection measured at the intersection of water surfaces of 12-degrees;
- Approximate uniform junction slopes of converging channels;
- Match flow depths within 0.1-feet;
- Match water surface elevations within 0.1-feet;
- Balance the momentum equation.

The remaining two junctions had side-channel flows approximately less than or equal 10% (11.8% for Junction 5) of the main channel flow. These junctions were designed to meet criteria #5 including the following:


- Maximum angle of intersection measured at the intersection of water surfaces of 24-degrees;
- Match water surface elevations within 0.2-feet.

The junction analysis is presented in Attachment 3 and includes the design criteria table and the momentum equation results as provided as guidance from the EPA. Note that the side channel of Junction 3 was modified to a bottom width of 6.5-ft to allow for the water surface elevations to match. The EPA momentum equation was updated and the contracting transition length was increased to 70-ft to account for a 2-ft increase in the combined exit channel bottom width. Junctions design slopes, widths, and transition lengths are provided on Sheet B-10 of the construction drawings.

## Diversion Berm Erosion Protection

The erosion protection in the channel created by the diversion berm will extend up slope, replacing the 13 or 14-inch erosion layer for some distance as shown on Figure 01. The erosion resistance of the erosion protection was computed using the average flow conditions in the channel as is standard practice. Velocity is higher than average where flow is deep, toward the center of the channel, and flow velocities are much lower at the outer edge where flow depths gradually decline to zero. As flow depths are reduced and flow depth decline, eventually the water's applied shear stress can be adequately resisted by the erosion layer and no riprap is required. This was examined in some detail and a generalized solution was developed. For landfill cross slopes  $< 10\%$ ,  $W = 8D_1$ , where  $W$  is the width of the riprap up-gradient of the channel lowpoint (invert), and  $D_1$  is the flow depth at the deepest point. For landfill cross slopes  $> 10\%$ ,  $W = 4D_1$ .



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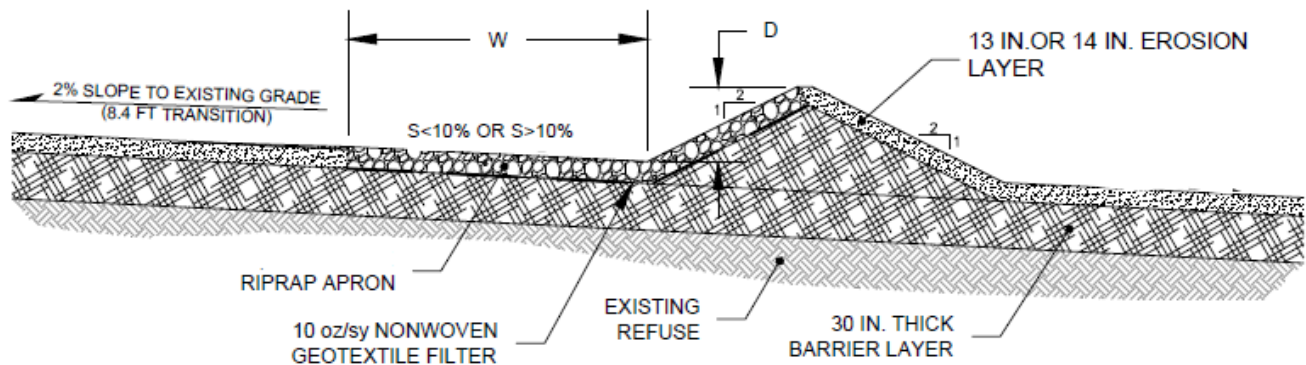


Figure 01

The depth of flow at the edge of the riprap is illustrated on Figure 02, as a function of the deepest flow depth and the cross slope. Typically, for cross slopes <10%, the lining width up-gradient of the deepest point ranged from 26 ft to 8 ft.

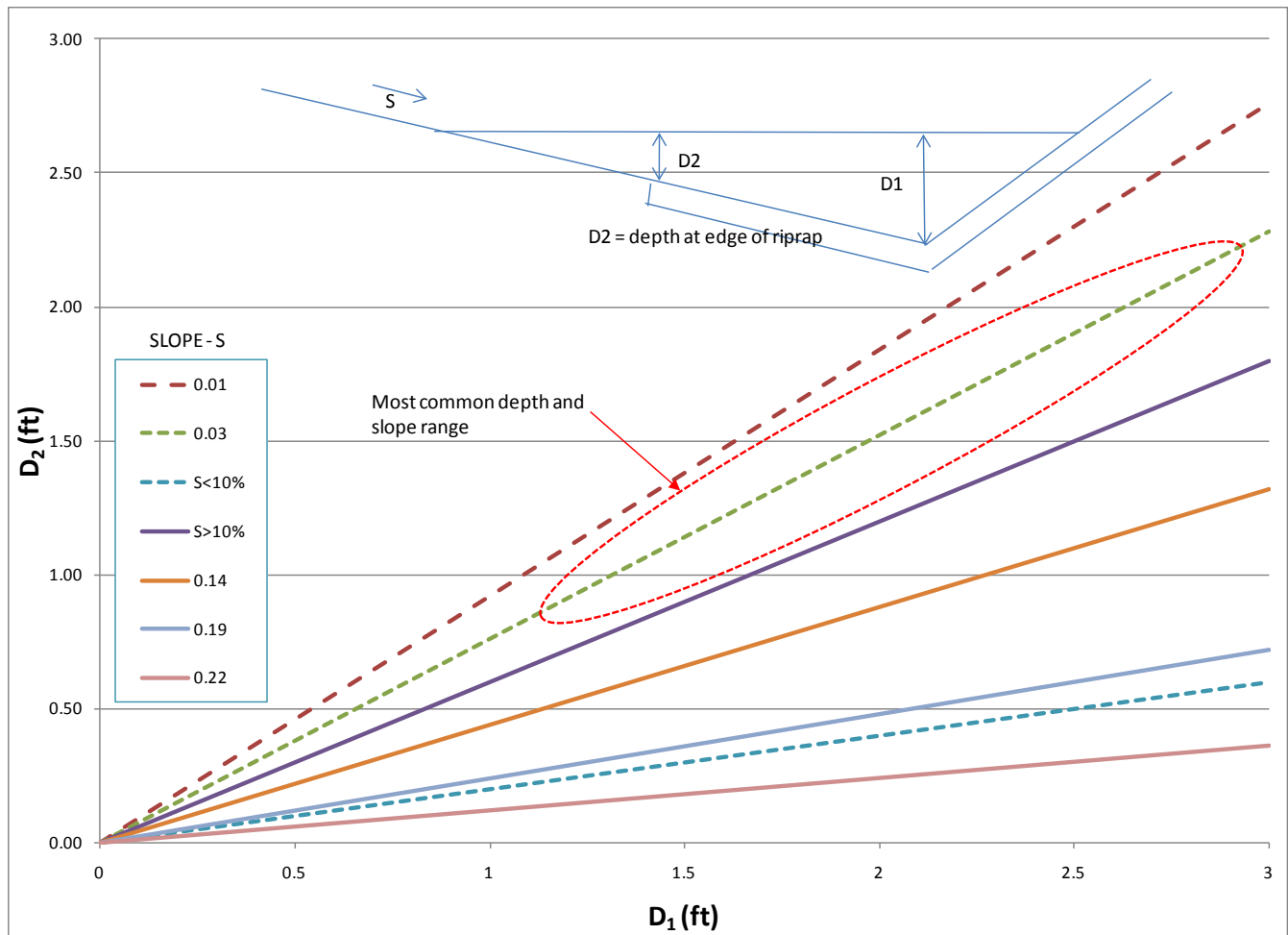


Figure 02



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## Channel Bends

Super-elevation of the water surface was determined at all channel bends and the design of the channel section was adjusted accordingly. Super-elevation of the water surface was limited to 2 feet as stipulated in the manual. The summary tables provided in Attachment 1 (under column “Min Curve Radius”) provide the minimum radius of curvature for all channel bends.

The design increase (super-elevation) of the water surface at channel bends was calculated using the following equation from Section 706.2.5 of the Manual:

$$Se = CV^2T_w / gr$$

Where:

Se = Super-Elevation Water Surface Increase (ft)

V = Average Flow Velocity (fps)

T<sub>w</sub> = Normal Channel Flow Top Width (ft)

r = Channel Centerline Radius (ft)

g = Acceleration of Gravity (ft/sec<sup>2</sup>)

C = 0.5 For Rectangular Channels With Spiral Transition Curves

1.0 For All Other Channel Sections, With or Without Spiral Transition Curves

## Loose Riprap Channel lining

Loose riprap was designed for channels and berms to a thickness of twice the d<sub>50</sub> with a minimum bedding of 12-inches of Type II, Class B aggregate or a 10 oz/sy geotextile. The riprap d<sub>50</sub> was calculated with equation 736 of the Manual.

Equation 736

$$d_{50} = 14.2 F_s Y_{\max} S_e / K_1$$

Where:

- F<sub>s</sub> = Stability Factor
- Y<sub>max</sub> = Maximum Channel Depth
- S<sub>e</sub> = average energy slope (ft/ft)
- K<sub>1</sub> = Bank Angle Modification factor

K<sub>1</sub> was calculated to be 0.744 for trapezoidal sections with 2:1 sideslopes and a riprap material angle of repose of 42 from Figure 705A of the Manual).

A stability factor of 1.0 was selected since the design storm event is a 200-yr storm compared to the 100-yr required by the Manual.

Attachments 1 and 2 contain the calculated d<sub>50</sub> for riprap lined channels or berms.



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## **Continuously Reinforced Concrete Channel Lining**

Section 705.7 of the Manual was followed for the design of the concrete channels and berms. The concrete lining will be 6-inches thick for flows less than 30 fps and 7-inches thick for flows greater than 30 fps. Longitudinal cut-off walls, 2-ft deep, will be constructed on all concrete lined channels and on the upslope end of all diversion berms. Expansion joints will be constructed with cut-off walls every 100-ft as shown on Detail 3 on Drawing B4 of the Construction drawings. The reinforcement steel is as noted on the drawings and is in conformance with section 705.7.1.6 of the Manual. The concrete will be broom finished.

### **Existing Concrete Structure Analysis (Construction Debris Area)**

An existing concrete structure protects the construction debris area from a 37-acre upstream watershed. The watershed was modeled in HEC-HMS provided in Appendix F and analyzed to determine if the existing structure can safely convey the design storm event. The existing concrete structure is "V" shaped, with approximately 6:1 outside sideslopes, and is 4 feet deep. Attachment 4 provides the analysis of the channel and indicates that it is capable of handling the design storm event.

### **Flow Path Evaluation**

An evaluation of the channel and berm layout to determine compliance with maximum slope length requirements is included in Attachment 5. Attachment 7, Appendix D provides the maximum flow lengths for corresponding erosion layer thicknesses and percent slopes. The 12-inch erosion layer for slopes less than 10% and the 14-inch erosion layer for slopes greater than 10% were selected for the design and evaluated accordingly.

### **CONCLUSIONS:**

Attachments 1 and 2 summarize the results of the hydraulic analyses of the structures. The summary tables show that the principal and rockfall channels have been analyzed for super elevation, channel lining, and freeboard requirements. The results for the diversion berms and secondary channels also indicate that they have been designed with adequate erosion protection and freeboard.

# ATTACHMENT 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Sunrise Mountain Landfill Hydraulics Verification - Rockfall Basin																							
2	Reach	River Sta	Plan Sta.	Segment Length	Bulk Flow	Min Ch Elev	W.S. Elev	Flow Depth	Min. Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	BANK Elev	Excess Bank Freeboard
3				(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(MSL)	(ft)
4	C-DOC1	18110	0.0	24.0	692	2303.0	2304.93	1.93	5.5	4.02	2315.3	17.73	25.85	3.71	0.015	10.88	1.80	2.00	2.00	-	NA	2306.93	2308.5	1.6
5	C-DOC1	18086	24.0	24.0	692	2302.0	2303.93	1.93	5.5	4.02	2314.29	17.73	25.83	3.7	0.015	10.86	1.80	2.00	2.00	-	NA	2305.93	2307.5	1.6
6	C-DOC1	18062	48.0	24.0	692	2301.0	2302.93	1.93	5.5	4.02	2313.29	17.73	25.83	3.7	0.015	10.86	1.80	2.00	2.00	-	NA	2304.93	2306.5	1.6
7	C-DOC1	18038	72.0	24.0	692	2300.0	2301.93	1.93	5.5	4.02	2312.29	17.73	25.83	3.7	0.015	10.86	1.80	2.00	2.00	-	NA	2303.93	2305.5	1.6
8	C-DOC1	18014	96.0	4.0	692	2299.0	2300.93	1.93	5.5	4.02	2311.29	17.73	25.83	3.7	0.015	10.86	1.80	2.00	2.00	-	NA	2302.93	2304.5	1.6
9	C-DOC1	18010	100.0	19.0	692	2298.8	2300.76	1.93	5.5	4.02	2311.13	17.73	25.85	3.71	0.015	10.88	1.80	2.00	2.00	-	NA	2302.76	2304.33	1.6
10	C-DOC1	17991	119.0	24.0	692	2298.0	2299.93	1.93	5.5	4.02	2310.33	17.72	25.88	3.71	0.015	10.90	1.81	2.00	2.00	-	NA	2301.93	2303.5	1.6
11	C-DOC1	17967	143.0	24.0	692	2297.0	2298.93	1.93	5.5	4.02	2309.32	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.00	-	NA	2300.93	2302.5	1.6
12	C-DOC1	17943	167.0	24.0	692	2296.0	2297.93	1.93	5.5	4.02	2308.32	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.00	-	NA	2299.93	2301.5	1.6
13	C-DOC1	17919	191.0	9.0	692	2295.0	2296.93	1.93	5.5	4.02	2307.32	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.00	-	NA	2298.93	2300.5	1.6
14	C-DOC1	17910	200.0	15.0	692	2294.6	2296.56	1.93	5.5	4.02	2306.94	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.74	0.74	500	2299.30	2300.13	0.8
15	C-DOC1	17895	215.0	24.0	692	2294.0	2295.93	1.93	5.5	4.02	2306.32	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.74	0.74	500	2298.67	2299.5	0.8
16	C-DOC1	17871	239.0	24.0	692	2293.0	2294.93	1.93	5.5	4.02	2305.32	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.74	0.74	500	2297.67	2298.5	0.8
17	C-DOC1	17847	263.0	24.0	692	2292.0	2293.93	1.93	5.5	4.02	2304.32	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.74	0.74	500	2296.67	2297.5	0.8
18	C-DOC1	17823	287.0	13.0	692	2291.0	2292.93	1.93	5.5	4.02	2303.32	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.74	0.74	500	2295.67	2296.5	0.8
19	C-DOC1	17810	300.0	11.0	692	2290.5	2292.39	1.93	5.5	4.02	2302.77	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.74	0.74	500	2295.13	2295.96	0.8
20	C-DOC1	17799	311.0	25.0	692	2290.0	2291.93	1.93	5.5	4.02	2302.32	17.72	25.86	3.71	0.015	10.88	1.80	2.00	2.74	0.74	500	2294.67	2295.5	0.8
21	C-DOC1	17774	336.0	25.0	692	2289.0	2290.94	1.94	5.5	4.02	2301.25	17.74	25.77	3.69	0.015	10.81	1.80	2.00	2.73	0.73	500	2293.67	2294.5	0.8
22	C-DOC1	17749	361.0	25.0	692	2288.0	2289.94	1.94	5.5	4.02	2300.19	17.76	25.7	3.68	0.015	10.76	1.80	2.00	2.73	0.73	500	2292.67	2293.5	0.8
23	C-DOC1	17724	386.0	14.0	692	2287.0	2288.94	1.94	5.5	4.02	2299.15	17.77	25.64	3.67	0.015	10.71	1.80	2.00	2.73	0.73	500	2291.67	2292.5	0.8
24	C-DOC1	17710	400.0	11.0	692	2286.4	2288.39	1.95	5.5	4.02	2298.58	17.78	25.62	3.66	0.015	10.69	1.80	2.00	2.72	0.72	500	2291.11	2291.94	0.8
25	C-DOC1	17699	411.0	25.0	692	2286.0	2287.95	1.95	5.5	4.02	2298.12	17.78	25.6	3.66	0.015	10.68	1.80	2.00	2.72	0.72	500	2290.67	2291.5	0.8
26	C-DOC1	17674	436.0	25.0	692	2285.0	2286.95	1.95	5.5	4.02	2297.1	17.79	25.57	3.65	0.015	10.65	1.80	2.00	2.72	0.72	500	2289.67	2290.5	0.8
27	C-DOC1	17649	461.0	25.0	692	2284.0	2285.95	1.95	5.5	4.02	2296.08	17.8	25.55	3.65	0.015	10.64	1.80	2.00	2.72	0.72	500	2288.67	2289.5	0.8
28	C-DOC1	17624	486.0	14.0	692	2283.0	2284.95	1.95	5.5	4.02	2295.07	17.8	25.53	3.65	0.015	10.62	1.80	2.00	2.72	0.72	500	2287.67	2288.5	0.8
29	C-DOC1	17610	500.0	11.0	692	2282.4	2284.39	1.95	5.5	4.02	2294.51	17.8	25.53	3.65	0.015	10.62	1.80	2.00	2.72	0.72	500	2287.11	2287.94	0.8
30	C-DOC1	17599	511.0	25.0	692	2282.0	2283.95	1.95	5.5	4.02	2294.07	17.8	25.53	3.65	0.015	10.62	1.80	2.00	2.72	0.72	500	2286.67	2287.5	0.8
31	C-DOC1	17574	536.0	25.0	692	2281.0	2282.95	1.95	5.5	4.02	2293.05	17.81	25.51	3.64	0.015	10.60	1.80	2.00	2.72	0.72	500	2285.67	2286.5	0.8
32	C-DOC1	17549	561.0	25.0	692	2280.0	2281.95	1.95	5.5	4.02	2292.04	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2284.67	2285.5	0.8
33	C-DOC1	17524	586.0	14.0	692	2279.0	2280.95	1.95	5.5	4.02	2291.04	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2283.67	2284.5	0.8
34	C-DOC1	17510	600.0	11.0	692	2278.4	2280.39	1.95	5.5	4.02	2290.48	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2283.11	2283.94	0.8
35	C-DOC1	17499	611.0	25.0	692	2278.0	2279.95	1.95	5.5	4.02	2290.04	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2282.67	2283.5	0.8
36	C-DOC1	17474	636.0	25.0	692	2277.0	2278.95	1.95	5.5	4.02	2289.04	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2281.67	2282.5	0.8
37	C-DOC1	17449	661.0	25.0	692	2276.0	2277.95	1.95	5.5	4.02	2288.04	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2280.67	2281.5	0.8
38	C-DOC1	17424	686.0	14.0	692	2275.0	2276.95	1.95	5.5	4.02	2287.04	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2279.67	2280.5	0.8
39	C-DOC1	17410	700.0	11.0	692	2274.4	2276.39	1.95	5.5	4.02	2286.48	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2279.11	2279.94	0.8
40	C-DOC1	17399	711.0	27.0	692	2274.0	2275.95	1.95	5.5	4.02	2286.04	17.81	25.49	3.64	0.015	10.59	1.80	2.00	2.72	0.72	500	2278.67	2279.5	0.8
41	C-DOC1	17372	738.0	30.0	692	2273.0	2274.96	1.96	5.5	4.02	2284.92	17.85	25.32	3.61	0.015	10.46	1.79	2.00	2.71	0.71	500	2277.67	2278.5	0.8
42	C-DOC1	17342	768.0	32.0	692	2272.0	2273.98	1.98	5.5	4.02	2283.67	17.94	24.97	3.54	0.015	10.18	1.78	2.00	2.69	0.69	500	2276.67	2277.5	0.8
43	C-DOC1	17310	800.0	1.0	692	2271.0	2273.04	2.01	5.5	4.02	2282.37	18.05	24.51	3.45	0.015	9.83	1.77	2.00	2.67	0.67	500	2275.71	2276.53	0.8
44	C-DOC1	17309	801.0	39.0	692	2271.0	2273.01	2.01	5.5	4.02	2282.34	18.05	24.51	3.45	0.015	9.83	1.77	2.00	2.67	0.67	500	2275.68	2276.5	0.8
45	C-DOC1	17270	840.0	50.0	692	2270.0	2272.06	2.06	5.5	4.02	2280.83	18.25	23.76	3.31	0.015	9.27	1.76	2.00	2.64	0.64	500	2274.70	2275.5	0.8
46	C-DOC1	17220	890.0	10.0	692	2269.0	2271.15	2.15	5.5	4.02	2279.03	18.59	22.53	3.09	0.015	8.38	1.73	2.00	2.59	0.59	500	2273.74	2274.5	0.8
47	C-DOC1	17210	900.0	52.0	692	2268.8	2271.01	2.17	5.5	4.02	2278.68	18.68	22.23	3.03	0.015	8.17	1.72	2.00	2.57	0.57	500	2273.58	2274.34	0.8
48	C-DOC1	17158	952.0	48.0	692	2268.0	2270.27	2.27	5.5	4.02	2277.12	19.07	21	2.82	0.015	7.35	1.69	2.00	2.52	0.52	500	2272.79	2273.5	0.7
49	C-DOC1	17110	1000.0	16.0	692	2267.3	2269.59	2.34	5.5	4.02	2275.9	19.36	20.15	2.67	0.015	6.80	1.67	2.00	2.49	0.49	500	2272.08	2272.75	0.7
50	C-DOC1	17094	1016.0	63.0	692	2267.0	2269.36	2.36	5.5	4.02	2275.53	19.44	19.93	2.63	0.015	6.67	1.66	2.00	2.48	0.48	500	2271.84	2272.5	0.7
51	C-DOC1	17031	1079.0	21.0	692	2266.0	2268.42	2.42	5.5	4.02	2274.2	19.67	19.3	2.52	0.015	6.28	1.65	2.00	2.46	0.46	500	2270.88	2271.5	0.6
52	C-DOC1	17010	1100.0	42.0	692	2265.7	2268.1	2.43	5.5	4.02	2273.81	19.72	19.17	2.5	0.015	6.21	1.64	2.00						



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Sunrise Mountain Landfill Hydraulics Verification - Rockfall Basin																							
2	Reach	River Sta	Plan Sta.	Segment Length	Bulk Flow	Min Ch Elev	W.S. Elev	Flow Depth	Min. Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	BANK Elev	Excess Bank Freeboard
3				(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(MSL)	(ft)
64	C-DOC1	16651	1459.0	20.0	692	2254.0	2256.07	2.07	5.5	4.02	2264.78	18.27	23.68	3.3	0.015	9.21	1.75	2.00	2.64	0.64	500	2258.71	2259.5	0.8
65	C-DOC1	16631	1479.0	20.0	692	2253.0	2255.04	2.04	5.5	4.02	2264.07	18.15	24.12	3.38	0.015	9.53	1.76	2.00	2.66	0.66	500	2257.70	2258.5	0.8
66	C-DOC1	16610	1500.0	25.0	692	2252.0	2254.01	2.01	5.5	3.94	2263.34	18.05	24.51	3.45	0.015	9.83	1.77	2.00	2.67	0.67	500	2256.68	2257.5	0.8
67	C-DOC1	16585	1525.0	124.0	692	2251.0	2253.01	2.01	5.5	3.94	2262.43	18.02	24.63	3.48	0.015	9.92	1.78	2.00	2.68	0.68	500	2255.69	2256.5	0.8
68	C-W1	17174	15.8	38.0	417	2265	2267.64	2.64	5.0	3.31	2269.84	18.55	11.91	1.53	0.03	2.70	1.41	2.00	2.48	0.48	170	2270.12	2270	-0.1
69	C-W1	17136	53.8	38.0	417	2264	2266.66	2.66	5.0	3.31	2268.82	18.62	11.8	1.51	0.03	2.66	1.41	2.00	2.47	0.47	170	2269.13	2269	-0.1
70	C-W1	17098	91.8	38.0	417	2263	2265.66	2.66	5.0	3.31	2267.82	18.62	11.8	1.51	0.03	2.66	1.41	2.00	2.47	0.47	170	2268.13	2268	-0.1
71	C-W1	17060	129.8	38.0	417	2262	2264.66	2.66	5.0	3.31	2266.82	18.62	11.8	1.51	0.03	2.66	1.41	2.00	2.47	0.47	170	2267.13	2267	-0.1
72	C-W1	17023	167.8	38.0	417	2261	2263.66	2.66	5.0	3.31	2265.82	18.62	11.8	1.51	0.03	2.66	1.41	2.00	2.47	0.47	170	2266.13	2266	-0.1
73	C-W1	16985	205.8	38.0	417	2260	2262.66	2.66	5.0	3.31	2264.82	18.62	11.8	1.51	0.03	2.66	1.41	2.00	2.47	0.47	170	2265.13	2265	-0.1
74	C-W1	16947	243.8	38.0	417	2259	2261.66	2.66	5.0	3.31	2263.82	18.62	11.8	1.51	0.03	2.66	1.41	2.00	2.47	0.47	170	2264.13	2264	-0.1
75	C-W1	16909	281.8	38.0	417	2258	2260.66	2.66	5.0	3.31	2262.82	18.62	11.8	1.51	0.03	2.66	1.41	2.00	2.47	0.47	170	2263.13	2263	-0.1
76	C-W1	16872	319.8	7.0	417	2257	2259.66	2.66	5.0	3.31	2261.82	18.62	11.8	1.51	0.03	2.66	1.41	2.00	2.47	0.47	170	2262.13	2262	-0.1
77	C-W1	16865	326.8	49.0	417	2256.82	2259.42	2.6	5.0	3.31	2261.71	18.4	12.14	1.57	0.015	2.79	1.42	2.00	2.50	0.50	170	2261.92	2261.82	-0.1
78	C-W1	16816	375.8	52.0	417	2255.53	2256.53	1	5.0	2.04	2260.86	25	16.7	2.95	0.015	4.83	1.42	2.00	3.27	1.27	170	2259.80	2260.53	0.7
79	C-W1	16815	427.8	Culvert																				
80	C-W1	16764	427.8	80.0	417	2254.16	2255.15	0.99	5.0	2.05	2259.54	25	16.8	2.97	0.015	4.88	1.42	2.00	3.29	1.29	170	2258.44	2259.16	0.7
81	C-W1	16684	507.8	2.0	417	2252.05	2254.29	2.24	5.0	3.32	2257.74	16.97	14.9	2.04	0.015	3.95	1.49	2.00	2.69	0.69	170	2256.98	2257.05	0.1
82	C-W1	16682	509.8	38.0	417	2252	2254.24	2.24	6.0	3.32	2257.71	16.94	14.96	2.06	0.015	3.98	1.49	2.00	3.18	1.18	100	2257.42	2258	0.6
83	C-W1	16645	546.8	43.0	417	2251	2253.12	2.12	6.0	3.31	2257.13	16.48	16.06	2.26	0.015	4.51	1.52	2.00	3.32	1.32	100	2256.44	2257	0.6
84	C-W1	16602	589.8	17.0	417	2250	2252.3	2.3	6.0	3.54	2256.44	15.7	16.34	2.26	0.015	4.65	1.54	2.00	3.30	1.30	100	2255.60	2256	0.4
85	C-W1	16585	606.8	124.0	417	2249.6	2251.87	2.27	6.0	3.54	2256.16	15.58	16.61	2.31	0.015	4.78	1.55	2.00	3.33	1.33	100	2255.20	2255.6	0.4
86	C-DOC2	16461	1645.9	31.0	1135	2247	2248.95	1.95	8.5	4.02	2258.21	27.78	24.43	3.33	0.015	9.77	1.76	2.00	3.03	1.03	500	2251.98	2255.5	3.5
87	C-DOC2	16430	1676.9	20.0	1135	2246	2247.95	1.95	8.5	4.02	2257.21	27.78	24.43	3.33	0.015	9.77	1.76	2.00	3.03	1.03	500	2250.98	2254.5	3.5
88	C-DOC2	16410	1696.9	11.0	1135	2245.36	2247.3	1.94	8.5	4.02	2256.57	27.78	24.44	3.33	0.015	9.78	1.76	2.00	3.03	1.03	500	2250.33	2253.86	3.5
89	C-DOC2	16399	1707.9	31.0	1135	2245	2246.94	1.94	8.5	4.01	2256.23	27.77	24.45	3.33	0.015	9.78	1.76	2.00	3.03	1.03	500	2249.97	2253.5	3.5
90	C-DOC2	16368	1738.9	18.0	1135	2244	2245.94	1.94	8.5	4.02	2255.24	27.77	24.47	3.34	0.015	9.80	1.76	2.00	3.03	1.03	500	2248.97	2252.5	3.5
91	C-DOC2	16350	1756.9	15.0	1135	2243	2245.02	2.02	8.5	4.15	2254.63	26.66	24.88	3.35	0.015	10.11	1.79	2.00	3.03	1.03	500	2248.05	2251.5	3.5
92	C-DOC2	16335	1771.9	15.0	1135	2242	2244.14	2.14	8.5	4.35	2254.11	25.24	25.35	3.35	0.015	10.48	1.82	2.00	3.01	1.01	500	2247.15	2250.5	3.4
93	C-DOC2	16320	1786.9	10.0	1135	2241	2243.28	2.28	8.5	4.57	2253.6	23.9	25.78	3.35	0.015	10.82	1.85	2.00	2.99	0.99	500	2246.27	2249.5	3.2
94	C-DOC2	16310	1796.9	4.0	1135	2240.29	2242.68	2.39	8.5	4.76	2253.25	22.95	26.09	3.34	0.015	11.07	1.87	2.00	2.97	0.97	500	2245.65	2248.79	3.1
95	C-DOC2	16306	1800.9	15.0	1135	2240	2242.45	2.45	8.5	4.82	2253.11	22.59	26.2	3.33	0.015	11.16	1.88	2.00	2.96	0.96	500	2245.41	2248.5	3.1
96	C-DOC2	16291	1815.9	31.0	1135	2239	2241.61	2.61	8.5	5.08	2252.6	21.55	26.61	3.33	0.015	11.50	1.92	2.00	2.95	0.95	500	2244.56	2247.5	2.9
97	C-DOC2	16260	1846.9	50.0	1135	2238	2240.76	2.76	8.5	5.23	2251.63	21.05	26.45	3.26	0.015	11.36	1.93	2.00	2.91	0.91	500	2243.67	2246.5	2.8
98	C-DOC2	16210	1896.9	7.0	1135	2237.12	2239.98	2.86	8.5	5.23	2249.94	21.41	25.34	3.09	0.015	10.47	1.90	2.00	2.85	0.85	500	2242.83	2245.62	2.8
99	C-DOC2	16203	1903.9	57.0	1135	2237	2239.86	2.86	8.5	5.23	2249.73	21.45	25.2	3.07	0.015	10.36	1.89	2.00	2.85	0.85	500	2242.71	2245.5	2.8
100	C-DOC2	16146	1960.9	36.0	1135	2236	2238.94	2.94	8.5	5.22	2248.1	21.77	24.28	2.92	0.015	9.65	1.87	2.00	2.80	0.80	500	2241.74	2244.5	2.8
101	C-DOC2	16110	1996.9	21.0	1135	2235.37	2238.35	2.98	8.5	5.23	2247.17	21.93	23.83	2.85	0.015	9.32	1.86	2.00	2.77	0.77	500	2241.12	2243.87	2.7
102	C-DOC2	16089	2017.9	57.0	1135	2235	2238	3	8.5	5.23	2246.66	22.01	23.61	2.81	0.015	9.16	1.85	2.00	2.76	0.76	500	2240.76	2243.5	2.7
103	C-DOC2	16032	2074.9	22.0	1135	2234	2237.05	3.05	8.5	5.22	2245.34	22.2	23.11	2.74	0.015	8.79	1.84	2.00	2.74	0.74	500	2239.79	2242.5	2.7
104	C-DOC2	16010	2096.9	35.0	1135	2233.61	2236.68	3.07	8.5	5.23	2244.86	22.26	22.96	2.71	0.015	8.69	1.83	2.00	2.73	0.73	500	2239.41	2242.11	2.7
105	C-DOC2	15975	2131.9	57.0	1135	2233	2236.09	3.09	8.5	5.23	2244.12	22.34	22.75	2.68	0.015	8.54	1.83	2.00	2.72	0.72	500	2238.81	2241.5	2.7
106	C-DOC2	15918	2188.9	8.0	1135	2232	2235.11	3.11	8.5	5.22	2242.96	22.45	22.48	2.64	0.015	8.35	1.82	2.00	2.70	0.70	500	2237.81	2240.5	2.7
107	C-DOC2	15910	2196.9	49.0	1135	2231.86	2234.98	3.12	8.5	5.23	2242.8	22.46	22.45	2.64	0.015	8.33	1.82	2.00	2.70	0.70	500	2237.68	2240.36	2.7
108	C-DOC2	15861	2245.9	51.0	1135	2231	2234.13	3.13	8.5	5.23	2241.85	22.52	22.3	2.61	0.015	8.22	1.82	2.00	2.70	0.70	500	2236.83	2239.5	2.7
109	C-DOC2	15810	2296.9	5.0	1135	2230.09	2233.23	3.14	8.5	5.22	2240.9	22.55	22.22	2.6	0.015	8.17	1.81	2.00	2.69	0.69	500	2235.92	2238.59	2.7
110	C-DOC2	15805	2301.9	171.0	1135	2230	2233.14	3.14	8.5	5.23	2240.81	22.55	22.22	2.6	0.015	8.17	1.81	2.00	2.69	0.69	500	2235.83	2238.5	2.7
111	B-E1	2374.27	0.0	76.2	452	2321.0	2324.22	3.22	5.5	3.22	2325.04	38.59	7.29	1.01	0.03	1.33	1.27	2.00	2.00	-	NA	2326.22	2326.5	0.3
112	B-E1	2298.03	76.2	99.7	452	2320.0	2323.41	3.41	5.5	3.23	2324.06	40.88	6.57	0.89	0.03	1.17	1.25	2.00	2.00	-	NA	2325.41	2325.5	0.1
113	B-E1	2198.29	176.0	55.1	452	2319.0	2322.22	3.22	5.5															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Sunrise Mountain Landfill Hydraulics Verification - Rockfall Basin																							
2	Reach	River Sta	Plan Sta.	Segment Length	Bulk Flow	Min Ch Elev	W.S. Elev	Flow Depth	Min. Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	BANK Elev	Excess Bank Freeboard
3				(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(MSL)	(ft)
124	B-E1	1769.12	605.2	31.3	452	2308.0	2310.67	2.67	5.5	3.22	2312.41	32.02	10.58	1.61	0.03	2.24	1.37	2.00	2.00	-	NA	2312.67	2313.5	0.8
125	B-E1	1737.83	636.4	36.5	452	2307.0	2309.67	2.67	5.5	3.22	2311.4	32.07	10.55	1.61	0.03	2.23	1.37	2.00	2.00	-	NA	2311.67	2312.5	0.8
126	B-E1	1701.3	673.0	55.7	452	2306.0	2308.76	2.76	5.5	3.22	2310.28	33.15	9.87	1.48	0.03	2.01	1.35	2.00	2.00	-	NA	2310.76	2311.5	0.7
127	B-E1	1645.59	728.7	48.4	452	2305.0	2308.03	3.03	5.5	3.22	2309.08	36.3	8.23	1.18	0.028	1.55	1.30	2.00	2.00	-	NA	2310.03	2310.5	0.5
128	B-E1	1597.19	777.1	54.1	452	2304.0	2306.85	2.85	5.5	3.22	2308.19	34.2	9.28	1.37	0.03	1.84	1.33	2.00	2.00	-	NA	2308.85	2309.5	0.7
129	B-E1	1543.07	831.2	41.9	452	2303.0	2306.04	3.04	5.5	3.22	2307.07	36.43	8.17	1.17	0.03	1.54	1.30	2.00	2.00	-	NA	2308.04	2308.5	0.5
130	B-E1	1501.14	873.1	39.8	452	2302.0	2304.82	2.82	5.5	3.22	2306.22	33.83	9.48	1.41	0.03	1.90	1.33	2.00	2.00	-	NA	2306.82	2307.5	0.7
131	B-E1	1461.32	913.0	21.6	452	2301.0	2303.8	2.8	5.5	3.22	2305.24	33.57	9.63	1.43	0.03	1.94	1.34	2.00	2.00	-	NA	2305.80	2306.5	0.7
132	B-E1	1439.74	934.5	15.7	452	2300.0	2302.6	2.6	5.5	3.22	2304.53	31.17	11.17	1.73	0.03	2.44	1.38	2.00	2.00	-	NA	2304.60	2305.5	0.9
133	B-E1	1424.04	950.2	41.4	452	2299.0	2301.47	2.47	5.5	3.22	2303.83	29.66	12.33	1.95	0.03	2.86	1.42	2.00	2.00	-	NA	2303.47	2304.5	1.0
134	B-E1	1382.64	991.6	62.2	452	2298.0	2300.83	2.83	5.5	3.22	2302.2	34	9.38	1.39	0.03	1.87	1.33	2.00	2.00	-	NA	2302.83	2303.5	0.7
135	B-E1	1320.41	1053.9	74.4	452	2297.0	2299.8	2.8	5.5	3.22	2301.23	33.61	9.6	1.43	0.028	1.93	1.34	2.00	2.00	-	NA	2301.80	2302.5	0.7
136	B-E1	1245.99	1128.3	19.7	452	2296.0	2298.9	2.9	5.5	3.22	2300.15	34.77	8.97	1.31	0.028	1.75	1.32	2.00	2.00	-	NA	2300.90	2301.5	0.6
137	B-E1	1226.32	1148.0	20.3	452	2295.0	2297.58	2.58	5.5	3.22	2299.57	30.95	11.33	1.76	0.03	2.49	1.39	2.00	2.00	-	NA	2299.58	2300.5	0.9
138	B-E1	1206.07	1168.2	26.1	452	2294.0	2296.52	2.52	5.5	3.22	2298.71	30.21	11.89	1.87	0.03	2.70	1.40	2.00	2.00	-	NA	2298.52	2299.5	1.0
139	B-E1	1180.02	1194.3	19.7	452	2293.0	2295.57	2.57	5.5	3.22	2297.58	30.88	11.37	1.77	0.03	2.51	1.39	2.00	2.00	-	NA	2297.57	2298.5	0.9
140	B-E1	1160.31	1214.0	20.8	452	2292.0	2294.51	2.51	5.5	3.22	2296.74	30.07	11.99	1.89	0.03	2.73	1.41	2.00	2.00	-	NA	2296.51	2297.5	1.0
141	B-E1	1139.56	1234.7	27.5	452	2291.0	2293.49	2.49	5.5	3.22	2295.79	29.86	12.16	1.92	0.03	2.80	1.41	2.00	2.00	-	NA	2295.49	2296.5	1.0
142	B-E1	1112.05	1262.2	29.6	452	2290.0	2292.6	2.6	5.5	3.22	2294.54	31.14	11.19	1.73	0.03	2.44	1.38	2.00	2.00	-	NA	2294.60	2295.5	0.9
143	B-E1	1082.47	1291.8	16.7	452	2289.0	2291.64	2.64	5.5	3.22	2293.45	31.71	10.79	1.65	0.03	2.31	1.37	2.00	2.00	-	NA	2293.64	2294.5	0.9
144	B-E1	1065.79	1308.5	17.5	452	2288.0	2290.5	2.5	5.5	3.22	2292.76	29.98	12.07	1.9	0.03	2.76	1.41	2.00	2.00	-	NA	2292.50	2293.5	1.0
145	B-E1	1048.29	1326.0	16.1	452	2287.0	2289.45	2.45	5.5	3.22	2291.9	29.38	12.57	2	0.03	2.95	1.42	2.00	2.00	-	NA	2291.45	2292.5	1.1
146	B-E1	1032.24	1342.0	15.6	452	2286.0	2288.41	2.41	5.5	3.22	2291.03	28.88	13	2.09	0.03	3.12	1.44	2.00	2.00	-	NA	2290.41	2291.5	1.1
147	B-E1	1016.67	1357.6	15.6	452	2285.0	2287.38	2.38	5.5	3.22	2290.12	28.57	13.29	2.15	0.03	3.24	1.44	2.00	2.00	-	NA	2289.38	2290.5	1.1
148	B-E1	1001.06	1373.2	17.0	452	2284.0	2286.37	2.37	5.5	3.22	2289.18	28.4	13.45	2.18	0.03	3.31	1.45	2.00	2.00	-	NA	2288.37	2289.5	1.1
149	B-E1	984.02	1390.3	17.2	452	2283.0	2285.38	2.38	5.5	3.22	2288.13	28.54	13.32	2.15	0.03	3.26	1.44	2.00	2.00	-	NA	2287.38	2288.5	1.1
150	B-E1	966.78	1407.5	15.7	452	2282.0	2284.39	2.39	5.5	3.22	2287.1	28.65	13.22	2.13	0.03	3.21	1.44	2.00	2.00	-	NA	2286.39	2287.5	1.1
151	B-E1	951.08	1423.2	22.9	452	2281.0	2283.37	2.37	5.5	3.22	2286.16	28.44	13.41	2.17	0.03	3.29	1.45	2.00	2.00	-	NA	2285.37	2286.5	1.1
152	B-E1	928.17	1446.1	26.1	452	2280.0	2282.48	2.48	5.5	3.22	2284.8	29.8	12.22	1.93	0.03	2.82	1.41	2.00	2.00	-	NA	2284.48	2285.5	1.0
153	B-E1	902.07	1472.2	27.9	452	2279.0	2281.57	2.57	5.5	3.22	2283.59	30.83	11.41	1.77	0.03	2.52	1.39	2.00	2.00	-	NA	2283.57	2284.5	0.9
154	B-E1	874.19	1500.1	29.4	452	2278.0	2280.61	2.61	5.5	3.22	2282.51	31.33	11.05	1.7	0.03	2.40	1.38	2.00	2.00	-	NA	2282.61	2283.5	0.9
155	B-E1	844.82	1529.5	37.8	452	2277.0	2279.64	2.64	5.5	3.22	2281.46	31.62	10.85	1.67	0.03	2.33	1.37	2.00	2.00	-	NA	2281.64	2282.5	0.9
156	B-E1	807	1567.3	36.2	452	2276.0	2278.79	2.79	5.5	3.22	2280.25	33.44	9.7	1.45	0.03	1.96	1.34	2.00	2.00	-	NA	2280.79	2281.5	0.7
157	B-E1	770.82	1603.5	34.3	452	2275.0	2277.75	2.75	5.5	3.22	2279.29	33.02	9.95	1.49	0.03	2.04	1.35	2.00	2.00	-	NA	2279.75	2280.5	0.8
158	B-E1	736.52	1637.8	33.3	452	2274.0	2276.72	2.72	5.5	3.22	2278.32	32.69	10.15	1.53	0.03	2.10	1.35	2.00	2.00	-	NA	2278.72	2279.5	0.8
159	B-E1	703.27	1671.0	34.3	452	2273.0	2275.71	2.71	5.5	3.22	2277.34	32.52	10.26	1.55	0.03	2.13	1.36	2.00	2.00	-	NA	2277.71	2278.5	0.8
160	C-E1	16463	0.0	17.0	514	2267	2268.4	1.4	5.0	3.17	2278.74	18.41	25.8	4.37	0.015	10.84	1.72	2.00	2.76	0.76	500	2271.16	2272	0.8
161	C-E1	16446	25.0	17.0	514	2266	2267.41	1.41	5.0	3.16	2277.64	18.45	25.67	4.34	0.015	10.73	1.72	2.00	2.76	0.76	500	2270.17	2271	0.8
162	C-E1	16429	42.0	17.0	514	2265	2266.41	1.41	5.0	3.16	2276.56	18.47	25.57	4.32	0.015	10.65	1.72	2.00	2.75	0.75	500	2269.16	2270	0.8
163	C-E1	16413	59.0	17.0	514	2264	2265.42	1.42	5.0	3.16	2275.5	18.49	25.49	4.3	0.015	10.59	1.72	2.00	2.75	0.75	500	2268.17	2269	0.8
164	C-E1	16396	76.0	17.0	514	2263	2264.42	1.42	5.0	3.16	2274.47	18.51	25.44	4.29	0.015	10.55	1.71	2.00	2.74	0.74	500	2267.16	2268	0.8
165	C-E1	16379	93.0	8.0	514	2262	2263.42	1.42	5.0	3.16	2273.42	18.52	25.38	4.28	0.015	10.50	1.71	2.00	2.74	0.74	500	2266.16	2267	0.8
166	C-E1	16371	101.0	9.0	514	2261.53	2262.95	1.42	5.0	3.16	2272.94	18.52	25.37	4.27	0.015	10.49	1.71	2.00	2.74	0.74	500	2265.69	2266.53	0.8
167	C-E1	16363	110.0	17.0	514	2261	2262.42	1.42	5.0	3.16	2272.41	18.53	25.36	4.27	0.015	10.49	1.71	2.00	2.74	0.74	500	2265.16	2266	0.8
168	C-E1	16346	127.0	17.0	514	2260	2261.42	1.42	5.0	3.16	2271.38	18.54	25.32	4.26	0.015	10.46	1.71	2.00	2.74	0.74	500	2264.16	2265	0.8
169	C-E1	16329	144.0	17.0	514	2259	2260.42	1.42	5.0	3.16	2270.36	18.54	25.3	4.26	0.015	10.44	1.71	2.00	2.74	0.74	500	2263.16	2264	0.8
170	C-E1	16313	161.0	17.0	514	2258	2259.42	1.42	5.0	3.16	2269.35	18.55	25.28	4.26	0.015	10.42	1.71	2.00	2.74	0.74	500	2262.16	2263	0.8
171	C-E1	16296	178.0	15.0	514	2257	2258.43	1.43	5.0	3.16	2268.34	18.55	25.27	4.25	0.015	10.42	1.71	2.00	2.74	0.74	500	2261.17	2262	0.8
172	C-E1	16281	193.0	10.0	514	2256	2257.42	1.42	5.0	3.16	2267.43	18.52	25.39	4.28	0.015	10.51	1.71	2.00	2.74	0.74	500	2260.16	2261	0.8
173	C-E1	16271	203.0	18.0	514	2255.31	2256.73	1.42	5.0	3.16	2266.82	18.49	25.49	4.3	0.015	10.59								

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Sunrise Mountain Landfill Hydraulics Verification - Rockfall Basin																							
2	Reach	River Sta	Plan Sta.	Segment Length	Bulk Flow	Min Ch Elev	W.S. Elev	Flow Depth	Min. Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	BANK Elev	Excess Bank Freeboard
3				(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(MSL)	(ft)
184	C-E1	16151	320.0	13.0	514	2245	2246.33	1.33	5.0	3.16	2258.25	17.96	27.71	4.81	0.015	12.42	1.76	2.00	2.86	0.86	500	2249.19	2250	0.8
185	C-E1	16138	333.0	15.0	514	2244	2245.33	1.33	5.0	3.16	2257.25	17.96	27.71	4.81	0.015	12.42	1.76	2.00	2.86	0.86	500	2248.19	2249	0.8
186	C-E1	16123	348.0	17.0	514	2243	2244.34	1.34	5.0	3.16	2256.04	18.02	27.45	4.75	0.015	12.20	1.76	2.00	2.84	0.84	500	2247.18	2248	0.8
187	C-E1	16106	365.0	21.0	514	2242	2243.35	1.35	5.0	3.16	2254.67	18.12	27	4.64	0.015	11.82	1.75	2.00	2.82	0.82	500	2246.17	2247	0.8
188	C-E1	16085	386.0	14.0	514	2241	2242.39	1.39	5.0	3.16	2253.02	18.32	26.17	4.45	0.015	11.13	1.73	2.00	2.78	0.78	500	2245.17	2246	0.8
189	C-E1	16071	400.0	12.0	514	2240.47	2241.89	1.42	5.0	3.16	2251.97	18.49	25.48	4.3	0.015	10.58	1.72	2.00	2.75	0.75	500	2244.64	2245.47	0.8
190	C-E1	16058	412.0	27.0	514	2240	2241.44	1.44	5.0	3.16	2251.15	18.62	25	4.19	0.015	10.20	1.71	2.00	2.72	0.72	500	2244.16	2245	0.8
191	C-E1	16032	439.0	27.0	514	2239	2240.48	1.48	5.0	3.16	2249.46	18.88	24.05	3.98	0.015	9.48	1.69	2.00	2.68	0.68	500	2243.16	2244	0.8
192	C-E1	16005	466.0	27.0	514	2238	2239.52	1.52	5.0	3.16	2247.97	19.09	23.33	3.83	0.015	8.95	1.67	2.00	2.65	0.65	500	2242.17	2243	0.8
193	C-E1	15979	493.0	8.0	514	2237	2238.54	1.54	5.0	3.16	2246.6	19.25	22.79	3.71	0.015	8.56	1.66	2.00	2.62	0.62	500	2241.16	2242	0.8
194	C-E1	15971	501.0	19.0	514	2236.71	2238.26	1.55	5.0	3.16	2246.22	19.3	22.64	3.68	0.015	8.46	1.66	2.00	2.61	0.61	500	2240.87	2241.71	0.8
195	C-E1	15952	518.9	27.0	514	2236	2237.56	1.56	5.0	3.16	2245.36	19.37	22.4	3.63	0.015	8.29	1.65	2.00	2.60	0.60	500	2240.16	2241	0.8
196	C-E1	15925	545.9	27.0	514	2235	2236.58	1.58	5.0	3.16	2244.17	19.46	22.12	3.57	0.015	8.10	1.64	2.00	2.59	0.59	500	2239.17	2240	0.8
197	C-E1	15899	572.9	27.0	514	2234	2235.59	1.59	5.0	3.16	2243.05	19.53	21.92	3.52	0.015	7.96	1.64	2.00	2.58	0.58	500	2238.17	2239	0.8
198	C-E1	15872	599.9	27.0	514	2233	2234.6	1.6	5.0	3.16	2241.95	19.58	21.76	3.49	0.015	7.85	1.64	2.00	2.58	0.58	500	2237.18	2238	0.8
199	C-E1	15845	625.3	27.0	514	2232	2234.53	2.53	5.0	4.19	2240.85	15.13	20.17	2.74	0.015	6.82	1.69	2.00	2.38	0.38	500	2236.91	2237	0.1
200	C-E1	15819	652.3	27.0	514	2231	2234.02	3.02	6.0	4.61	2240.21	14.56	19.98	2.65	0.015	6.70	1.72	2.00	2.36	0.36	500	2236.38	2237	0.6
201	C-E1	15792	679.3	158.0	514	2230	2233.23	3.23	6.0	4.93	2239.63	12.5	20.31	2.51	0.015	6.91	1.75	2.00	2.32	0.32	500	2235.55	2236	0.4
202	C-EPC1	15634	2472.3	24.0	1752	2227	2230.1	3.1	8.5	5.27	2237.9	31.41	22.4	2.5	0.015	8.29	1.82	2.00	2.98	0.98	500	2233.08	2235.5	2.4
203	C-EPC1	15610	2496.3	33.0	1752	2226.58	2229.68	3.1	8.5	5.27	2237.5	31.39	22.45	2.51	0.015	8.33	1.82	2.00	2.98	0.98	500	2232.66	2235.08	2.4
204	C-EPC1	15577	2529.3	66.0	1752	2226	2229.09	3.09	8.5	5.27	2236.96	31.36	22.51	2.52	0.015	8.37	1.82	2.00	2.99	0.99	500	2232.08	2234.5	2.4
205	C-EPC1	15511	2595.3	1.0	1752	2225	2229.31	4.31	8.5	6.3	2235.65	28.74	20.21	2.05	0.015	6.84	1.82	2.00	2.73	0.73	500	2232.04	2233.5	1.5
206	C-EPC1	15510	2596.3	78.0	1752	2224.99	2229.3	4.31	8.5	6.3	2235.64	28.73	20.21	2.05	0.015	6.84	1.82	2.00	2.73	0.73	500	2232.03	2233.49	1.5
207	C-EPC1	15432	2674.3	22.0	1752	2224	2228.56	4.56	8.5	6.54	2234.83	28.24	20.09	2.01	0.015	6.77	1.83	2.00	2.71	0.71	500	2231.27	2232.5	1.2
208	C-EPC1	15410	2696.3	58.0	1752	2223.73	2228.27	4.54	8.5	6.54	2234.6	28.19	20.18	2.03	0.015	6.82	1.84	2.00	2.71	0.71	500	2230.98	2232.23	1.2
209	C-EPC1	15352	2754.3	42.0	1752	2223	2227.51	4.51	8.5	6.54	2233.98	28.05	20.41	2.06	0.015	6.97	1.84	2.00	2.73	0.73	500	2230.24	2231.5	1.3
210	C-EPC1	15310	2796.3	38.0	1752	2222.48	2226.97	4.49	8.5	6.52	2233.53	27.96	20.56	2.08	0.015	7.06	1.85	2.00	2.73	0.73	500	2229.70	2230.98	1.3
211	C-EPC1	15272	2834.3	62.0	1752	2222	2226.48	4.48	8.5	6.52	2233.1	27.9	20.66	2.09	0.015	7.13	1.85	2.00	2.74	0.74	500	2229.22	2230.5	1.3
212	C-EPC1	15210	2896.4	17.0	1752	2221.22	2225.66	4.44	8.5	6.52	2232.41	27.79	20.84	2.11	0.015	7.24	1.86	2.00	2.75	0.75	500	2228.41	2229.72	1.3
213	C-EPC1	15193	2913.4	80.0	1752	2221	2225.44	4.44	8.5	6.52	2232.22	27.77	20.89	2.12	0.015	7.28	1.86	2.00	2.75	0.75	500	2228.19	2229.5	1.3
214	C-EPC1	15113	2993.4	3.0	1752	2220	2224.42	4.42	8.5	6.52	2231.3	27.67	21.06	2.14	0.015	7.39	1.86	2.00	2.76	0.76	500	2227.18	2228.5	1.3
215	C-EPC1	15110	2996.4	77.0	1752	2219.96	2224.38	4.42	8.5	6.52	2231.26	27.68	21.04	2.14	0.015	7.37	1.86	2.00	2.76	0.76	500	2227.14	2228.46	1.3
216	C-EPC1	15033	3073.3	23.0	1752	2219	2223.4	4.4	8.5	6.52	2230.36	27.61	21.17	2.15	0.015	7.46	1.87	2.00	2.77	0.77	500	2226.17	2227.5	1.3
217	C-EPC1	15010	3096.3	56.0	1752	2218.71	2223.11	4.4	8.5	6.52	2230.09	27.58	21.21	2.16	0.015	7.49	1.87	2.00	2.77	0.77	500	2225.88	2227.21	1.3
218	C-EPC1	14954	3152.3	44.0	1752	2218	2222.39	4.39	8.5	6.52	2229.42	27.54	21.29	2.17	0.015	7.54	1.87	2.00	2.78	0.78	500	2225.17	2226.5	1.3
219	C-EPC1	14910	3196.3	36.0	1752	2217.45	2221.83	4.38	8.5	6.52	2228.9	27.51	21.34	2.18	0.015	7.57	1.87	2.00	2.78	0.78	500	2224.61	2225.95	1.3
220	C-EPC1	14874	3232.3	64.0	1752	2217	2221.37	4.37	8.5	6.52	2228.47	27.49	21.37	2.18	0.015	7.59	1.87	2.00	2.78	0.78	500	2224.15	2225.5	1.4
221	C-EPC1	14810	3296.3	16.0	1752	2216.2	2220.57	4.37	8.5	6.52	2227.7	27.46	21.43	2.19	0.015	7.63	1.88	2.00	2.78	0.78	500	2223.35	2224.7	1.3
222	C-EPC1	14794	3312.3	79.0	1752	2216	2220.36	4.36	8.5	6.52	2227.51	27.45	21.45	2.19	0.015	7.64	1.88	2.00	2.78	0.78	500	2223.14	2224.5	1.4
223	C-EPC1	14715	3390.3	38.0	1752	2215	2219.35	4.35	8.5	6.52	2226.55	27.41	21.52	2.2	0.015	7.69	1.88	2.00	2.79	0.79	500	2222.14	2223.5	1.4
224	C-EPC1	14677	3428.3	42.0	1752	2214.53	2218.88	4.35	8.5	6.37	2226.09	27.4	21.55	2.2	0.015	7.71	1.88	2.00	2.79	0.79	500	2221.67	2223.03	1.4
225	C-EPC1	14635	3469.9	55.0	1752	2214	2217.4	3.4	8.5	5.59	2225.43	29.48	22.74	2.48	0.015	8.53	1.85	2.00	2.95	0.95	500	2220.35	2222.5	2.2
226	C-EPC1	14580	3524.9	191.0	1752	2213.27	2216.55	3.28	8.5	5.44	2224.56	29	22.71	2.45	0.015	8.51	1.84	2.00	2.93	0.93	500	2219.48	2221.77	2.3
227	C-EPC2	14389	3715.8	53.0	2459	2210.0	2213.12	3.12	9.5	5.49	2221.87	39.47	23.74	2.58	0.015	9.25	1.87	2.00	3.38	1.38	500	2216.50	2219.5	3.0
228	C-EPC2	14336	3768.8	26.0	2459	2209.0	2212.1	3.1	9.5	5.5	2220.96	39.4	23.89	2.6	0.015	9.36	1.87	2.00	3.40	1.40	500	2215.50	2218.5	3.0
229	C-EPC2	14310	3794.8	26.0	2459	2208.5	2212.55	4.05	9.5	6.36	2220.26	35.35	22.28	2.22	0.015	8.21	1.89	2.00	3.09	1.09	500	2215.64	2218	2.4
230	C-EPC2	14284	3820.8	74.0	2459	2208.0	2213.62	5.62	9.5	7.51	2219.47	33.79	19.4	1.77	0.015	6.34	1.86	2.00	2.79	0.79	500	2216.41	2217.5	1.1
231	C-EPC2	14210	3894.8	1.0	2459	2207.0	2212.77	5.76	9.5	7.74	2218.89	33.03	19.85	1.81	0.015	6.62	1.89	2.00	2.81	0.81	500	2215.58	2216.51	0.9
232	C-EPC2	14209	3895.8	76.0	2459	2207.0	2212.76	5.76	9.5	7.74	2218.87	33.04	19.84	1.81	0.015	6.								



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Sunrise Mountain Landfill Hydraulics Verification - Rockfall Basin																							
2	Reach	River Sta	Plan Sta.	Segment Length	Bulk Flow	Min Ch Elev	W.S. Elev	Flow Depth	Min. Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	BANK Elev	Excess Bank Freeboard
3				(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(MSL)	(ft)
244	C-EPC2	13674	4429.5	64.0	2459	2200.0	2205.24	5.24	9.5	7.74	2213.41	30.95	22.93	2.17	0.015	8.66	2.00	2.00	3.01	1.01	500	2208.25	2209.5	1.2
245	C-EPC2	13610	4493.4	13.0	2459	2199.2	2204.38	5.21	9.5	7.74	2212.67	30.85	23.1	2.19	0.015	8.79	2.00	2.00	3.02	1.02	500	2207.40	2208.67	1.3
246	C-EPC2	13597	4505.8	76.0	2459	2199.0	2204.21	5.21	9.5	7.74	2212.52	30.83	23.13	2.2	0.015	8.81	2.00	2.00	3.03	1.02	500	2207.24	2208.5	1.3
247	C-EPC2	13521	4581.8	11.0	2459	2198.0	2203.18	5.18	9.5	7.74	2211.61	30.73	23.3	2.22	0.015	8.93	2.01	2.00	3.04	1.04	500	2206.22	2207.5	1.3
248	C-EPC2	13510	4592.8	65.0	2459	2197.9	2203.04	5.18	9.5	7.74	2211.47	30.72	23.31	2.22	0.015	8.94	2.01	2.00	3.05	1.04	500	2206.09	2207.36	1.3
249	C-EPC2	13445	4657.8	35.0	2459	2197.0	2202.16	5.16	9.5	7.74	2210.69	30.65	23.43	2.23	0.015	9.02	2.01	2.00	3.06	1.05	500	2205.22	2206.5	1.3
250	C-EPC2	13410	4692.8	47.0	2459	2196.6	2201.73	5.16	9.5	7.74	2210.27	30.64	23.45	2.23	0.015	9.04	2.01	2.00	3.06	1.05	500	2204.79	2206.07	1.3
251	C-EPC2	13363	4739.8	53.0	2459	2196.0	2201.16	5.16	9.5	7.74	2209.71	30.63	23.47	2.24	0.015	9.05	2.01	2.00	3.06	1.05	500	2204.22	2205.5	1.3
252	C-EPC2	13310	4792.8	12.0	2459	2195.2	2200.31	5.12	9.5	7.74	2209.04	30.48	23.72	2.27	0.015	9.24	2.02	2.00	3.09	1.07	500	2203.40	2204.69	1.3
253	C-EPC2	13298	4804.8	51.0	2459	2195.0	2200.11	5.11	9.5	7.74	2208.89	30.45	23.77	2.27	0.015	9.27	2.02	2.00	3.09	1.07	500	2203.20	2204.5	1.3
254	C-EPC2	13247	4855.4	27.0	2459	2194.0	2199.04	5.04	9.5	7.64	2208.19	30.18	24.27	2.33	0.015	9.65	2.04	2.00	3.14	1.10	500	2202.18	2203.5	1.3
255	C-EPC2	13220	4882.4	127.0	2459	2193.4	2198.39	5	9.5	7.58	2207.8	29.98	24.62	2.38	0.015	9.91	2.05	2.00	3.18	1.13	500	2201.57	2202.89	1.3
256	C-1	15929	0.0	11	578	2231	2232.29	1.29	6.0	3.66	2252.06	15.15	35.68	6.08	0.015	20.27	1.97	2.00	2.00	-	NA	2234.29	2237	2.7
257	C-1	15918	10.6	11	578	2230	2231.3	1.3	6.0	3.66	2250.56	15.21	35.21	5.97	0.015	19.75	1.96	2.00	2.00	-	NA	2233.30	2236	2.7
258	C-1	15908	21.6	11	578	2229	2230.32	1.32	6.0	3.67	2249.12	15.26	34.8	5.88	0.015	19.30	1.95	2.00	2.00	-	NA	2232.32	2235	2.7
259	C-1	15896	32.6	15	578	2228	2229.33	1.33	6.0	3.67	2247.74	15.31	34.44	5.8	0.015	18.92	1.95	2.00	2.00	-	NA	2231.33	2234	2.7
260	C-1	15881	47.6	38	578	2227	2228.36	1.36	6.0	3.67	2245.84	15.42	33.55	5.59	0.015	17.98	1.93	2.00	2.00	-	NA	2230.36	2233	2.6
261	C-1	15844	85.6	15	578	2226	2227.49	1.49	6.0	3.67	2241.43	15.95	29.97	4.8	0.015	14.45	1.86	2.00	2.00	-	NA	2229.49	2232	2.5
262	C-1	15829	100.6	82.98	578	2225.85	2227.4	1.55	6.0	3.67	2239.98	16.2	28.46	4.48	0.015	13.08	1.82	2.00	2.00	-	NA	2229.40	2231.85	2.4
263	C-1	15746	183.5	17	578	2225	2226.86	1.86	6.0	3.65	2234.83	17.44	22.65	3.3	0.015	8.47	1.70	2.00	2.00	-	NA	2228.86	2231	2.1
264	C-1	15729	200.5	81	578	2224.83	2226.75	1.92	6.0	3.65	2234.1	17.68	21.76	3.13	0.015	7.85	1.68	2.00	2.00	-	NA	2228.75	2230.83	2.1
265	C-1	15648	281.5	18	578	2224	2226.16	2.16	6.0	3.65	2231.6	18.63	18.71	2.56	0.015	5.94	1.60	2.00	2.00	-	NA	2228.16	2230	1.8
266	C-1	15629	299.5	79.04	578	2223.81	2226.01	2.2	6.0	3.65	2231.17	18.8	18.23	2.48	0.015	5.66	1.59	2.00	2.00	-	NA	2228.01	2229.81	1.8
267	C-1	15550	378.5	20	578	2223	2225.36	2.36	6.0	3.65	2229.66	19.44	16.65	2.2	0.015	4.80	1.55	2.00	2.00	-	NA	2227.36	2229	1.6
268	C-1	15529	398.5	76.96	578	2222.79	2225.18	2.39	6.0	3.65	2229.35	19.55	16.39	2.15	0.015	4.67	1.55	2.00	2.00	-	NA	2227.18	2228.79	1.6
269	C-1	15452	475.5	23.01	578	2222	2224.47	2.47	6.0	3.65	2228.27	19.89	15.64	2.02	0.015	4.30	1.53	2.00	2.00	-	NA	2226.47	2228	1.5
270	C-1	15429	498.5	75.04	578	2221.76	2224.25	2.49	6.0	3.65	2227.99	19.94	15.53	2	0.015	4.25	1.53	2.00	2.50	0.50	300	2226.75	2227.76	1.0
271	C-1	15354	573.5	24.99	578	2221	2223.53	2.53	6.0	3.65	2227.1	20.12	15.17	1.94	0.015	4.07	1.52	2.00	2.48	0.48	300	2226.01	2227	1.0
272	C-1	15329	598.5	72.96	578	2220.74	2223.27	2.53	6.0	3.65	2226.83	20.13	15.14	1.94	0.015	4.06	1.52	2.00	2.48	0.48	300	2225.75	2226.74	1.0
273	C-1	15256	672.6	27	578	2220	2222.55	2.55	6.0	3.65	2226.05	20.2	15.01	1.92	0.015	4.00	1.51	2.00	2.47	0.47	300	2225.02	2226	1.0
274	C-1	15229	699.6	71.04	578	2219.72	2222.27	2.55	6.0	3.65	2225.77	20.2	15.01	1.92	0.015	4.00	1.51	2.00	2.47	0.47	300	2224.74	2225.72	1.0
275	C-1	15158	770.6	30	578	2219	2221.56	2.56	6.0	3.65	2225.02	20.24	14.93	1.9	0.015	3.96	1.51	2.00	2.47	0.47	300	2224.03	2225	1.0
276	C-1	15128	800.6	43	578	2218.7	2221.26	2.56	6.0	3.65	2224.71	20.25	14.9	1.9	0.015	3.95	1.51	2.00	2.47	0.47	300	2223.73	2224.7	1.0
277	C-1	15085	843.6	49	578	2218.26	2220.82	2.56	6.0	3.65	2224.27	20.25	14.9	1.9	0.015	3.95	1.51	2.00	2.47	0.47	300	2223.29	2224.26	1.0
278	C-1	15036	892.6	52	578	2217.75	2219.13	1.38	6.0	2.54	2223.48	25	16.73	2.51	0.015	4.85	1.47	2.00	2.72	0.72	300	2221.85	2223.75	1.9
279	C-1	15034		Culvert				0	6.0							0.50	1.00	na	0.50	-	300	0.50	6	5.5
280	C-1	14984	944.6	79.04	578	2217.22	2218.83	1.61	6.0	2.54	2222.02	25	14.34	1.99	0.015	3.69	1.42	2.00	2.53	0.53	300	2221.36	2223.22	1.9
281	C-1	14905	1023.7	41	578	2216.42	2220.07	3.65	6.0	3.65	2221.37	24.6	9.16	1.01	0.015	1.80	1.35	2.00	2.21	0.21	300	2222.28	2222.42	0.1
282	C-1	14864	1064.7	37	578	2216	2219.11	3.11	6.0	3.65	2221.15	22.44	11.46	1.35	0.015	2.54	1.42	2.00	2.31	0.31	300	2221.42	2222	0.6
283	C-1	14828	1101.7	60.97	578	2215.63	2218.6	2.97	6.0	3.65	2220.92	21.88	12.21	1.46	0.015	2.81	1.44	2.00	2.34	0.34	300	2220.94	2221.63	0.7
284	C-1	14766	1161.8	38	578	2215	2217.82	2.82	6.0	3.65	2220.49	21.28	13.1	1.6	0.015	3.16	1.46	2.00	2.38	0.38	300	2220.20	2221	0.8
285	C-1	14728	1199.8	60	578	2214.61	2217.38	2.77	6.0	3.65	2220.19	21.06	13.45	1.66	0.015	3.31	1.47	2.00	2.39	0.39	300	2219.77	2220.61	0.8
286	C-1	14668	1259.8	40	578	2214	2216.71	2.71	6.0	3.65	2219.69	20.83	13.85	1.72	0.015	3.48	1.48	2.00	2.41	0.41	300	2219.12	2220	0.9
287	C-1	14628	1299.8	32	578	2213.44	2217.01	3.57	6.0	4.17	2219.2	20.78	11.87	1.37	0.015	2.69	1.45	2.00	2.30	0.30	300	2219.31	2219.44	0.1
288	C-1	14596	1331.8	16	578	2213	2216.38	3.38	6.0	4.14	2218.97	20.01	12.91	1.52	0.015	3.09	1.48	2.00	2.35	0.35	300	2218.73	2219	0.3
289	C-1	14580	1347.8	191	578	2212.77	2216.26	3.49	6.0	4.25	2218.86	19.08	12.93	1.49	0.015	3.10	1.49	2.00	2.33	0.33	300	2218.59	2218.77	0.2
290	C-2A	13823	9.3	9.0	230	2230.0	2230.68	0.68	3.0	2.18	2244.47	12.72	29.8	6.74	0.015	14.29	1.66	na	1.66	-	NA	2232.34	2233	0.7
291	C-2A	13814	18.3	10.0	230	2229.0	2229.7	0.7	3.0	2.17	2242.66	12.79	28.89	6.45	0.015	13.46	1.64	na	1.64	-	NA	2231.34	2232	0.7
292	C-2A	13804	28.3	9.0	230	2228.0	2228.72	0.72	3.0	2.18	2240.83	12.88	27.92	6.15	0.015	12.60	1.63	na	1.63	-	NA	2230.35	2231	0.7
293	C-2A	13795	37.3	9.0	230	2227.0	2227.73	0.73	3.0	2.17	2239.39	12.93	27.4	5.99	0.015	12.16	1.6							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Sunrise Mountain Landfill Hydraulics Verification - Rockfall Basin																							
2	Reach	River Sta	Plan Sta.	Segment Length	Bulk Flow	Min Ch Elev	W.S. Elev	Flow Depth	Min. Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	BANK Elev	Excess Bank Freeboard
3				(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(MSL)	(ft)
304	C-2A	13681	151.3	16.0	230	2217.0	2217.87	0.87	3.0	2.17	2225.83	13.46	22.65	4.6	0.015	8.47	1.54	na	1.54	-	NA	2219.41	2220	0.6
305	C-2A	13665	167.3	16.0	230	2216.0	2216.88	0.88	3.0	2.18	2224.49	13.53	22.14	4.45	0.015	8.11	1.53	na	1.53	-	NA	2218.41	2219	0.6
306	C-2A	13649	183.3	17.0	230	2215.0	2215.9	0.9	3.0	2.17	2223.26	13.58	21.78	4.35	0.015	7.87	1.53	na	1.53	-	NA	2217.43	2218	0.6
307	C-2A	13632	200.3	18.0	230	2214.0	2214.91	0.91	3.0	2.18	2222.02	13.64	21.4	4.25	0.015	7.61	1.52	na	1.52	-	NA	2216.43	2217	0.6
308	C-2A	13614	218.3	19.0	230	2213.0	2213.92	0.92	3.0	2.17	2220.77	13.7	21	4.14	0.015	7.35	1.51	na	1.51	-	NA	2215.43	2216	0.6
309	C-2A	13595	237.3	21.0	230	2212.0	2212.94	0.94	3.0	2.18	2219.53	13.76	20.6	4.03	0.015	7.09	1.50	na	1.50	-	NA	2214.44	2215	0.6
310	C-2A	13574	258.3	22.0	230	2211.0	2211.96	0.96	3.0	2.17	2218.22	13.84	20.07	3.89	0.015	6.75	1.49	na	1.49	-	NA	2213.45	2214	0.5
311	C-2A	13552	280.3	20.0	230	2210.0	2210.98	0.98	3.0	2.18	2216.95	13.92	19.61	3.77	0.015	6.47	1.49	na	1.49	-	NA	2212.47	2213	0.5
312	C-2A	13532	300.3	3.0	230	2209.1	2210.13	1	3.0	2.17	2215.88	13.98	19.25	3.67	0.015	6.25	1.48	na	2.02	0.54	300	2212.15	2212.13	0.0
313	C-2A	13529	303.3	23.0	230	2209.0	2210	1	3.0	2.18	2215.74	13.99	19.23	3.67	0.015	6.24	1.48	na	2.02	0.54	300	2212.02	2212	0.0
314	C-2A	13506	326.3	23.0	230	2208.0	2209.01	1.01	3.0	2.17	2214.6	14.04	18.97	3.6	0.015	6.09	1.48	na	2.00	0.52	300	2211.01	2211	0.0
315	C-2A	13483	349.3	23.0	230	2207.0	2208.02	1.02	3.0	2.18	2213.51	14.07	18.81	3.55	0.015	5.99	1.47	na	1.99	0.52	300	2210.01	2210	0.0
316	C-2A	13460	372.4	23.0	230	2206.0	2207.02	1.02	3.0	2.17	2212.45	14.08	18.7	3.53	0.015	5.93	1.47	na	1.98	0.51	300	2209.00	2209	0.0
317	C-2A	13437	395.4	5.0	230	2205.0	2206.02	1.02	3.0	2.18	2211.42	14.1	18.64	3.51	0.015	5.90	1.47	na	1.98	0.51	300	2208.00	2208	0.0
318	C-2A	13432	400.4	17.0	230	2204.8	2205.8	1.03	3.0	2.17	2211.2	14.09	18.65	3.51	0.015	5.90	1.47	na	1.98	0.51	300	2207.78	2207.77	0.0
319	C-2A	13415	417.4	23.0	230	2204.0	2205.02	1.02	3.0	2.17	2210.44	14.09	18.68	3.52	0.015	5.92	1.47	na	1.98	0.51	300	2207.00	2207	0.0
320	C-2A	13392	440.4	23.0	230	2203.0	2204.02	1.02	3.0	2.18	2209.42	14.1	18.64	3.51	0.015	5.90	1.47	na	1.98	0.51	300	2206.00	2206	0.0
321	C-2A	13369	463.4	23.0	230	2202.0	2203.03	1.03	3.0	2.17	2208.41	14.1	18.62	3.51	0.015	5.88	1.47	na	1.98	0.51	300	2205.01	2205	0.0
322	C-2A	13346	486.4	14.0	230	2201.0	2202.03	1.03	3.0	2.18	2207.39	14.11	18.59	3.5	0.015	5.87	1.47	na	1.97	0.50	300	2204.00	2204	0.0
323	C-2A	13332	500.4	9.0	230	2200.4	2201.42	1.03	3.0	2.17	2206.79	14.11	18.59	3.5	0.015	5.87	1.47	na	1.97	0.50	300	2203.39	2203.39	0.0
324	C-2A	13323	509.4	23.0	230	2200.0	2201.03	1.03	3.0	2.18	2206.39	14.11	18.59	3.5	0.015	5.87	1.47	na	1.97	0.50	300	2203.00	2203	0.0
325	C-2A	13300	532.4	22.0	230	2199.0	2200.03	1.03	3.0	2.17	2205.38	14.11	18.57	3.49	0.015	5.85	1.47	na	1.97	0.50	300	2202.00	2202	0.0
326	C-2A	13278	554.4	31.0	230	2198.0	2199.03	1.03	3.0	2.18	2204.41	14.1	18.63	3.51	0.015	5.89	1.47	na	1.98	0.51	300	2201.01	2201	0.0
327	C-2A	13247	585.4	15.0	230	2197.7	2198.8	1.15	3.0	2.17	2202.93	14.59	16.3	2.92	0.015	4.63	1.43	na	1.83	0.40	300	2200.63	2200.65	0.0
328	C-2A	13232	600.4	16.0	230	2197.5	2198.68	1.2	3.0	2.18	2202.38	14.81	15.43	2.71	0.015	4.20	1.41	na	1.77	0.37	300	2200.45	2200.48	0.0
329	C-2A	13216	616.4	123.0	230	2197.3	2198.55	1.25	3.0	2.17	2201.89	15.01	14.66	2.53	0.015	3.84	1.39	na	1.73	0.33	300	2200.28	2200.3	0.0
330	C-2B	13093	5009.1	35.0	2743	2190.0	2195.15	5.15	9.5	7.98	2205.84	30.6	26.23	2.5	0.015	11.18	2.13	2.00	3.44	1.31	500	2198.59	2199.5	0.9
331	C-2B	13058	5044.1	36.0	2743	2189.0	2194.08	5.08	9.5	8.16	2205.25	30.3	26.83	2.57	0.015	11.68	2.15	2.00	3.51	1.35	500	2197.59	2198.5	0.9
332	C-2B	13022	5080.1	12.0	2743	2188.0	2193.01	5.01	9.5	8.14	2204.61	30.05	27.32	2.63	0.015	12.09	2.17	2.00	3.56	1.39	500	2196.57	2197.5	0.9
333	C-2B	13010	5092.1	23.0	2743	2187.7	2192.65	4.99	9.5	8.14	2204.39	29.97	27.49	2.66	0.015	12.23	2.17	2.00	3.58	1.41	500	2196.23	2197.16	0.9
334	C-2B	12987	5115.4	20.0	2743	2187.0	2191.96	4.96	9.5	8.14	2203.96	29.82	27.8	2.69	0.015	12.50	2.19	2.00	3.62	1.43	500	2195.58	2196.5	0.9
335	C-2B	12967	5135.4	122.0	2743	2186.4	2191.36	4.93	9.5	8.02	2203.58	29.7	28.06	2.73	0.015	12.73	2.19	2.00	3.65	1.45	500	2195.01	2195.93	0.9
336	C-1A	13791	0.0	10.0	323	2202.0	2204.04	2.04	4.0	2.33	2205.22	26.35	8.7	1.29	0.03	1.68	1.28	2.00	2.00	-	NA	2206.04	2206	0.0
337	C-1A	13781	10.1	41.0	323	2201.8	2203.87	2.07	4.0	2.33	2205.01	26.54	8.55	1.26	0.03	1.64	1.27	2.00	2.00	-	NA	2205.87	2205.8	-0.1
338	C-1A	13740	51.1	51.0	323	2201.0	2203.06	2.06	4.0	2.33	2204.21	26.45	8.62	1.28	0.03	1.65	1.27	2.00	2.00	-	NA	2205.06	2205	-0.1
339	C-1A	13689	102.1	8.0	323	2200.0	2202.05	2.05	4.0	2.33	2203.21	26.41	8.65	1.28	0.03	1.66	1.27	2.00	2.00	-	NA	2204.05	2204	-0.1
340	C-1A	13681	110.1	42.0	323	2199.8	2201.89	2.05	4.0	2.33	2203.05	26.43	8.63	1.28	0.03	1.66	1.27	2.00	2.00	-	NA	2203.89	2203.84	0.0
341	C-1A	13639	152.1	51.0	323	2199.0	2201.05	2.05	4.0	2.33	2202.22	26.38	8.67	1.29	0.03	1.67	1.28	2.00	2.00	-	NA	2203.05	2203	-0.1
342	C-1A	13588	203.1	7.0	323	2198.0	2200.05	2.05	4.0	2.33	2201.21	26.43	8.63	1.28	0.03	1.66	1.27	2.00	2.00	-	NA	2202.05	2202	-0.1
343	C-1A	13581	210.1	43.0	323	2197.9	2199.92	2.06	4.0	2.33	2201.07	26.45	8.62	1.28	0.03	1.65	1.27	2.00	2.00	-	NA	2201.92	2201.86	-0.1
344	C-1A	13538	253.1	51.0	323	2197.0	2199.05	2.05	4.0	2.33	2200.21	26.39	8.66	1.28	0.03	1.66	1.28	2.00	2.00	-	NA	2201.05	2201	-0.1
345	C-1A	13487	304.1	6.0	323	2196.0	2198.05	2.05	4.0	2.33	2199.21	26.39	8.66	1.28	0.03	1.66	1.28	2.00	2.06	0.06	1000	2200.11	2200	-0.1
346	C-1A	13481	310.1	44.0	323	2195.9	2197.93	2.05	4.0	2.33	2199.09	26.4	8.65	1.28	0.03	1.66	1.27	2.00	2.06	0.06	1000	2199.99	2199.88	-0.1
347	C-1A	13437	354.6	51.0	323	2195.0	2197.05	2.05	4.0	2.33	2198.22	26.37	8.68	1.29	0.03	1.67	1.28	2.00	2.06	0.06	1000	2199.11	2199	-0.1
348	C-1A	13386	405.6	5.0	323	2194.0	2196.05	2.05	4.0	2.33	2197.21	26.44	8.63	1.28	0.03	1.66	1.27	2.00	2.06	0.06	1000	2198.11	2198	-0.1
349	C-1A	13381	410.6	46.0	323	2193.9	2195.96	2.06	4.0	2.33	2197.11	26.44	8.63	1.28	0.03	1.66	1.27	2.00	2.06	0.06	1000	2198.02	2197.9	-0.1
350	C-1A	13335	455.7	50.0	323	2193.0	2195.06	2.06	4.0	2.33	2196.21	26.45	8.62	1.28	0.03	1.65	1.27	2.00	2.06	0.06	1000	2197.12	2197	-0.1
351	C-1A	13285	505.7	4.0	323	2192.5	2194.51	2.01	4.0	2.33	2195.74	26.09	8.9	1.33	0.015	1.73	1.28	2.00	2.06	0.06	1000	2196.57	2196.5	-0.1
352	C-1A	13281	509.7	75.0	323	2192.5	2194.48	2.01	4.0	2.33	2195.71	26.1	8.89	1.33	0.015	1.73	1.28	2.00	2.06	0.06	1000	2196.54	2196.47	-0.1
353	C-1A	13206	584.7	125.0	323	2191.6	2193.59	1.98	4.0	2.47	2195.22	21.87	10.25											

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Sunrise Mountain Landfill Hydraulics Verification - Rockfall Basin																							
2	Reach	River Sta	Plan Sta.	Segment Length	Bulk Flow	Min Ch Elev	W.S. Elev	Flow Depth	Min. Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	BANK Elev	Excess Bank Freeboard
3				(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(MSL)	(ft)
364	C-3	12694	5408.6	29.0	3143	2176.0	2180.83	4.83	11.0	8.71	2197.82	29.33	33.08	3.24	0.015	17.49	2.40	2.00	4.39	1.99	500	2185.22	2187	1.8
365	C-3	12665	5437.6	30.0	3143	2175.0	2179.81	4.81	11.0	8.71	2197.05	29.23	33.32	3.27	0.015	17.74	2.41	2.00	4.42	2.02	500	2184.23	2186	1.8
366	C-3	12635	5467.6	25.0	3143	2174.0	2178.79	4.79	11.0	8.71	2196.23	29.16	33.52	3.29	0.015	17.95	2.41	2.00	4.45	2.04	500	2183.24	2185	1.8
367	C-3	12610	5492.6	4.0	3143	2173.1	2177.91	4.77	11.0	8.71	2195.54	29.09	33.7	3.32	0.015	18.13	2.42	2.00	4.47	2.05	500	2182.38	2184.14	1.8
368	C-3	12606	5496.6	30.0	3143	2173.0	2177.77	4.77	11.0	8.71	2195.43	29.08	33.73	3.32	0.015	18.17	2.42	2.00	4.47	2.05	500	2182.24	2184	1.8
369	C-3	12576	5526.6	29.0	3143	2172.0	2176.75	4.75	11.0	8.71	2194.59	29.01	33.9	3.34	0.015	18.34	2.42	2.00	4.50	2.07	500	2181.25	2183	1.8
370	C-3	12547	5555.6	30.0	3143	2171.0	2175.74	4.74	11.0	8.71	2193.77	28.94	34.08	3.36	0.015	18.53	2.43	2.00	4.52	2.09	500	2180.26	2182	1.7
371	C-3	12517	5584.7	7.0	3143	2170.0	2174.72	4.72	11.0	8.71	2192.91	28.89	34.23	3.38	0.015	18.69	2.44	2.00	4.54	2.10	500	2179.26	2181	1.7
372	C-3	12510	5591.7	22.0	3143	2169.8	2174.48	4.72	11.0	8.71	2192.71	28.87	34.27	3.39	0.015	18.74	2.44	2.00	4.54	2.11	500	2179.02	2180.76	1.7
373	C-3	12488	5613.7	30.0	3143	2169.0	2173.71	4.71	11.0	8.71	2192.08	28.83	34.39	3.4	0.015	18.86	2.44	2.00	4.56	2.12	500	2178.27	2180	1.7
374	C-3	12458	5643.7	29.0	3143	2168.0	2172.7	4.7	11.0	8.71	2191.2	28.78	34.52	3.42	0.015	19.00	2.45	2.00	4.58	2.13	500	2177.28	2179	1.7
375	C-3	12429	5672.7	19.0	3143	2167.0	2171.68	4.68	11.0	8.71	2190.34	28.73	34.67	3.44	0.015	19.16	2.45	2.00	4.59	2.14	500	2176.27	2178	1.7
376	C-3	12410	5691.7	11.0	3143	2166.4	2171.04	4.67	11.0	8.71	2189.78	28.7	34.74	3.45	0.015	19.24	2.45	2.00	4.60	2.15	500	2175.64	2177.37	1.7
377	C-3	12399	5702.7	29.0	3143	2166.0	2170.67	4.67	11.0	8.71	2189.45	28.69	34.78	3.45	0.015	19.28	2.45	2.00	4.61	2.16	500	2175.28	2177	1.7
378	C-3	12370	5731.7	29.0	3143	2165.0	2169.66	4.66	11.0	8.71	2188.58	28.64	34.91	3.47	0.015	19.42	2.46	2.00	4.63	2.17	500	2174.29	2176	1.7
379	C-3	12341	5760.7	30.0	3143	2164.0	2168.65	4.65	11.0	8.71	2187.7	28.6	35.03	3.48	0.015	19.55	2.46	2.00	4.64	2.18	500	2173.29	2175	1.7
380	C-3	12311	5790.7	1.0	3143	2163.0	2167.64	4.64	11.0	8.71	2186.79	28.57	35.11	3.5	0.015	19.64	2.46	2.00	4.65	2.19	500	2172.29	2174	1.7
381	C-3	12310	5791.7	31.0	3143	2163.0	2167.61	4.64	11.0	8.71	2186.74	28.57	35.1	3.49	0.015	19.63	2.46	2.00	4.65	2.19	500	2172.26	2173.97	1.7
382	C-3	12279	5822.7	36.0	3143	2162.0	2166.64	4.64	11.0	8.71	2185.81	28.56	35.14	3.5	0.015	19.67	2.47	2.00	4.66	2.19	500	2171.30	2173	1.7
383	C-3	12243	5858.7	33.0	3143	2161.0	2165.65	4.65	11.0	8.71	2184.68	28.6	35.01	3.48	0.015	19.53	2.46	2.00	4.64	2.18	500	2170.29	2172	1.7
384	C-3	12210	5891.7	10.0	3143	2160.2	2164.91	4.68	11.0	8.71	2183.6	28.72	34.69	3.44	0.015	19.19	2.45	2.00	4.60	2.15	500	2169.51	2171.23	1.7
385	C-3	12200	5901.5	58.0	3143	2160.0	2164.69	4.69	11.0	8.71	2183.28	28.75	34.6	3.43	0.015	19.09	2.45	2.00	4.59	2.14	500	2169.28	2171	1.7
386	C-3	12142	5959.5	32.0	3143	2159.0	2163.78	4.78	11.0	8.71	2181.36	29.11	33.65	3.31	0.015	18.08	2.42	2.00	4.46	2.05	500	2168.24	2170	1.8
387	C-3	12110	5991.5	55.0	3143	2158.6	2163.48	4.85	11.0	8.71	2180.29	29.4	32.9	3.22	0.015	17.31	2.39	2.00	4.37	1.98	500	2167.85	2169.63	1.8
388	C-3	12055	6046.5	45.0	3625	2158.0	2163.53	5.53	11.0	9.27	2178.54	32.14	31.09	2.88	0.015	15.51	2.37	2.00	4.30	1.93	500	2167.83	2169	1.2
389	C-3	12010	6091.5	46.0	3625	2157.5	2163.12	5.61	11.0	9.27	2177.5	32.45	30.43	2.8	0.015	14.88	2.35	2.00	4.22	1.87	500	2167.34	2168.51	1.2
390	C-3	11964	6137.5	54.0	3625	2157.0	2162.69	5.69	11.0	9.27	2176.5	32.75	29.82	2.73	0.015	14.31	2.33	2.00	4.14	1.81	500	2166.83	2168	1.2
391	C-3	11910	6191.5	37.0	3625	2156.4	2162.17	5.76	11.0	9.27	2175.41	33.07	29.19	2.65	0.015	13.73	2.31	2.00	4.06	1.75	500	2166.23	2167.41	1.2
392	C-3	11873	6228.5	63.0	3625	2156.0	2161.82	5.82	11.0	9.27	2174.7	33.27	28.8	2.61	0.015	13.38	2.30	2.00	4.01	1.71	500	2165.83	2167	1.2
393	C-3	11810	6291.5	28.0	3625	2155.3	2161.21	5.9	11.0	9.27	2173.55	33.59	28.2	2.54	0.015	12.85	2.27	2.00	3.93	1.66	500	2165.14	2166.31	1.2
394	C-3	11782	6318.8	72.0	3625	2155.0	2160.93	5.93	11.0	9.27	2173.07	33.72	27.97	2.51	0.015	12.65	2.27	2.00	3.90	1.64	500	2164.83	2166	1.2
395	C-3	11710	6390.8	19.0	3625	2154.2	2160.21	6	11.0	9.27	2171.9	34.02	27.43	2.45	0.015	12.18	2.25	2.00	3.84	1.59	500	2164.05	2165.21	1.2
396	C-3	11691	6409.8	81.0	3625	2154.0	2160.02	6.02	11.0	9.27	2171.61	34.08	27.32	2.44	0.015	12.09	2.24	2.00	3.82	1.58	500	2163.84	2165	1.2
397	C-3	11610	6490.8	10.0	3625	2153.1	2159.2	6.09	11.0	9.27	2170.4	34.35	26.86	2.39	0.015	11.70	2.23	2.00	3.77	1.54	500	2162.97	2164.11	1.1
398	C-3	11600	6500.8	90.0	3625	2153.0	2159.09	6.09	11.0	9.27	2170.26	34.37	26.81	2.38	0.015	11.66	2.22	2.00	3.76	1.53	500	2162.85	2164	1.2
399	C-3	11510	6590.8	81.0	3625	2152.0	2158.15	6.15	11.0	9.27	2169	34.6	26.44	2.34	0.015	11.36	2.21	2.00	3.71	1.50	500	2161.86	2163	1.1
400	C-3	11429	6671.8	19.0	3625	2151.0	2157.16	6.16	11.0	9.27	2167.97	34.63	26.39	2.33	0.015	11.31	2.21	2.00	3.71	1.50	500	2160.87	2162	1.1
401	C-3	11410	6690.8	56.0	3625	2150.8	2156.9	6.15	11.0	9.27	2167.72	34.62	26.4	2.34	0.015	11.32	2.21	2.00	3.71	1.50	500	2160.61	2161.75	1.1
402	C-3	11354	6746.5	44.0	3625	2150.0	2156.15	6.15	11.0	9.27	2167.01	34.59	26.45	2.34	0.015	11.36	2.21	2.00	3.71	1.50	500	2159.86	2161	1.1
403	C-3	11310	6790.5	28.0	3625	2149.4	2155.53	6.14	11.0	9.27	2166.45	34.55	26.52	2.35	0.015	11.42	2.21	2.00	3.72	1.51	500	2159.25	2160.39	1.1
404	C-3	11282	6818.5	71.0	3625	2149.0	2155.13	6.13	11.0	9.27	2166.09	34.52	26.56	2.35	0.015	11.45	2.22	2.00	3.73	1.51	500	2158.86	2160	1.1
405	C-3	11211	6889.5	1.0	3625	2148.0	2154.11	6.11	11.0	9.27	2165.16	34.46	26.68	2.37	0.015	11.55	2.22	2.00	3.74	1.52	500	2157.85	2159	1.1
406	C-3	11210	6890.5	71.0	3625	2148.0	2154.1	6.11	11.0	9.27	2165.15	34.46	26.67	2.37	0.015	11.54	2.22	2.00	3.74	1.52	500	2157.84	2158.99	1.1
407	C-3	11139	6961.5	29.0	3625	2147.0	2153.1	6.1	11.0	9.27	2164.21	34.41	26.75	2.38	0.015	11.61	2.22	2.00	3.75	1.53	500	2156.85	2158	1.1
408	C-3	11110	6990.6	42.0	3625	2146.6	2152.69	6.1	11.0	9.27	2163.83	34.39	26.78	2.38	0.015	11.64	2.22	2.00	3.76	1.53	500	2156.45	2157.59	1.1
409	C-3	11068	7032.6	58.0	3625	2146.0	2152.09	6.09	11.0	9.27	2163.27	34.36	26.84	2.39	0.015	11.69	2.23	2.00	3.76	1.54	500	2155.85	2157	1.1
410	C-3	11010	7090.6	13.0	3625	2145.2	2151.28	6.09	11.0	9.27	2162.5	34.33	26.89	2.39	0.015	11.73	2.23	2.00	3.77	1.54	500	2155.05	2156.19	1.1
411	C-3	10996	7103.6	64.0	3625	2145.0	2151.08	6.08	11.0	9.27	2162.32	34.32	26.91	2.39	0.015	11.74	2.23	2.00	3.77	1.54	500	2154.85	2156	1.1
412	C-3	10932	7167.6	22																				



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Sunrise Mountain Landfill Hydraulics Verification - Rockfall Basin																							
2	Reach	River Sta	Plan Sta.	Segment Length	Bulk Flow	Min Ch Elev	W.S. Elev	Flow Depth	Min. Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	BANK Elev	Excess Bank Freeboard
3				(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(MSL)	(ft)
424	C-3	10625	7474.1	15.0	3790	2135.0	2141.88	6.88	11.0	10.76	2155.8	22.89	29.95	2.24	0.015	14.43	2.42	2.00	3.70	1.28	500	2145.58	2146	0.4
425	C-3	10610	7489.1	15.0	3790	2134.5	2141.1	6.6	11.0	10.77	2155.51	18.85	30.47	2.09	0.015	14.92	2.43	2.00	3.52	1.09	500	2144.62	2145.5	0.9
426	C-3	10595	7504.4	21.0	3790	2134.0	2140.07	6.07	11.0	10.34	2155.2	20	31.21	2.23	0.015	15.63	2.42	2.00	3.63	1.21	500	2143.70	2145	1.3
427	ROCKFALL	10574	7525.1	15.0	3790	2133.0	2138.94	5.94	7.0	10.34	2154.77	20	31.93	2.31	0.015	16.33	2.45	2.00	2.45	-	NA	2138.94	2140	1.1
428	ROCKFALL	10559	7540.1	12.0	3790	2132.0	2137.79	5.79	7.0	10.34	2154.41	20	32.71	2.4	0.015	17.11	2.47	2.00	2.47	-	NA	2137.79	2139	1.2
429	ROCKFALL	10547	7552.1	12.0	3790	2131.0	2136.66	5.66	7.0	10.34	2154.09	20	33.51	2.48	0.015	17.94	2.49	2.00	2.49	-	NA	2136.66	2138	1.3
430	ROCKFALL	10535	7564.1	9.0	3790	2130.0	2135.53	5.53	7.0	10.34	2153.76	20	34.26	2.57	0.015	18.73	2.51	2.00	2.51	-	NA	2135.53	2137	1.5
431	ROCKFALL	10526	7573.1	16.0	3790	2129.0	2134.41	5.41	7.0	10.34	2153.47	20	35.04	2.66	0.015	19.57	2.54	2.00	2.54	-	NA	2134.41	2136	1.6
432	ROCKFALL	10510	7589.1	2.0	3790	2127.2	2132.44	5.22	7.0	10.34	2152.93	20	36.32	2.8	0.015	20.98	2.58	2.00	2.58	-	NA	2132.44	2134.22	1.8
433	ROCKFALL	10508	7591.1	16.0	3790	2127.0	2132.2	5.2	7.0	10.34	2152.86	20	36.48	2.82	0.015	21.16	2.58	2.00	2.58	-	NA	2132.20	2134	1.8
434	ROCKFALL	10492	7607.1	13.0	3790	2125.0	2130.01	5.01	7.0	10.34	2152.26	20	37.85	2.98	0.015	22.75	2.62	2.00	2.62	-	NA	2130.01	2132	2.0





Sunrise Mountain Landfill Hydraulics Verification - West Basin																						
Reach	River Sta	Plan Sta.	Segment Length	Clear Flow	Min Ch Elev	W.S. Elev	Flow Depth	Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	Excess Bank Freeboard
			(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(ft)
C-W2A	597	1170	25	337	1991.9	1993.26	1.36	5.0	2.71	1999.18	15.43	19.53	3.25	0.015	6.42	1.54	2.00	2.91	0.91	200	1996.17	0.7
C-W2A	572	1195	25	337	1991.4	1992.81	1.41	5.0	2.71	1998.19	15.65	18.62	3.05	0.015	5.88	1.52	2.00	2.84	0.84	200	1995.65	0.7
C-W2A	547	1220	25	337	1990.9	1992.36	1.46	5.0	2.71	1997.35	15.82	17.93	2.9	0.015	5.49	1.51	2.00	2.79	0.79	200	1995.15	0.8
C-W2A	522	1245	25	337	1990.4	1991.89	1.49	5.0	2.71	1996.6	15.96	17.42	2.79	0.015	5.21	1.50	2.00	2.75	0.75	200	1994.64	0.8
C-W2A	497	1270	25	337	1989.9	1991.42	1.52	5.0	2.71	1995.92	16.07	17.02	2.7	0.015	5.00	1.49	2.00	2.72	0.72	200	1994.14	0.8
C-W2A	472	1295	25	337	1989.4	1990.94	1.54	5.0	2.71	1995.29	16.16	16.75	2.64	0.015	4.86	1.48	2.00	2.70	0.70	200	1993.64	0.8
C-W2A	447	1320	25	337	1989	1990.58	1.58	5.0	2.71	1994.68	16.31	16.25	2.54	0.015	4.60	1.47	2.00	2.67	0.67	200	1993.25	0.8
C-W2A	422	1345	25	337	1988.6	1990.21	1.61	5.0	2.71	1994.13	16.42	15.89	2.46	0.015	4.42	1.47	2.00	2.64	0.64	200	1992.85	0.7
C-W2A	397	1370	25	337	1988.2	1989.83	1.63	5.0	2.71	1993.61	16.52	15.6	2.4	0.015	4.28	1.46	2.00	2.62	0.62	200	1992.45	0.7
C-W2A	372	1395	25	337	1987.8	1989.45	1.65	5.0	2.71	1993.13	16.59	15.39	2.36	0.015	4.18	1.45	2.00	2.61	0.61	200	1992.06	0.7
C-W2A	347	1420	25	337	1987.5	1989.19	1.69	5.0	2.71	1992.64	16.76	14.91	2.26	0.015	3.95	1.44	2.00	2.58	0.58	200	1991.77	0.7
C-W2A	322	1445	25	337	1987.3	1989.06	1.76	5.0	2.71	1992.17	17.04	14.15	2.11	0.015	3.61	1.43	2.00	2.53	0.53	200	1991.59	0.7
C-W2A	297	1470	25	337	1987	1988.78	1.78	5.0	2.71	1991.8	17.12	13.95	2.07	0.015	3.52	1.42	2.00	2.52	0.52	200	1991.30	0.7
C-W2A	272	1495	25	337	1986.8	1988.64	1.84	5.0	2.71	1991.42	17.37	13.37	1.96	0.015	3.28	1.41	2.00	2.48	0.48	200	1991.12	0.7
C-W2A	247	1520	25	337	1986.5	1988.34	1.84	5.0	2.71	1991.12	17.37	13.37	1.96	0.015	3.28	1.41	2.00	2.48	0.48	200	1990.82	0.7
C-W2A	222	1545	25	337	1986.3	1988.19	1.89	5.0	2.71	1990.78	17.58	12.91	1.87	0.015	3.09	1.40	2.00	2.45	0.45	200	1990.64	0.7
C-W2A	197	1570	25	337	1986	1987.88	1.88	5.0	2.71	1990.51	17.53	13	1.88	0.015	3.12	1.40	2.00	2.46	0.46	200	1990.34	0.7
C-W2A	172	1595	25	337	1985.8	1987.73	1.93	5.0	2.71	1990.2	17.71	12.62	1.81	0.015	2.97	1.39	2.00	2.44	0.44	200	1990.17	0.6
C-W2A	147	1620	25	337	1985.5	1987.41	1.91	5.0	2.71	1989.94	17.65	12.75	1.84	0.015	3.02	1.40	2.00	2.45	0.45	200	1989.86	0.6
C-W2A	122	1645	25	337	1985.3	1987.25	1.95	5.0	2.71	1989.65	17.8	12.43	1.78	0.015	2.90	1.39	2.00	2.43	0.43	200	1989.68	0.6
C-W2A	97	1670	25	337	1985	1986.93	1.93	5.0	2.71	1989.4	17.71	12.62	1.81	0.015	2.97	1.39	2.00	2.44	0.44	200	1989.37	0.6
C-W2A	72	1695	25	337	1984.8	1986.76	1.96	5.0	2.71	1989.13	17.85	12.34	1.76	0.015	2.86	1.39	2.00	2.42	0.42	200	1989.18	0.6
C-W2A	47	1720	25	337	1984.5	1986.44	1.94	5.0	2.71	1988.88	17.74	12.55	1.8	0.015	2.95	1.39	2.00	2.43	0.43	200	1988.87	0.6
C-W2A	22	1745	21.72	337	1984.3	1986.26	1.96	5.0	2.71	1988.63	17.84	12.34	1.76	0.015	2.86	1.39	2.00	2.42	0.42	200	1988.68	0.6
C-W2A	0	1767		337	1984	1985.93	1.93	5.0	2.71	1988.4	17.71	12.62	1.81	0.015	2.97	1.39	2.00	2.44	0.44	200	1988.37	0.6





Sunrise Mountain Landfill Hydraulics Verification - Southeast Basin																						
Reach	River Sta	Plan Sta.	Segment Length	Clear Flow	Min Ch Elev	W.S. Elev	Flow Depth	Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	Excess Bank Freeboard
			(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(ft)
ROADBERM1	4310.00	0.00	20	122.1	2159.44	2160.25	0.81	2.5	1.22	2161.93	28.79	10.41	2.88	0.016	2.18	1.24	na	1.24	-	NA	2161.49	0.4
ROADBERM1	4290.00	20.00	25	122.1	2157.68	2158.42	0.74	2.5	1.21	2160.82	26.36	12.42	3.58	0.016	2.90	1.28	na	1.28	-	NA	2159.70	0.5
ROADBERM1	4265.00	45.00	25	122.1	2155.47	2156.19	0.72	3.0	1.22	2158.94	25.46	13.31	3.91	0.016	3.25	1.30	na	1.30	-	NA	2157.49	1.0
ROADBERM1	4240.00	70.00	25	122.1	2153.27	2153.98	0.71	3.0	1.21	2156.86	25.19	13.6	4.01	0.016	3.37	1.30	na	1.30	-	NA	2155.28	1.0
ROADBERM1	4215.00	95.00	25	122.1	2151.07	2151.78	0.71	3.0	1.22	2154.69	25.1	13.69	4.05	0.016	3.41	1.31	na	1.31	-	NA	2153.09	1.0
ROADBERM1	4190.00	120.00	25	122.1	2148.87	2149.58	0.71	3.0	1.21	2152.5	25.08	13.72	4.06	0.016	3.42	1.31	na	1.31	-	NA	2150.89	1.0
ROADBERM1	4165.00	145.00	30	122.1	2146.67	2147.38	0.71	3.0	1.22	2150.31	25.06	13.74	4.07	0.016	3.43	1.31	na	1.31	-	NA	2148.69	1.0
ROADBERM1	4135.00	175.00	20	122.1	2144.03	2144.73	0.7	3.0	1.21	2147.67	25.06	13.74	4.07	0.016	3.43	1.30	na	1.30	-	NA	2146.03	1.0
ROADBERM1	4115.00	195.00	25	122.1	2142.26	2142.97	0.71	3.0	1.22	2145.9	25.07	13.73	4.06	0.016	3.43	1.31	na	1.31	-	NA	2144.28	1.0
ROADBERM1	4090.00	220.00	28.7	122.1	2140.13	2140.85	0.72	3.0	1.21	2143.72	25.19	13.6	4.01	0.016	3.37	1.30	na	1.30	-	NA	2142.15	1.0
ROADBERM1	4061.00	248.70	24.28	122.1	2137.95	2138.68	0.73	3.0	1.22	2141.32	25.71	13.05	3.81	0.016	3.14	1.29	na	1.97	0.68	200	2140.65	0.3
ROADBERM1	4037.00	272.98	25	122.1	2136.47	2137.22	0.75	3.0	1.21	2139.53	26.61	12.18	3.5	0.016	2.80	1.28	na	1.89	0.61	200	2139.11	0.4
ROADBERM1	4012.00	297.98	25	122.1	2135.29	2136.08	0.79	3.0	1.22	2138	27.83	11.14	3.13	0.016	2.43	1.26	na	1.79	0.54	200	2137.87	0.4
ROADBERM1	3987.00	322.98	24.59	122.1	2134.3	2135.11	0.81	3.0	1.21	2136.79	28.81	10.39	2.87	0.016	2.18	1.24	na	1.73	0.48	200	2136.84	0.5
ROADBERM1	3962.00	347.57	23.47	122.1	2133.3	2134.12	0.82	3.0	1.22	2135.76	28.95	10.28	2.83	0.016	2.14	1.24	na	1.72	0.48	200	2135.84	0.5
ROADBERM1	3939.00	371.04	25	122.1	2132.31	2133.13	0.82	3.0	1.22	2134.8	28.82	10.39	2.87	0.016	2.18	1.24	na	1.73	0.48	200	2134.86	0.5
ROADBERM1	3914.00	396.04	25	122.1	2131.32	2132.14	0.82	3.0	1.22	2133.76	29.06	10.22	2.81	0.016	2.12	1.24	na	1.71	0.47	200	2133.85	0.5
ROADBERM1	3889.00	421.04	25	122.1	2130.33	2131.15	0.82	3.0	1.22	2132.77	29.05	10.22	2.81	0.016	2.12	1.24	na	1.71	0.47	200	2132.86	0.5
ROADBERM1	3864.00	446.04	25	122.1	2129.33	2130.16	0.83	3.0	1.21	2131.78	29.05	10.22	2.81	0.016	2.12	1.24	na	1.71	0.47	200	2131.87	0.5
ROADBERM1	3839.00	471.04	25	122.1	2128.34	2129.16	0.82	3.0	1.22	2130.79	29.05	10.22	2.81	0.016	2.12	1.24	na	1.71	0.47	200	2130.87	0.5
ROADBERM1	3814.00	496.04	27.44	122.1	2127.35	2128.17	0.82	3.0	1.22	2129.79	29.06	10.22	2.81	0.016	2.12	1.24	na	1.71	0.47	200	2129.88	0.5
ROADBERM1	3787.00	523.48	26.29	122.1	2126.27	2127.09	0.82	3.0	1.22	2128.7	29.12	10.17	2.79	0.016	2.11	1.24	na	1.71	0.47	200	2128.80	0.5
ROADBERM1	3760.00	549.77	23.85	122.1	2125.22	2126.04	0.82	3.0	1.21	2127.66	29.07	10.21	2.81	0.016	2.12	1.24	na	1.71	0.47	200	2127.75	0.5
ROADBERM1	3736.00	573.62	23.85	122.1	2124.29	2125.12	0.83	3.0	1.22	2126.71	29.17	10.14	2.78	0.016	2.10	1.24	na	1.70	0.47	200	2126.82	0.5
ROADBERM1	3713.00	597.47	23.85	122.1	2123.39	2124.22	0.83	3.0	1.21	2125.79	29.31	10.04	2.75	0.016	2.07	1.24	na	1.69	0.46	200	2125.91	0.5
ROADBERM1	3689.00	621.32	28.62	122.1	2122.51	2123.35	0.84	3.0	1.22	2124.89	29.44	9.95	2.72	0.016	2.04	1.23	na	1.69	0.45	200	2125.04	0.5
ROADBERM1	3660.00	649.94	23.85	122.1	2121.46	2122.3	0.84	3.0	1.21	2123.82	29.5	9.91	2.7	0.016	2.02	1.23	na	1.68	0.45	200	2123.98	0.5
ROADBERM1	3636.00	673.79	23.85	122.1	2120.59	2121.43	0.84	3.0	1.22	2122.94	29.55	9.88	2.69	0.016	2.02	1.23	na	1.68	0.45	200	2123.11	0.5
ROADBERM1	3612.00	697.64	23.85	122.1	2119.78	2120.63	0.85	3.0	1.21	2122.08	29.87	9.67	2.62	0.016	1.95	1.23	na	1.66	0.43	200	2122.29	0.5
ROADBERM1	3589.00	721.49	23.85	122.1	2119.04	2119.89	0.85	3.0	1.22	2121.26	30.31	9.39	2.53	0.016	1.87	1.22	na	1.64	0.41	200	2121.53	0.5
ROADBERM1	3565.00	745.34	28.62	122.1	2118.36	2119.23	0.87	3.0	1.21	2120.51	30.82	9.08	2.42	0.016	1.78	1.22	na	1.61	0.39	200	2120.84	0.5
ROADBERM1	3536.00	773.96	23.85	122.1	2117.61	2118.5	0.89	3.0	1.22	2119.68	31.28	8.72	2.3	0.016	1.68	1.21	na	1.58	0.37	200	2120.08	0.5
ROADBERM1	3512.00	797.81	23.85	122.1	2117	2117.89	0.89	3.0	1.21	2119.07	31.28	8.72	2.3	0.016	1.68	1.21	na	1.58	0.37	200	2119.47	0.5
ROADBERM1	3488.00	821.66	23.85	122.1	2116.39	2117.28	0.89	3.0	1.22	2118.46	31.28	8.72	2.3	0.016	1.68	1.21	na	1.58	0.37	200	2118.86	0.5
ROADBERM1	3465.00	845.51	28.62	122.1	2115.78	2116.67	0.89	3.0	1.21	2117.84	31.29	8.67	2.28	0.016	1.67	1.21	na	1.57	0.37	200	2118.24	0.5
ROADBERM1	3436.00	874.13	23.85	122.1	2115.15	2116.06	0.91	3.0	1.22	2117.12	31.33	8.28	2.13	0.016	1.56	1.20	na	1.53	0.33	200	2117.59	0.6
ROADBERM1	3412.00	897.98	23.85	122.1	2114.72	2115.66	0.94	3.0	1.21	2116.61	31.39	7.82	1.95	0.016	1.45	1.19	na	1.49	0.30	200	2117.15	0.6
ROADBERM1	3388.00	921.83	23.85	122.1	2114.38	2115.36	0.98	3.0	1.22	2116.19	31.47	7.29	1.76	0.016	1.33	1.18	na	1.44	0.26	200	2116.80	0.6
ROADBERM1	3364.00	945.68	28.62	122.1	2114.12	2115.14	1.02	3.0	1.21	2115.85	31.56	6.74	1.57	0.016	1.21	1.17	na	1.39	0.22	200	2116.53	0.6
ROADBERM1	3336.00	974.30	25.56	122.1	2113.82	2114.85	1.03	3.0	1.22	2115.54	31.58	6.65	1.54	0.016	1.19	1.17	na	1.38	0.22	200	2116.23	0.6
ROADBERM1	3310.00	999.86	22.8	122.1	2113.55	2114.58	1.03	3.0	1.21	2115.27	31.58	6.65	1.54	0.016	1.19	1.17	na	1.38	0.22	200	2115.96	0.6
ROADBERM1	3287.00	1022.66	25	122.1	2113.24	2114.24	1	3.0	1.22	2115	31.52	6.96	1.65	0.016	1.25	1.17	na	1.41	0.24	200	2115.65	0.6
ROADBERM1	3262.00	1047.66	25	122.1	2112.72	2113.66	0.94	3.0	1.21	2114.61	31.4	7.8	1.95	0.016	1.44	1.19	na	1.49	0.30	200	2115.15	0.6
ROADBERM1	3237.00	1072.66	26.8	122.1	2112.01	2112.91	0.9	3.0	1.22	2114.06	31.29	8.63	2.26	0.016	1.66	1.21	na	1.57	0.36	200	2114.48	0.5
ROADBERM1	3211.00	1099.46	23.2	122.1	2111.04	2111.9	0.86	3.0	1.21	2113.28	30.23	9.44	2.54	0.016	1.88	1.22	na	1.64	0.42	200	2113.54	0.5
ROADBERM1	3187.00	1122.66	25	122.1	2110.1	2110.94	0.84	3.0	1.22	2112.46	29.54	9.89	2.7	0.016	2.02	1.23	na	1.68	0.45	200	2112.62	0.5
ROADBERM1	3162.00	1147.66	25	122.1	2109.1	2109.92	0.82	3.0	1.21	2111.51	29.21	10.11	2.77	0.016	2.09	1.24	na	1.70	0.46	200	2111.62	0.5
ROADBERM1	3137.00	1172.66	25	122.1	2108.09	2108.91	0.82	3.0	1.22	2110.52	29.11	10.18	2.79	0.016	2.11	1.24	na	1.71	0.47	200	2110.62	0.5
ROADBERM1	3112.00	1197.66	25	122.1	2107.08	2107.9	0.82	3.0	1.21	2109.53	29.03	10.24	2.82	0.016	2.13	1.24	na	1.71	0.47	200	2109.61	0.5
ROADBERM1	3087.00	1222.66	25	122.1	2106.07	2106.9	0.83	3.0	1.22	2108.53	29.02	10.25	2.82	0.016	2.13	1.24	na	1.71	0.47	200	2108.61	0.5
ROADBERM1	3062.00	1247.66	25	122.1	2105.07	2105.89	0.82	3.0	1.21	2107.52	29	10.26	2.82	0.016	2.13	1.24	na	1.71	0.47	200	2107.60	0.5
ROADBERM1	3037.00	1272.66	25.51	122.1	2104.06	2104.88	0.82	3.0	1.22	2106.52	29	10.26	2.82	0.016	2.13	1.24	na	1.71	0.47	200	2106.59	0.5
ROADBERM1	3012.00	1298.17	25.91	122.1	2103.05	2103.88	0.83	3.0	1.21	2105.49	29.09	10.2	2.8	0.016	2.12	1.24						

Sunrise Mountain Landfill Hydraulics Verification - Southeast Basin																						
Reach	River Sta	Plan Sta.	Segment Length (ft)	Clear Flow (cfs)	Min Ch Elev (MSL)	W.S. Elev (MSL)	Flow Depth (ft)	Channel Depth (ft)	Critical Depth (ft)	E.G. Elev (MSL)	Top Width (ft)	Vel Chnl (ft/s)	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB (ft)	Controlling FB (ft)	Max Super Elevation (ft)	Min Curve Radius 50 ft min	Req FB Elev (MSL)	Excess Bank Freeboard (ft)
ROADBERM1	2913.00	1396.62	25.91	122.1	2098.26	2099.02	0.76	3.0	1.21	2101.15	27.15	11.71	3.33	0.016	2.63	1.27	na	1.85	0.58	200	2100.87	0.4
ROADBERM1	2888.00	1422.53	25.91	122.1	2096.27	2097.01	0.74	3.0	1.22	2099.48	26.16	12.6	3.65	0.016	2.97	1.28	na	1.93	0.64	200	2098.94	0.3
ROADBERM1	2862.00	1448.44	25.91	122.1	2093.98	2094.7	0.72	3.0	1.21	2097.49	25.38	13.4	3.94	0.016	3.29	1.30	na	2.01	0.71	200	2096.71	0.3
ROADBERM1	2836.00	1474.35	24.26	122.1	2091.63	2092.34	0.71	3.0	1.22	2095.27	25.07	13.73	4.06	0.016	3.43	1.31	na	2.04	0.73	200	2094.38	0.2
ROADBERM1	2811.00	1498.61	21.59	122.1	2089.43	2090.13	0.7	3.0	1.21	2093.11	24.97	13.84	4.1	0.016	3.47	1.31	na	2.05	0.74	200	2092.18	0.3
ROADBERM1	2790.00	1520.20	25	122.1	2087.4	2088.1	0.7	3.0	1.22	2091.14	24.83	14	4.16	0.016	3.54	1.31	na	2.07	0.76	200	2090.17	0.2
ROADBERM1	2765.00	1545.20	25	122.1	2085.04	2085.75	0.71	3.0	1.21	2088.81	24.77	14.06	4.18	0.016	3.57	1.31	na	2.07	0.76	200	2087.82	0.2
ROADBERM1	2740.00	1570.20	25	122.1	2082.69	2083.39	0.7	3.0	1.22	2086.47	24.75	14.09	4.19	0.016	3.58	1.31	na	2.08	0.76	200	2085.47	0.2
ROADBERM1	2715.00	1595.20	25	122.1	2080.34	2081.04	0.7	3.0	1.21	2084.12	24.75	14.09	4.19	0.016	3.58	1.31	na	2.08	0.76	200	2083.12	0.2
ROADBERM1	2690.00	1620.20	25	122.1	2077.99	2078.69	0.7	3.0	1.22	2081.77	24.75	14.09	4.19	0.016	3.58	1.31	na	2.08	0.76	200	2080.77	0.2
ROADBERM1	2665.00	1645.20	25	122.1	2075.64	2076.34	0.7	3.0	1.21	2079.42	24.75	14.09	4.19	0.016	3.58	1.31	na	2.08	0.76	200	2078.42	0.2
ROADBERM1	2640.00	1670.20	25	122.1	2073.31	2074.01	0.7	3.0	1.22	2077.08	24.78	14.05	4.18	0.016	3.57	1.31	na	2.07	0.76	200	2076.08	0.2
ROADBERM1	2615.00	1695.20	28.49	122.1	2070.99	2071.69	0.7	3.0	1.21	2074.75	24.8	14.03	4.17	0.016	3.56	1.31	na	2.07	0.76	200	2073.76	0.2
ROADBERM1	2586.00	1723.69	22.55	122.1	2068.36	2069.07	0.71	3.0	1.22	2072.1	24.84	13.98	4.16	0.016	3.53	1.31	na	2.07	0.75	200	2071.14	0.2
ROADBERM1	2564.00	1746.24	26.21	122.1	2066.39	2067.09	0.7	3.0	1.21	2070.04	25.03	13.77	4.08	0.016	3.44	1.31	na	2.04	0.74	200	2069.13	0.3
ROADBERM1	2538.00	1772.45	26.21	122.1	2064.09	2064.79	0.7	3.0	1.22	2067.72	25.07	13.73	4.06	0.016	3.43	1.30	na	2.04	0.73	200	2066.83	0.3
ROADBERM1	2511.00	1798.66	26.21	122.1	2061.79	2062.49	0.7	3.0	1.21	2065.42	25.07	13.73	4.06	0.016	3.43	1.30	na	2.04	0.73	200	2064.53	0.3
ROADBERM1	2485.00	1824.87	20.97	122.1	2059.49	2060.2	0.71	3.0	1.22	2063.12	25.07	13.73	4.06	0.016	3.43	1.31	na	2.04	0.73	200	2062.24	0.2
ROADBERM1	2464.00	1845.84	26.21	122.1	2057.65	2058.36	0.71	3.0	1.21	2061.28	25.07	13.73	4.06	0.016	3.43	1.31	na	2.04	0.73	200	2060.40	0.2
ROADBERM1	2438.00	1872.05	26.21	122.1	2055.35	2056.06	0.71	3.0	1.22	2058.98	25.07	13.73	4.06	0.016	3.43	1.31	na	2.04	0.73	200	2058.10	0.2
ROADBERM1	2412.00	1898.26	26.21	122.1	2053.05	2053.76	0.71	3.0	1.21	2056.68	25.07	13.73	4.06	0.016	3.43	1.31	na	2.04	0.73	200	2055.80	0.2
ROADBERM1	2386.00	1924.47	20.97	122.1	2050.75	2051.46	0.71	3.0	1.22	2054.38	25.07	13.73	4.06	0.016	3.43	1.31	na	2.04	0.73	200	2053.50	0.2
ROADBERM1	2365.00	1945.44	26.21	122.1	2048.91	2049.62	0.71	3.0	1.21	2052.54	25.07	13.73	4.06	0.016	3.43	1.31	na	2.04	0.73	200	2051.66	0.2
ROADBERM1	2338.00	1971.65	20.77	122.1	2046.71	2047.43	0.72	3.0	1.22	2050.26	25.27	13.51	3.98	0.016	3.33	1.30	na	2.02	0.72	200	2049.45	0.3
ROADBERM 1A	2318.00	1992.42	29.43	219.2	2045.29	2046.26	0.97	3.5	1.59	2049.02	31.45	13.34	3.25	0.016	3.26	1.33	na	2.20	0.87	200	2048.46	0.3
ROADBERM 1A	2288.00	2021.85	24.81	219.2	2045.29	2046.48	1.19	3.5	1.59	2047.84	31.92	9.38	1.93	0.016	1.87	1.25	na	1.68	0.44	200	2048.16	0.6
ROADBERM 1A	2263.00	2046.66	27.82	219.2	2044.64	2045.78	1.14	3.5	1.59	2047.37	31.8	10.14	2.17	0.016	2.10	1.26	na	1.77	0.51	200	2047.55	0.6
ROADBERM 1A	2236.00	2074.48	23.19	219.2	2044.01	2045.13	1.12	3.5	1.59	2046.79	31.78	10.33	2.23	0.016	2.16	1.27	na	1.79	0.53	200	2046.92	0.6
ROADBERM 1A	2212.00	2097.67	23.19	219.2	2043.37	2044.47	1.1	3.5	1.59	2046.25	31.72	10.71	2.35	0.016	2.28	1.28	na	1.84	0.56	200	2046.31	0.6
ROADBERM 1A	2189.00	2120.86	27.82	219.2	2042.23	2043.25	1.02	3.5	1.59	2045.52	31.57	12.1	2.81	0.016	2.77	1.30	na	2.02	0.72	200	2045.27	0.5
ROADBERM 1A	2161.00	2148.68	23.19	219.2	2040.32	2041.27	0.95	3.5	1.59	2044.22	31.41	13.79	3.42	0.016	3.45	1.34	na	2.27	0.93	200	2043.54	0.3
ROADBERM 1A	2138.00	2171.87	27.82	219.2	2038.75	2039.69	0.94	3.5	1.59	2042.84	31.38	14.26	3.59	0.016	3.66	1.35	na	2.34	0.99	200	2042.03	0.2
ROADBERM 1A	2110.00	2199.69	23.19	219.2	2037.26	2038.21	0.95	3.5	1.59	2041.16	31.41	13.79	3.42	0.016	3.45	1.34	na	2.27	0.93	200	2040.48	0.3
ROADBERM 1A	2087.00	2222.88	23.19	219.2	2036.35	2037.34	0.99	3.5	1.59	2039.89	31.49	12.82	3.07	0.016	3.05	1.32	na	2.12	0.80	200	2039.46	0.4
ROADBERM 1A	2064.00	2246.07	27.82	219.2	2035.76	2036.8	1.04	3.5	1.59	2038.9	31.62	11.62	2.65	0.016	2.60	1.29	na	1.96	0.66	200	2038.76	0.5
ROADBERM 1A	2036.00	2273.89	23.19	219.2	2035.3	2036.43	1.13	3.5	1.59	2038.05	31.79	10.22	2.19	0.016	2.12	1.27	na	1.78	0.52	200	2038.21	0.6
ROADBERM 1A	2013.00	2297.08	27.82	219.2	2034.93	2036.09	1.16	3.5	1.59	2037.56	31.86	9.74	2.04	0.016	1.97	1.26	na	1.73	0.47	200	2037.82	0.6
ROADBERM 1A	1985.00	2324.90	23.19	219.2	2034.48	2035.65	1.17	3.5	1.59	2037.05	31.9	9.5	1.97	0.016	1.90	1.25	na	1.70	0.45	200	2037.35	0.6
ROADBERM 1A	1962.00	2348.09	23.19	219.2	2034.1	2035.28	1.18	3.5	1.59	2036.68	31.9	9.5	1.97	0.016	1.90	1.25	na	1.70	0.45	200	2036.98	0.6
ROADBERM 1A	1939.00	2371.28	23.92	219.2	2033.73	2034.9	1.17	3.5	1.59	2036.3	31.9	9.5	1.97	0.016	1.90	1.25	na	1.70	0.45	200	2036.60	0.6
ROADBERM 1A	1915.00	2395.20	25	219.2	2033.35	2034.53	1.18	3.5	1.59	2035.92	31.91	9.44	1.95	0.016	1.88	1.25	na	1.69	0.44	200	2036.22	0.6
ROADBERM 1A	1890.00	2420.20	25	219.2	2032.98	2034.17	1.19	3.5	1.59	2035.51	31.93	9.32	1.91	0.016	1.85	1.25	na	1.68	0.43	200	2035.85	0.6
ROADBERM 1A	1865.00	2445.20	25	219.2	2032.6	2033.8	1.2	3.5	1.59	2035.13	31.94	9.28	1.9	0.016	1.84	1.25	na	1.67	0.43	200	2035.47	0.6
ROADBERM 1A	1840.00	2470.20	25	219.2	2032.23	2033.42	1.19	3.5	1.59	2034.76	31.94	9.28	1.9	0.016	1.84	1.25	na	1.67	0.43	200	2035.09	0.6
ROADBERM 1A	1815.00	2495.20	25	219.2	2031.85	2033.05	1.2	3.5	1.59	2034.38	31.94	9.28	1.9	0.016	1.84	1.25	na	1.67	0.43	200	2034.72	0.6
ROADBERM 1A	1790.00	2520.20	25	219.2	2031.48	2032.67	1.19	3.5	1.59	2034.01	31.94	9.28	1.9	0.016	1.84	1.25	na	1.67	0.43	200	2034.34	0.6
ROADBERM 1A	1765.00	2545.20	25	219.2	2031.1	2032.3	1.2	3.5	1.59	2033.63	31.94	9.28	1.9	0.016	1.84	1.25	na	1.67	0.43	200	2033.97	0.6
ROADBERM 1A	1740.00	2570.20	25	219.2	2030.73	2031.92	1.19	3.5	1.59	2033.26	31.94	9.28	1.9	0.016	1.84	1.25	na	1.67	0.43	200	2033.59	0.6
ROADBERM 1A	1715.00	2595.20	25	219.2	2030.35	2031.55	1.2	3.5	1.59	2032.88	31.94	9.28	1.9	0.016	1.84	1.25	na	1.67	0.43	200	2033.22	0.6
ROADBERM 1A	1690.00	2620.20	25	219.2	2029.97	2031.16	1.19	3.5	1.59	2032.5	31.94	9.28	1.9	0.016	1.84	1.25	na	1.67	0.43	200	2032.83	0.6
ROADBERM 1A	1665.00	2645.20	25	219.2	2029.51	2030.69	1.18	3.5	1.59	2032.09	31.9	9.51	1.97	0.016	1.90	1.25	na	1.70	0.45	200	2032.39	0.6
ROADBERM 1A	1640.00	2670.20	25	219.2	2028.97	2030.11	1.14	3.5	1.59	2031.64	31.84	9.91	2.1	0.016	2.02	1.26	na	1.74	0.49	200	2031.85	0.6
ROADBERM 1A	1615.00	2695.20	25	219.2	2028.32																	

Sunrise Mountain Landfill Hydraulics Verification - Southeast Basin																						
Reach	River Sta	Plan Sta.	Segment Length	Clear Flow	Min Ch Elev	W.S. Elev	Flow Depth	Channel Depth	Critical Depth (ft)	E.G. Elev	Top Width	Vel Chnl	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB	Controlling FB	Max Super Elevation	Min Curve Radius	Req FB Elev	Excess Bank Freeboard
			(ft)	(cfs)	(MSL)	(MSL)	(ft)	(ft)		(MSL)	(ft)	(ft/s)					(ft)	(ft)	(ft)	50 ft min	(MSL)	(ft)
ROADBERM 1A	1515.00	2795.20	25	219.2	2025.34	2026.4	1.06	3.5	1.59	2028.4	31.65	11.34	2.56	0.016	2.50	1.29	na	1.92	0.63	200	2028.32	0.5
ROADBERM 1A	1490.00	2820.20	25	219.2	2024.59	2025.65	1.06	3.5	1.59	2027.67	31.64	11.4	2.58	0.016	2.52	1.29	na	1.93	0.64	200	2027.58	0.5
ROADBERM 1A	1465.00	2845.20	25	219.2	2023.84	2024.9	1.06	3.5	1.59	2026.92	31.64	11.42	2.58	0.016	2.53	1.29	na	1.93	0.64	200	2026.83	0.5
ROADBERM 1A	1440.00	2870.20	25	219.2	2023.09	2024.15	1.06	3.5	1.59	2026.18	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2026.08	0.5
ROADBERM 1A	1415.00	2895.20	25	219.2	2022.34	2023.4	1.06	3.5	1.59	2025.43	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2025.33	0.5
ROADBERM 1A	1390.00	2920.20	25	219.2	2021.59	2022.65	1.06	3.5	1.59	2024.68	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2024.58	0.5
ROADBERM 1A	1365.00	2945.20	25	219.2	2020.84	2021.9	1.06	3.5	1.59	2023.93	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2023.83	0.5
ROADBERM 1A	1340.00	2970.20	25	219.2	2020.09	2021.15	1.06	3.5	1.59	2023.18	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2023.08	0.5
ROADBERM 1A	1315.00	2995.20	25	219.2	2019.34	2020.4	1.06	3.5	1.59	2022.43	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2022.33	0.5
ROADBERM 1A	1290.00	3020.20	25	219.2	2018.59	2019.65	1.06	3.5	1.59	2021.68	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2021.58	0.5
ROADBERM 1A	1265.00	3045.20	25	219.2	2017.84	2018.9	1.06	3.5	1.59	2020.93	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2020.83	0.5
ROADBERM 1A	1240.00	3070.20	25	219.2	2017.09	2018.15	1.06	3.5	1.59	2020.18	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2020.08	0.5
ROADBERM 1A	1215.00	3095.20	25	219.2	2016.34	2017.4	1.06	3.5	1.59	2019.43	31.64	11.44	2.59	0.016	2.53	1.29	na	1.93	0.64	200	2019.33	0.5
ROADBERM 1A	1190.00	3120.20	25	219.2	2015.57	2016.62	1.05	3.5	1.59	2018.67	31.63	11.47	2.6	0.016	2.54	1.29	na	1.94	0.65	200	2018.56	0.5
ROADBERM 1A	1165.00	3145.20	25	219.2	2014.77	2015.82	1.05	3.5	1.59	2017.89	31.62	11.56	2.63	0.016	2.58	1.29	na	1.95	0.66	200	2017.77	0.5
ROADBERM 1A	1140.00	3170.20	25	219.2	2013.93	2014.98	1.05	3.5	1.59	2017.09	31.61	11.68	2.67	0.016	2.62	1.30	na	1.97	0.67	200	2016.95	0.5
ROADBERM 1A	1115.00	3195.20	25	219.2	2013.07	2014.1	1.03	3.5	1.59	2016.27	31.59	11.81	2.72	0.016	2.67	1.30	na	1.98	0.68	200	2016.08	0.5
ROADBERM 1A	1090.00	3220.20	25	219.2	2012.17	2013.2	1.03	3.5	1.59	2015.41	31.58	11.94	2.76	0.016	2.71	1.30	na	2.00	0.70	200	2015.20	0.5
ROADBERM 1A	1065.00	3245.20	25	219.2	2011.24	2012.27	1.03	3.5	1.59	2014.53	31.57	12.07	2.8	0.016	2.76	1.30	na	2.02	0.71	200	2014.29	0.5
ROADBERM 1A	1040.00	3270.20	25	219.2	2010.28	2011.3	1.02	3.5	1.59	2013.61	31.55	12.2	2.85	0.016	2.81	1.31	na	2.04	0.73	200	2013.34	0.4
ROADBERM 1A	1015.00	3295.20	25	219.2	2009.29	2010.3	1.01	3.5	1.59	2012.66	31.54	12.32	2.89	0.016	2.86	1.31	na	2.05	0.74	200	2012.35	0.4
ROADBERM 1A	990.00	3320.20	25	219.2	2008.29	2009.3	1.01	3.5	1.59	2011.68	31.54	12.39	2.91	0.016	2.88	1.31	na	2.06	0.75	200	2011.36	0.4
ROADBERM 1A	965.00	3345.20	25	219.2	2007.29	2008.3	1.01	3.5	1.59	2010.7	31.53	12.43	2.93	0.016	2.90	1.31	na	2.07	0.76	200	2010.37	0.4
ROADBERM 1A	940.00	3370.20	25	219.2	2006.33	2007.34	1.01	3.5	1.59	2009.72	31.54	12.38	2.91	0.016	2.88	1.31	na	2.06	0.75	200	2009.40	0.4
ROADBERM 1A	915.00	3395.20	25	219.2	2005.42	2006.44	1.02	3.5	1.59	2008.75	31.56	12.19	2.85	0.016	2.81	1.31	na	2.03	0.73	200	2008.47	0.4
ROADBERM 1A	890.00	3420.20	25	219.2	2004.56	2005.59	1.03	3.5	1.59	2007.82	31.58	11.98	2.77	0.016	2.73	1.30	na	2.01	0.70	200	2007.60	0.5
ROADBERM 1A	865.00	3445.20	25	219.2	2003.76	2004.8	1.04	3.5	1.59	2006.94	31.6	11.76	2.7	0.016	2.65	1.30	na	1.98	0.68	200	2006.78	0.5
ROADBERM 1A	840.00	3470.20	25	219.2	2003.01	2004.06	1.05	3.5	1.59	2006.12	31.63	11.53	2.62	0.016	2.56	1.29	na	1.95	0.65	200	2006.01	0.5
ROADBERM 1A	815.00	3495.20	25	219.2	2002.31	2003.37	1.06	3.5	1.59	2005.35	31.65	11.28	2.54	0.016	2.48	1.29	na	1.91	0.63	200	2005.28	0.5
ROADBERM 1A	790.00	3520.20	29.82	219.2	2001.66	2002.74	1.08	3.5	1.59	2004.62	31.68	11.03	2.45	0.016	2.39	1.28	na	1.88	0.60	200	2004.62	0.5
ROADBERM 1A	760.00	3550.02	23.55	219.2	2000.95	2002.04	1.09	3.5	1.59	2003.83	31.72	10.74	2.36	0.016	2.29	1.28	na	1.84	0.57	200	2003.88	0.6
ROADBERM 1A	737.00	3573.57	23.55	219.2	2000.37	2001.46	1.09	3.5	1.59	2003.25	31.72	10.74	2.36	0.016	2.29	1.28	na	1.84	0.57	200	2003.30	0.6
ROADBERM 1A	713.00	3597.12	23.55	219.2	1999.79	2000.89	1.1	3.5	1.59	2002.67	31.72	10.72	2.35	0.016	2.28	1.28	na	1.84	0.57	200	2002.73	0.6
ROADBERM 1A	689.00	3620.67	28.26	219.2	1999.21	2000.31	1.1	3.5	1.59	2002.1	31.72	10.74	2.36	0.016	2.29	1.28	na	1.85	0.57	200	2002.16	0.6
ROADBERM 1A	661.00	3648.93	23.55	219.2	1998.49	1999.58	1.09	3.5	1.59	2001.4	31.71	10.81	2.38	0.016	2.31	1.28	na	1.85	0.58	200	2001.43	0.6
ROADBERM 1A	638.00	3672.48	24.18	219.2	1997.77	1998.83	1.06	3.5	1.59	2000.77	31.67	11.18	2.5	0.016	2.44	1.28	na	1.90	0.61	200	2000.73	0.5
ROADBERM 1A	613.00	3696.66	25	219.2	1996.9	1997.95	1.05	3.5	1.59	2000.04	31.62	11.62	2.65	0.016	2.60	1.30	na	1.96	0.66	200	1999.91	0.5
ROADBERM 1A	588.00	3721.66	25	219.2	1995.9	1996.93	1.03	3.5	1.59	1999.19	31.57	12.06	2.8	0.016	2.76	1.30	na	2.02	0.71	200	1998.95	0.5
ROADBERM 1A	563.00	3746.66	25	219.2	1994.77	1995.77	1	3.5	1.59	1998.21	31.52	12.54	2.97	0.016	2.94	1.31	na	2.08	0.77	200	1997.85	0.4
ROADBERM 1A	538.00	3771.66	25	219.2	1993.5	1994.48	0.98	3.5	1.59	1997.11	31.48	13.02	3.14	0.016	3.13	1.32	na	2.15	0.83	200	1996.63	0.4
ROADBERM 1A	513.00	3796.66	25	219.2	1992.1	1993.06	0.96	3.5	1.59	1995.88	31.44	13.48	3.3	0.016	3.32	1.33	na	2.22	0.89	200	1995.28	0.3
ROADBERM 1A	488.00	3821.66	25	219.2	1990.56	1991.5	0.94	3.5	1.59	1994.5	31.4	13.91	3.46	0.016	3.50	1.34	na	2.28	0.94	200	1993.78	0.3
ROADBERM 1A	463.00	3846.66	25	219.2	1988.9	1989.84	0.94	3.5	1.59	1993	31.37	14.28	3.6	0.016	3.67	1.35	na	2.34	0.99	200	1992.18	0.2
ROADBERM 1A	438.00	3871.66	25	219.2	1987.24	1988.17	0.93	3.5	1.59	1991.41	31.36	14.45	3.66	0.016	3.74	1.35	na	2.37	1.02	200	1990.54	0.2
ROADBERM 1A	413.00	3896.66	25	219.2	1985.58	1986.5	0.92	3.5	1.59	1989.79	31.36	14.54	3.69	0.016	3.78	1.35	na	2.38	1.03	200	1988.88	0.2
ROADBERM 1A	388.00	3921.66	25	219.2	1984.02	1984.95	0.93	3.5	1.59	1988.15	31.37	14.35	3.62	0.016	3.70	1.35	na	2.35	1.00	200	1987.30	0.2
ROADBERM 1A	363.00	3946.66	25	219.2	1982.74	1983.7	0.96	3.5	1.59	1986.61	31.42	13.68	3.38	0.016	3.41	1.34	na	2.25	0.91	200	1985.95	0.3
ROADBERM 1A	338.00	3971.66	25	219.2	1981.75	1982.74	0.99	3.5	1.59	1985.28	31.5	12.79	3.06	0.016	3.04	1.32	na	2.12	0.80	200	1984.86	0.4
ROADBERM 1A	313.00	3996.66	25	219.2	1981.04	1982.08	1.04	3.5	1.59	1984.22	31.6	11.75	2.69	0.016	2.64	1.30	na	1.98	0.68	200	1984.06	0.5
ROADBERM 1A	288.00	4021.66	25	219.2	1980.51	1981.6	1.09	3.5	1.59	1983.42	31.71	10.82	2.39	0.016	2.32	1.28	na	1.85	0.58	200	1983.45	0.6
ROADBERM 1A	263.00	4046.66	25	219.2	1979.98	1981.1	1.12	3.5	1.59	1982.79	31.76	10.45	2.27	0.016	2.20	1.27	na	1.81	0.54	200	1982.91	0.6
ROADBERM 1A	238.00	4071.66	25	219.2	1979.46	1980.58	1.12	3.5	1.59	1982.22	31.78	10.28	2.21	0.016	2.14	1.27	na	1.79	0.52	200	1982.37	0.6
ROADBERM 1A	213.00	4096.66																				

Sunrise Mountain Landfill Hydraulics Verification - Southeast Basin																						
Reach	River Sta	Plan Sta.	Segment Length (ft)	Clear Flow (cfs)	Min Ch Elev (MSL)	W.S. Elev (MSL)	Flow Depth (ft)	Channel Depth (ft)	Critical Depth (ft)	E.G. Elev (MSL)	Top Width (ft)	Vel Chnl (ft/s)	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB (ft)	Controlling FB (ft)	Max Super Elevation (ft)	Min Curve Radius 50 ft min	Req FB Elev (MSL)	Excess Bank Freeboard (ft)
ROADBERM 1A	112.00	4198.32	21.45	219.2	1976.42	1977.5	1.08	3.5	1.59	1979.35	31.7	10.92	2.42	0.016	2.35	1.28	na	1.87	0.59	200	1979.37	0.6
ROADBERM 1A	90.00	4219.77	26.81	219.2	1975.78	1976.85	1.07	3.5	1.59	1978.78	31.67	11.14	2.49	0.016	2.43	1.28	na	1.90	0.61	200	1978.75	0.5
ROADBERM 1A	64.00	4246.58	26.81	219.2	1974.96	1976.02	1.06	3.5	1.59	1978.01	31.65	11.33	2.55	0.016	2.49	1.29	na	1.92	0.63	200	1977.94	0.5
ROADBERM 1A	37.00	4273.39	21.45	219.2	1974.14	1975.19	1.05	3.5	1.59	1977.21	31.64	11.4	2.58	0.016	2.52	1.29	na	1.93	0.64	200	1977.12	0.5
ROADBERM 1A	15.00	4294.84	15.28	219.2	1973.48	1974.53	1.05	3.5	1.59	1976.57	31.63	11.47	2.6	0.016	2.54	1.29	na	1.94	0.65	200	1976.47	0.5
ROADBERM 1A	0.00	4310.12		219.2	1973.01	1974.06	1.05	3.5	1.59	1976.11	31.63	11.49	2.61	0.016	2.55	1.29	na	1.94	0.65	200	1976.00	0.5
Road/Berm 2	1693.21	115.00	39.41	72.6	2153.4	2154.17	0.75	2.5	1.16	2155.39	16.04	8.85	2.18	0.018	1.72	1.20	na	1.40	0.20	200	2155.57	0.4
Road/Berm 2	1653.80	154.41	39.15	72.6	2149.5	2150.12	0.58	2.5	1.18	2152.67	15.69	12.8	3.75	0.018	3.04	1.27	na	1.67	0.40	200	2151.79	0.3
Road/Berm 2	1614.65	193.56	43.41	72.6	2145.1	2145.68	0.57	2.5	1.15	2148.47	15.66	13.39	4.01	0.018	3.28	1.28	na	1.71	0.44	200	2147.39	0.2
Road/Berm 2	1571.24	236.97	39.77	72.6	2140.2	2140.77	0.57	2.5	1.15	2143.59	15.65	13.48	4.05	0.018	3.32	1.28	na	1.72	0.44	200	2142.49	0.2
Road/Berm 2	1531.47	276.74	40.00	72.6	2135.8	2136.37	0.57	2.5	1.16	2139.17	15.66	13.43	4.03	0.018	3.30	1.28	na	1.72	0.44	200	2138.09	0.2
Road/Berm 2	1491.47	316.74	40.00	72.6	2130.5	2131.03	0.54	2.5	1.14	2134.22	15.61	14.32	4.43	0.018	3.68	1.29	na	1.79	0.50	200	2132.82	0.2
Road/Berm 2	1451.47	356.74	55.00	72.6	2124.5	2125.08	0.54	2.5	1.15	2128.41	15.6	14.64	4.58	0.018	3.83	1.30	na	1.82	0.52	200	2126.90	0.1
Road/Berm 2	1396.47	411.74	34.77	72.6	2116.4	2116.91	0.54	2.5	1.15	2120.24	15.59	14.65	4.58	0.018	3.83	1.30	na	1.82	0.52	200	2118.73	0.1
Road/Berm 2	1361.70	446.51	54.61	72.6	2111.2	2111.71	0.54	2.5	1.15	2115.07	15.59	14.71	4.61	0.018	3.86	1.30	na	1.82	0.52	200	2113.53	0.1
Road/Berm 2	1307.09	501.12	44.68	72.6	2103.1	2103.59	0.54	2.5	1.11	2106.94	15.59	14.7	4.6	0.018	3.86	1.30	na	1.82	0.52	200	2105.41	0.1
Road/Berm 2	1262.41	545.80	49.65	72.6	2096.5	2097.01	0.54	2.5	1.15	2100.33	15.6	14.63	4.57	0.018	3.82	1.30	na	1.82	0.52	200	2098.83	0.1
Road/Berm 2	1212.76	595.45	44.68	72.6	2089.2	2089.72	0.54	2.5	1.15	2093.04	15.6	14.63	4.57	0.018	3.82	1.30	na	1.82	0.52	200	2091.54	0.1
Road/Berm 2	1168.08	640.13	44.68	72.6	2083.4	2084	0.56	2.5	1.15	2086.84	15.65	13.53	4.07	0.018	3.34	1.28	na	1.72	0.44	200	2085.72	0.2
Road/Berm 2	1123.40	684.81	34.75	72.6	2079.3	2079.86	0.59	2.5	1.16	2082.36	15.7	12.69	3.71	0.018	3.00	1.27	na	1.66	0.39	200	2081.52	0.3
Road/Berm 2	1088.65	719.57	39.91	72.6	2076.1	2076.67	0.59	2.5	1.16	2079.15	15.7	12.64	3.68	0.018	2.98	1.27	na	1.65	0.39	200	2078.32	0.3
Road/Berm 2	1048.74	759.47	45.00	72.6	2072.4	2073.03	0.59	2.5	1.16	2075.51	15.7	12.65	3.69	0.018	2.98	1.27	na	1.66	0.39	200	2074.69	0.3
Road/Berm 2	1003.74	804.47	40.00	72.6	2068.3	2068.93	0.59	2.5	1.16	2071.41	15.7	12.64	3.68	0.018	2.98	1.27	na	1.65	0.39	200	2070.58	0.3
Road/Berm 2	963.74	844.47	30.09	72.6	2064.7	2065.29	0.59	2.5	1.14	2067.77	15.7	12.65	3.69	0.018	2.98	1.27	na	1.66	0.39	200	2066.95	0.3
Road/Berm 2	933.64	874.57	45.16	72.6	2061.9	2062.47	0.59	2.5	1.14	2064.98	15.7	12.73	3.72	0.018	3.02	1.27	na	1.66	0.40	200	2064.13	0.2
Road/Berm 2	888.48	919.73	45.16	72.6	2057.3	2057.84	0.57	2.5	1.15	2060.5	15.68	13.09	3.88	0.018	3.16	1.27	na	1.69	0.42	200	2059.53	0.2
Road/Berm 2	843.32	964.89	40.14	72.6	2052.2	2052.79	0.57	2.5	1.15	2055.59	15.66	13.42	4.02	0.018	3.30	1.28	na	1.72	0.44	200	2054.51	0.2
Road/Berm 2	803.18	1005.03	45.16	72.6	2047.4	2048	0.56	2.5	1.15	2050.94	15.64	13.76	4.18	0.018	3.44	1.28	na	1.74	0.46	200	2049.74	0.2
Road/Berm 2	758.02	1050.19	30.11	72.6	2041.2	2041.71	0.55	2.5	1.16	2044.97	15.6	14.5	4.51	0.018	3.76	1.30	na	1.81	0.51	200	2043.52	0.1
Road/Berm 2	727.92	1080.29	35.12	72.6	2036.5	2036.98	0.53	2.5	1.16	2040.44	15.58	14.92	4.7	0.018	3.96	1.30	na	1.84	0.54	200	2038.82	0.1
Road/Berm 2	692.79	1115.42	35.09	72.6	2030.8	2031.31	0.53	2.5	1.15	2034.82	15.58	15.04	4.76	0.018	4.01	1.30	na	1.85	0.55	200	2033.16	0.1
Road/Berm 2	657.71	1150.50	35.00	72.6	2025.1	2025.64	0.53	2.5	1.15	2029.15	15.58	15.03	4.76	0.018	4.01	1.30	na	1.85	0.55	200	2027.49	0.1
Road/Berm 2	622.71	1185.50	35.00	72.6	2019.8	2020.34	0.54	2.5	1.16	2023.66	15.6	14.62	4.57	0.018	3.82	1.30	na	1.82	0.52	200	2022.16	0.1
Road/Berm 2	587.71	1220.50	35.00	72.6	2015.3	2015.84	0.55	2.5	1.15	2018.82	15.63	13.85	4.22	0.018	3.48	1.28	na	1.75	0.47	200	2017.59	0.2
Road/Berm 2	552.71	1255.50	45.00	72.6	2011.6	2012.15	0.58	2.5	1.15	2014.8	15.68	13.06	3.87	0.018	3.15	1.27	na	1.69	0.42	200	2013.84	0.2
Road/Berm 2	507.71	1300.50	30.55	72.6	2007.2	2007.82	0.59	2.5	1.16	2010.4	15.69	12.9	3.8	0.018	3.08	1.27	na	1.68	0.41	200	2009.50	0.2
Road/Berm 2	477.16	1331.05	46.06	72.6	2004.3	2004.92	0.58	2.5	1.16	2007.47	15.69	12.79	3.75	0.018	3.04	1.27	na	1.67	0.40	200	2006.59	0.3
Road/Berm 2	431.10	1377.11	30.71	72.6	1999.9	2000.44	0.58	2.5	1.16	2003.03	15.69	12.93	3.81	0.018	3.10	1.27	na	1.68	0.41	200	2002.12	0.2
Road/Berm 2	400.39	1407.82	46.06	72.6	1996.6	1997.19	0.58	2.5	1.16	1999.88	15.67	13.17	3.91	0.018	3.19	1.27	na	1.70	0.42	200	1998.89	0.2
Road/Berm 2	354.33	1453.88	30.71	72.6	1991.4	1991.92	0.56	2.5	1.16	1994.77	15.65	13.53	4.07	0.018	3.34	1.28	na	1.72	0.44	200	1993.64	0.2
Road/Berm 2	323.62	1484.59	35.83	72.6	1987.8	1988.4	0.57	2.5	1.16	1991.22	15.65	13.47	4.05	0.018	3.32	1.28	na	1.72	0.44	200	1990.12	0.2
Road/Berm 2	287.79	1520.42	40.94	72.6	1984.5	1985.11	0.59	2.5	1.15	1987.5	15.72	12.4	3.58	0.018	2.89	1.26	na	1.64	0.38	200	1986.75	0.3
Road/Berm 2	246.85	1561.36	35.83	72.6	1982.0	1982.63	0.65	2.5	1.16	1984.43	15.84	10.76	2.9	0.018	2.30	1.23	na	1.52	0.28	200	1984.15	0.3
Road/Berm 2	211.03	1597.19	35.83	72.6	1980.6	1981.34	0.71	2.5	1.18	1982.76	15.96	9.56	2.44	0.018	1.92	1.21	na	1.44	0.23	200	1982.78	0.4
Road/Berm 2	175.20	1633.01	5.12	72.6	1979.1	1979.75	0.7	2.5	1.15	1981.24	15.93	9.81	2.54	0.018	1.99	1.22	na	1.46	0.24	200	1981.21	0.3
Road/Berm 2	170.08	1638.13	3.56	72.6	1978.9	1979.57	0.7	2.5	1.15	1981.03	15.95	9.67	2.48	0.018	1.95	1.21	na	1.45	0.23	200	1981.02	0.4
Road/Berm 2	166.52	1641.69	1.52	72.6	1978.8	1979.58	0.74	2.5	1.15	1980.84	16.02	9.02	2.24	0.018	1.76	1.20	na	1.41	0.20	200	1980.99	0.4
Road/Berm 2	165.00	1643.21	5.00	72.6	1978.8	1979.52	0.73	2.5	1.15	1980.8	16.01	9.08	2.26	0.018	1.78	1.20	na	1.41	0.20	200	1980.93	0.4
Road/Berm 2	160.00	1648.21	5.00	72.6	1978.7	1979.46	0.76	2.5	1.15	1980.61	16.07	8.61	2.1	0.018	1.65	1.20	na	1.38	0.18	200	1980.84	0.4
Road/Berm 2	155.00	1653.21	5.00	72.6	1978.6	1979.4	0.78	2.5	1.15	1980.47	16.1	8.32	1.99	0.018	1.57	1.19	na	1.36	0.17	200	1980.76	0.4
Road/Berm 2	150.00	1658.21		72.6	1978.6	1979.46	0.84	2.5	1.16	1980.31	16.25	7.39	1.68	0.018	1.35	1.17	na	1.31	0.14	200	1980.77	0.3
C-SE1	429.13	4354.40	5.00	297.4	1968.0	1969.4	1.41	3.5	2.08	1971.57	20.64	11.84	1.89	0.03	2.68	1.33	na	1.78	0.45	200	1971.18	0.3
C-SE1	424.13	4359.40	5.00	297.4	1967.9	1969.32	1.47	3.5	2.08	1971.3	20.88	11.28	1.77	0.03	2.48							

Sunrise Mountain Landfill Hydraulics Verification - Southeast Basin																						
Reach	River Sta	Plan Sta.	Segment Length (ft)	Clear Flow (cfs)	Min Ch Elev (MSL)	W.S. Elev (MSL)	Flow Depth (ft)	Channel Depth (ft)	Critical Depth (ft)	E.G. Elev (MSL)	Top Width (ft)	Vel Chnl (ft/s)	Froude # Chl	Mannings N	FB Fr<1	FB Fr>1	>300cfs min FB (ft)	Controlling FB (ft)	Max Super Elevation (ft)	Min Curve Radius 50 ft min	Req FB Elev (MSL)	Excess Bank Freeboard (ft)
C-SE1	404.13	4379.40	5.00	297.4	1967.3	1968.93	1.61	3.5	2.08	1970.54	21.41	10.2	1.54	0.03	2.12	1.30	na	1.64	0.35	200	1970.57	0.2
C-SE1	399.13	4384.40	5.00	297.4	1967.2	1968.8	1.61	3.5	2.08	1970.4	21.44	10.14	1.53	0.03	2.10	1.30	na	1.64	0.34	200	1970.44	0.3
C-SE1	394.13	4389.40	5.00	297.4	1967.1	1968.68	1.62	3.5	2.08	1970.26	21.47	10.08	1.52	0.03	2.08	1.30	na	1.63	0.34	200	1970.31	0.2
C-SE1	389.13	4394.40	5.00	297.4	1966.9	1968.55	1.62	3.5	2.08	1970.12	21.49	10.04	1.51	0.03	2.07	1.29	na	1.63	0.34	200	1970.18	0.2
C-SE1	384.13	4399.40	5.00	297.4	1966.8	1968.42	1.62	3.5	2.08	1969.99	21.49	10.04	1.51	0.03	2.07	1.29	na	1.63	0.34	200	1970.05	0.2
C-SE1	379.13	4404.40	5.00	297.4	1966.7	1968.29	1.63	3.5	2.08	1969.85	21.49	10.04	1.51	0.03	2.07	1.30	na	1.63	0.34	200	1969.92	0.2
C-SE1	374.13	4409.40	5.00	297.4	1966.5	1968.16	1.63	3.5	2.08	1969.72	21.49	10.04	1.51	0.03	2.07	1.30	na	1.63	0.34	200	1969.79	0.2
C-SE1	369.13	4414.40	5.00	297.4	1966.4	1968.02	1.62	3.5	2.08	1969.59	21.49	10.04	1.51	0.03	2.07	1.29	na	1.63	0.34	200	1969.65	0.2
C-SE1	364.13	4419.40	5.00	297.4	1966.3	1967.89	1.62	3.5	2.08	1969.46	21.49	10.04	1.51	0.03	2.07	1.29	na	1.63	0.34	200	1969.52	0.2
C-SE1	359.13	4424.40	5.00	297.4	1966.1	1967.76	1.62	3.5	2.08	1969.33	21.49	10.04	1.51	0.03	2.07	1.29	na	1.63	0.34	200	1969.39	0.2
C-SE1	354.13	4429.40	5.00	297.4	1966.0	1967.63	1.63	3.5	2.08	1969.19	21.49	10.04	1.51	0.03	2.07	1.30	na	1.63	0.34	200	1969.26	0.2
C-SE1	349.13	4434.40	3.42	297.4	1965.9	1967.5	1.63	3.5	2.08	1969.06	21.49	10.04	1.51	0.03	2.07	1.30	na	1.63	0.34	200	1969.13	0.2
C-SE1	345.71	4437.82	2.50	297.4	1965.7	1967.34	1.6	3.5	2.08	1968.96	21.4	10.22	1.54	0.03	2.12	1.30	na	1.65	0.35	200	1968.99	0.3
C-SE1	343.21	4440.32	4.08	297.4	1965.7	1967.32	1.63	3.5	2.08	1968.88	21.5	10.03	1.5	0.03	2.06	1.30	na	1.63	0.34	200	1968.95	0.2
C-SE1	339.13	4444.40	5.00	297.4	1965.6	1967.27	1.66	3.5	2.08	1968.75	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1968.88	0.2
C-SE1	334.13	4449.40	5.00	297.4	1965.5	1967.14	1.66	3.5	2.08	1968.62	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1968.75	0.2
C-SE1	329.13	4454.40	5.00	297.4	1965.4	1967.01	1.66	3.5	2.08	1968.49	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1968.62	0.2
C-SE1	324.13	4459.40	5.00	297.4	1965.2	1966.88	1.66	3.5	2.08	1968.37	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1968.49	0.2
C-SE1	319.13	4464.40	5.00	297.4	1965.1	1966.75	1.66	3.5	2.08	1968.24	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1968.36	0.2
C-SE1	314.13	4469.40	5.00	297.4	1965.0	1966.62	1.65	3.5	2.08	1968.11	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1968.23	0.2
C-SE1	309.13	4474.40	5.00	297.4	1964.8	1966.5	1.66	3.5	2.08	1967.99	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1968.11	0.2
C-SE1	304.13	4479.40	5.00	297.4	1964.7	1966.37	1.65	3.5	2.08	1967.86	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1967.98	0.2
C-SE1	299.13	4484.40	5.00	297.4	1964.6	1966.25	1.66	3.5	2.08	1967.74	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1967.86	0.2
C-SE1	294.13	4489.40	5.00	297.4	1964.5	1966.13	1.66	3.5	2.08	1967.62	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1967.74	0.2
C-SE1	289.13	4494.40	5.00	297.4	1964.4	1966.01	1.66	3.5	2.08	1967.5	21.64	9.79	1.46	0.03	1.99	1.29	na	1.61	0.32	200	1967.62	0.2
C-SE1	284.13	4499.40	5.00	297.4	1964.2	1965.9	1.67	3.5	2.08	1967.37	21.66	9.74	1.45	0.03	1.97	1.29	na	1.61	0.32	200	1967.51	0.2
C-SE1	279.13	4504.40	5.00	297.4	1964.1	1965.78	1.67	3.5	2.08	1967.25	21.66	9.74	1.45	0.03	1.97	1.29	na	1.61	0.32	200	1967.39	0.2
C-SE1	274.13	4509.40	5.00	297.4	1964.0	1965.67	1.68	3.5	2.08	1967.12	21.69	9.69	1.43	0.03	1.96	1.29	na	1.60	0.32	200	1967.27	0.2
C-SE1	269.13	4514.40	5.00	297.4	1963.9	1965.55	1.67	3.5	2.08	1967.01	21.69	9.69	1.43	0.03	1.96	1.29	na	1.60	0.32	200	1967.15	0.2
C-SE1	264.13	4519.40	5.00	297.4	1963.8	1965.44	1.68	3.5	2.08	1966.88	21.73	9.63	1.42	0.03	1.94	1.29	na	1.60	0.31	200	1967.04	0.2
C-SE1	259.13	4524.40	5.00	297.4	1963.7	1965.33	1.68	3.5	2.08	1966.77	21.73	9.63	1.42	0.03	1.94	1.29	na	1.60	0.31	200	1966.93	0.2
C-SE1	254.13	4529.40	5.00	297.4	1963.5	1965.22	1.69	3.5	2.08	1966.65	21.76	9.58	1.41	0.03	1.93	1.29	na	1.60	0.31	200	1966.82	0.2
C-SE1	249.13	4534.40	5.00	297.4	1963.4	1965.12	1.7	3.5	2.08	1966.53	21.79	9.53	1.4	0.03	1.91	1.28	na	1.59	0.31	200	1966.71	0.2
C-SE1	244.13	4539.40	5.00	297.4	1963.3	1965.01	1.7	3.5	2.08	1966.42	21.79	9.53	1.4	0.03	1.91	1.28	na	1.59	0.31	200	1966.60	0.2
C-SE1	239.13	4544.40	5.00	297.4	1963.2	1964.9	1.7	3.5	2.08	1966.3	21.82	9.48	1.39	0.03	1.90	1.28	na	1.59	0.30	200	1966.49	0.2
C-SE1	234.13	4549.40	5.00	297.4	1963.1	1964.8	1.71	3.5	2.08	1966.19	21.82	9.48	1.39	0.03	1.90	1.28	na	1.59	0.30	200	1966.39	0.2
C-SE1	229.13	4554.40	5.00	297.4	1963.0	1964.7	1.72	3.5	2.08	1966.08	21.85	9.43	1.38	0.03	1.88	1.28	na	1.58	0.30	200	1966.28	0.2
C-SE1	224.13	4559.40	5.00	297.4	1962.9	1964.59	1.71	3.5	2.08	1965.97	21.85	9.43	1.38	0.03	1.88	1.28	na	1.58	0.30	200	1966.17	0.2
C-SE1	219.13	4564.40	5.00	297.4	1962.8	1964.49	1.72	3.5	2.08	1965.86	21.88	9.37	1.37	0.03	1.86	1.28	na	1.58	0.30	200	1966.07	0.2
C-SE1	214.13	4569.40	5.00	297.4	1962.7	1964.39	1.72	3.5	2.08	1965.75	21.88	9.37	1.37	0.03	1.86	1.28	na	1.58	0.30	200	1965.97	0.2
C-SE1	209.13	4574.40	5.00	297.4	1962.6	1964.29	1.73	3.5	2.08	1965.64	21.92	9.31	1.36	0.03	1.85	1.28	na	1.57	0.30	200	1965.86	0.2
C-SE1	204.13	4579.40	5.00	297.4	1962.5	1964.2	1.74	3.5	2.08	1965.53	21.95	9.26	1.35	0.03	1.83	1.28	na	1.57	0.29	200	1965.77	0.2
C-SE1	199.13	4584.40	5.00	297.4	1962.4	1964.1	1.74	3.5	2.08	1965.43	21.95	9.26	1.35	0.03	1.83	1.28	na	1.57	0.29	200	1965.67	0.2
C-SE1	194.13	4589.40	5.00	297.4	1962.3	1964.01	1.75	3.5	2.08	1965.32	21.99	9.2	1.34	0.03	1.81	1.28	na	1.57	0.29	200	1965.58	0.2
C-SE1	189.13	4594.40	5.00	297.4	1962.2	1963.91	1.75	3.5	2.08	1965.22	21.99	9.2	1.34	0.03	1.81	1.28	na	1.57	0.29	200	1965.48	0.2
C-SE1	184.13	4599.40	5.00	297.4	1962.1	1963.82	1.76	3.5	2.08	1965.12	22.02	9.15	1.33	0.03	1.80	1.28	na	1.56	0.29	200	1965.38	0.2
C-SE1	179.13	4604.40	5.00	297.4	1962.0	1963.72	1.75	3.5	2.08	1965.02	22.02	9.15	1.33	0.03	1.80	1.28	na	1.56	0.29	200	1965.28	0.2
C-SE1	174.13	4609.40	5.00	297.4	1961.9	1963.64	1.77	3.5	2.08	1964.92	22.06	9.09	1.31	0.03	1.78	1.27	na	1.56	0.28	200	1965.20	0.2
C-SE1	169.13	4614.40	5.00	297.4	1961.8	1963.54	1.76	3.5	2.08	1964.82	22.06	9.09	1.31	0.03	1.78	1.27	na	1.56	0.28	200	1965.10	0.2
C-SE1	164.13	4619.40	5.00	297.4	1961.7	1963.46	1.78	3.5	2.08	1964.72	22.11	9.02	1.3	0.03	1.76	1.27	na	1.55	0.28	200	1965.01	0.2
C-SE1	159.13	4624.40	5.00	297.4	1961.6	1963.37	1.78	3.5	2.08	1964.63	22.11	9.02	1.3	0.03	1.76	1.27	na	1.55	0.28	200	1964.92	0.2
C-SE1	154.13	4629.40	5.00	297.4	1960.8	1962.58	1.79	3.5	2.08	1963.82	22.15	8.95	1.29	0.03	1.74	1.27	na	1.55	0.28	200	1964.13	0.2
C-SE1	149.13	4634.40	3.42	297.4	1959.9	1961.59	1.72	3.5	2.08	1962.95	21.9	9.35	1.37	0.03	1.86	1.28	na	1.58	0.30	200	1963.17	0.2
C-SE1	145.71	4637.82	2.50	297.4	1959.1	1960.9	1.83	3.5														

## ATTACHMENT 2



## Sunrise Mountain Landfill Hydraulics Verification - HydroCAD Berms and Channels

Reach	Segment Length (ft)	Clear Q Inflow (cfs)	Manning N Check for Riprap	Lining	Mannings N	Slope (ft/ft)	Flow Depth (ft)	Bottom Width (ft)	Sideslope	Flow Top Width (ft)	Flow Velocity (ft/s)	Froude # Chl	Freeboard if Fr<1	Freeboard if Fr>1	>300cfs min FB (ft)	Controlling FB (ft)	Minimum Required Berm Height (ft)	Design Berm Height (ft)	Required Riprap d50 (inch)	Design Riprap d50
B-E1	1927.0	357	na	Grouted Riprap	0.03	0.010	3.04	0	2	12.16	6.44	0.65	1.14	1.23	2.00	2.00	5.04	5.50	na	Grouted
B-E1	1927.0	357	na	Grouted Riprap	0.03	0.080	2.06	0	2	8.24	14.06	1.73	3.57	1.45	2.00	2.00	4.06	5.50	na	Grouted
B-W1	1055.0	426	na	Grouted Riprap	0.03	0.010	3.25	0	2	13	6.74	0.66	1.21	1.25	2.00	2.00	5.25	5.50	na	Grouted
B-W1	1055.0	426	na	Grouted Riprap	0.03	0.015	3.01	0	2	12.04	7.84	0.80	1.45	1.28	2.00	2.00	5.01	5.50	na	Grouted
B-TD1	1800.0	174	na	Grouted Riprap	0.03	0.010	2.32	0	2	9.28	5.38	0.62	0.95	1.18	na	0.95	3.27	3.30	na	Grouted
B-TD1	1800.0	174	na	Grouted Riprap	0.03	0.030	1.89	0	2	7.56	8.13	1.04	1.53	1.25	na	1.25	3.14	3.30	na	Grouted
B-TD2	1389.0	138	0.035	Riprap	0.04	0.010	2.37	0	2	9.48	4.09	0.47	0.76	1.14	na	0.76	3.13	3.20	5.4	14.0
B-TD2	1389.0	138	0.041	Riprap	0.04	0.030	1.92	0	2	7.68	6.18	0.79	1.09	1.19	na	1.09	3.01	3.20	13.2	14.0
B-W2	936.0	70	0.032	Riprap	0.035	0.005	2.60	0	2	10.4	3.44	0.38	0.68	1.12	na	0.68	3.28	3.30	3.0	8.0
B-W2	936.0	70	0.033	Riprap	0.035	0.006	2.52	0	2	10.08	3.69	0.41	0.71	1.13	na	0.71	3.23	3.30	3.5	8.0
B-W2	936.0	70	0.033	Riprap	0.035	0.007	2.44	0	2	9.76	3.91	0.44	0.74	1.13	na	0.74	3.18	3.30	3.9	8.0
B-W2	936.0	70	0.034	Riprap	0.035	0.008	2.38	0	2	9.52	4.11	0.47	0.76	1.14	na	0.76	3.14	3.30	4.4	8.0
B-W2	936.0	70	0.034	Riprap	0.035	0.009	2.33	0	2	9.32	4.29	0.50	0.79	1.14	na	0.79	3.12	3.30	4.8	8.0
B-W2	936.0	70	0.035	Riprap	0.035	0.010	2.29	0	2	9.16	4.47	0.52	0.81	1.15	na	0.81	3.10	3.30	5.2	8.0
B-W2	936.0	70	0.035	Riprap	0.035	0.011	2.25	0	2	9	4.63	0.54	0.83	1.15	na	0.83	3.08	3.30	5.7	8.0
B-W2	936.0	70	0.036	Riprap	0.035	0.012	2.21	0	2	8.84	4.78	0.57	0.85	1.16	na	0.85	3.06	3.30	6.1	8.0
B-W2	936.0	70	0.036	Riprap	0.035	0.013	2.18	0	2	8.72	4.93	0.59	0.88	1.16	na	0.88	3.06	3.30	6.5	8.0
B-W2	936.0	70	0.036	Riprap	0.035	0.014	2.15	0	2	8.6	5.07	0.61	0.90	1.16	na	0.90	3.05	3.30	6.9	8.0
B-W2	936.0	70	0.037	Riprap	0.035	0.015	2.12	0	2	8.48	5.20	0.63	0.92	1.17	na	0.92	3.04	3.30	7.3	8.0
B-W3	944.0	87	0.032	Riprap	0.035	0.005	2.82	0	2	11.28	3.63	0.38	0.70	1.13	na	0.70	3.52	3.60	3.2	8.0
B-W3	944.0	87	0.033	Riprap	0.035	0.006	2.73	0	2	10.92	3.89	0.41	0.73	1.14	na	0.73	3.46	3.60	3.8	8.0
B-W3	944.0	87	0.034	Riprap	0.035	0.007	2.65	0	2	10.6	4.12	0.45	0.76	1.14	na	0.76	3.41	3.60	4.2	8.0
B-W3	944.0	87	0.034	Riprap	0.035	0.008	2.59	0	2	10.36	4.33	0.47	0.79	1.15	na	0.79	3.38	3.60	4.7	8.0
B-W3	944.0	87	0.035	Riprap	0.035	0.009	2.53	0	2	10.12	4.53	0.50	0.82	1.15	na	0.82	3.35	3.60	5.2	8.0
B-W3	944.0	87	0.035	Riprap	0.035	0.010	2.48	0	2	9.92	4.71	0.53	0.84	1.16	na	0.84	3.32	3.60	5.7	8.0
B-W3	944.0	87	0.036	Riprap	0.035	0.011	2.44	0	2	9.76	4.88	0.55	0.87	1.16	na	0.87	3.31	3.60	6.1	8.0
B-W3	944.0	87	0.036	Riprap	0.035	0.012	2.40	0	2	9.6	5.05	0.57	0.90	1.17	na	0.90	3.30	3.60	6.6	8.0
B-W3	944.0	87	0.037	Riprap	0.035	0.013	2.36	0	2	9.44	5.20	0.60	0.92	1.17	na	0.92	3.28	3.60	7.0	8.0
B-W3	944.0	87	0.037	Riprap	0.035	0.014	2.33	0	2	9.32	5.35	0.62	0.94	1.18	na	0.94	3.27	3.60	7.5	8.0
B-W3	944.0	87	0.037	Riprap	0.035	0.015	2.30	0	2	9.2	5.49	0.64	0.97	1.18	na	0.97	3.27	3.60	7.9	8.0
B-BP1	490.0	31	0.033	Riprap	0.035	0.010	1.59	0	2	6.36	3.53	0.49	0.69	1.10	na	0.69	2.28	2.50	3.6	9.0
B-BP1	490.0	31	0.036	Riprap	0.035	0.020	1.39	0	2	5.56	4.57	0.68	0.82	1.13	na	0.82	2.21	2.50	6.4	9.0
B-BP1	490.0	31	0.038	Riprap	0.035	0.030	1.29	0	2	5.16	5.32	0.83	0.94	1.14	na	0.94	2.23	2.50	8.9	9.0
B-SW1	1100.0	131	0.032	Riprap	0.035	0.005	2.52	0	2	10.08	3.44	0.38	0.68	1.12	na	0.68	3.20	3.10	2.9	6.0
B-SW1	1100.0	131	0.032	Riprap	0.035	0.006	2.43	0	2	9.72	3.69	0.42	0.71	1.12	na	0.71	3.14	3.10	3.3	6.0
B-SW1	1100.0	131	0.033	Riprap	0.035	0.007	2.36	0	2	9.44	3.91	0.45	0.74	1.13	na	0.74	3.10	3.10	3.8	6.0
B-SW1	1100.0	131	0.034	Riprap	0.035	0.008	2.30	0	2	9.2	4.11	0.48	0.76	1.14	na	0.76	3.06	3.10	4.2	6.0
B-SW1	1100.0	131	0.034	Riprap	0.035	0.009	2.25	0	2	9	4.29	0.50	0.79	1.14	na	0.79	3.04	3.10	4.6	6.0
B-SW1	1100.0	131	0.035	Riprap	0.035	0.010	2.21	0	2	8.84	4.47	0.53	0.81	1.15	na	0.81	3.02	3.10	5.1	6.0
B-SW1	1100.0	131	0.035	Riprap	0.035	0.011	2.17	0	2	8.68	4.63	0.55	0.83	1.15	na	0.83	3.00	3.10	5.5	6.0
B-SW1	1100.0	131	0.035	Riprap	0.035	0.012	2.13	0	2	8.52	4.78	0.58	0.85	1.15	na	0.85	2.98	3.10	5.9	6.0
B-SW2	612.0	21	0.028	Riprap	0.035	0.005	1.27	0	2	5.08	2.18	0.34	0.57	1.06	na	0.57	1.84	2.00	1.5	3.0
B-SW2	612.0	21	0.029	Riprap	0.035	0.006	1.22	0	2	4.88	2.33	0.37	0.58	1.06	na	0.58	1.80	2.00	1.7	3.0
B-SW2	612.0	21	0.029	Riprap	0.035	0.007	1.19	0	2	4.76	2.47	0.40	0.59	1.07	na	0.59	1.78	2.00	1.9	3.0
B-SW2	612.0	21	0.030	Riprap	0.035	0.008	1.16	0	2	4.64	2.60	0.43	0.60	1.07	na	0.60	1.76	2.00	2.1	3.0
B-SW2	612.0	21	0.030	Riprap	0.035	0.009	1.13	0	2	4.52	2.72	0.45	0.61	1.07	na	0.61	1.74	2.00	2.3	3.0
B-SW2	612.0	21	0.031	Riprap	0.035	0.010	1.11	0	2	4.44	2.83	0.47	0.62	1.07	na	0.62	1.73	2.00	2.5	3.0
B-SW2	612.0	21	0.031	Riprap	0.035	0.011	1.09	0	2	4.36	2.93	0.49	0.63	1.08	na	0.63	1.72	2.00	2.7	3.0
B-SW2	612.0	21	0.032	Riprap	0.035	0.012	1.08	0	2	4.32	3.03	0.51	0.64	1.08	na	0.64	1.72	2.00	3.0	3.0
B-SW3	1123.0	115	0.031	Riprap	0.035	0.005	2.40	0	2	9.6	3.34	0.38	0.67	1.11	na	0.67	3.07	3.00	2.7	5.0
B-SW3	1123.0	115	0.032	Riprap	0.035	0.006	2.32	0	2	9.28	3.57	0.41	0.70	1.12	na	0.70	3.02	3.00	3.2	5.0
B-SW3	1123.0	115	0.033	Riprap	0.035	0.007	2.25	0	2	9	3.78	0.44	0.72	1.12	na	0.72	2.97	3.00	3.6	5.0

## Sunrise Mountain Landfill Hydraulics Verification - HydroCAD Berms and Channels

Reach	Segment Length (ft)	Clear Q Inflow (cfs)	Manning N Check for Riprap	Lining	Mannings N	Slope (ft/ft)	Flow Depth (ft)	Bottom Width (ft)	Sideslope	Flow Top Width (ft)	Flow Velocity (ft/s)	Froude # Chl	Freeboard if Fr<1	Freeboard if Fr>1	>300cfs min FB (ft)	Controlling FB (ft)	Minimum Required Berm Height (ft)	Design Berm Height (ft)	Required Riprap d50 (inch)	Design Riprap d50
B-SW3	1123.0	115	0.033	Riprap	0.035	0.008	2.20	0	2	8.8	3.98	0.47	0.75	1.13	na	0.75	2.95	3.00	4.0	5.0
B-SW3	1123.0	115	0.034	Riprap	0.035	0.009	2.15	0	2	8.6	4.16	0.50	0.77	1.13	na	0.77	2.92	3.00	4.4	5.0
B-SW3	1123.0	115	0.034	Riprap	0.035	0.010	2.11	0	2	8.44	4.32	0.52	0.79	1.14	na	0.79	2.90	3.00	4.8	5.0
B-SW4	1135.0	158	0.032	Riprap	0.035	0.005	2.70	0	2	10.8	3.61	0.39	0.70	1.13	na	0.70	3.40	3.50	3.1	6.0
B-SW4	1135.0	158	0.033	Riprap	0.035	0.006	2.61	0	2	10.44	3.87	0.42	0.73	1.13	na	0.73	3.34	3.50	3.6	6.0
B-SW4	1135.0	158	0.033	Riprap	0.035	0.007	2.54	0	2	10.16	4.10	0.45	0.76	1.14	na	0.76	3.30	3.50	4.1	6.0
B-SW4	1135.0	158	0.034	Riprap	0.035	0.008	2.47	0	2	9.88	4.31	0.48	0.79	1.15	na	0.79	3.26	3.50	4.5	6.0
B-SW4	1135.0	158	0.035	Riprap	0.035	0.009	2.42	0	2	9.68	4.50	0.51	0.81	1.15	na	0.81	3.23	3.50	5.0	6.0
B-SW4	1135.0	158	0.035	Riprap	0.035	0.010	2.37	0	2	9.48	4.68	0.54	0.84	1.16	na	0.84	3.21	3.50	5.4	6.0
B-SW4	1135.0	158	0.035	Riprap	0.035	0.011	2.33	0	2	9.32	4.85	0.56	0.87	1.16	na	0.87	3.20	3.50	5.9	6.0
B-SW5	620.0	51	0.030	Riprap	0.035	0.005	1.77	0	2	7.08	2.72	0.36	0.61	1.08	na	0.61	2.38	2.50	2.0	4.0
B-SW5	620.0	51	0.030	Riprap	0.035	0.006	1.71	0	2	6.84	2.91	0.39	0.63	1.09	na	0.63	2.34	2.50	2.3	4.0
B-SW5	620.0	51	0.031	Riprap	0.035	0.007	1.66	0	2	6.64	3.09	0.42	0.65	1.09	na	0.65	2.31	2.50	2.7	4.0
B-SW5	620.0	51	0.032	Riprap	0.035	0.008	1.62	0	2	6.48	3.25	0.45	0.66	1.10	na	0.66	2.28	2.50	3.0	4.0
B-SW5	620.0	51	0.032	Riprap	0.035	0.009	1.58	0	2	6.32	3.39	0.48	0.68	1.10	na	0.68	2.26	2.50	3.3	4.0
B-SW5	620.0	51	0.033	Riprap	0.035	0.010	1.55	0	2	6.2	3.53	0.50	0.69	1.10	na	0.69	2.24	2.50	3.6	4.0
B-SW5	620.0	51	0.033	Riprap	0.035	0.011	1.52	0	2	6.08	3.66	0.52	0.71	1.11	na	0.71	2.23	2.50	3.8	4.0
B-SW5	620.0	51	0.033	Riprap	0.035	0.012	1.50	0	2	6	3.78	0.54	0.72	1.11	na	0.72	2.22	2.50	4.1	4.0
B-SW6	814.0	60	0.030	Riprap	0.035	0.005	1.88	0	2	7.52	2.83	0.36	0.62	1.09	na	0.62	2.50	2.50	2.2	4.0
B-SW6	814.0	60	0.031	Riprap	0.035	0.006	1.82	0	2	7.28	3.03	0.40	0.64	1.09	na	0.64	2.46	2.50	2.5	4.0
B-SW6	814.0	60	0.031	Riprap	0.035	0.007	1.76	0	2	7.04	3.22	0.43	0.66	1.10	na	0.66	2.42	2.50	2.8	4.0
B-SW6	814.0	60	0.032	Riprap	0.035	0.008	1.72	0	2	6.88	3.38	0.45	0.68	1.10	na	0.68	2.40	2.50	3.2	4.0
B-SW6	814.0	60	0.033	Riprap	0.035	0.009	1.68	0	2	6.72	3.53	0.48	0.69	1.10	na	0.69	2.37	2.50	3.5	4.0
B-SW6	814.0	60	0.033	Riprap	0.035	0.010	1.65	0	2	6.6	3.68	0.50	0.71	1.11	na	0.71	2.36	2.50	3.8	4.0
B-SW6	814.0	60	0.033	Riprap	0.035	0.011	1.62	0	2	6.48	3.81	0.53	0.73	1.11	na	0.73	2.35	2.50	4.1	4.0
B-SW7	1820.0	93	0.030	Riprap	0.035	0.005	1.76	0	2	7.04	2.73	0.36	0.62	1.08	na	0.62	2.38	2.50	2.0	5.0
B-SW7	1820.0	93	0.030	Riprap	0.035	0.006	1.70	0	2	6.8	2.93	0.40	0.63	1.09	na	0.63	2.33	2.50	2.3	5.0
B-SW7	1820.0	93	0.031	Riprap	0.035	0.007	1.65	0	2	6.6	3.10	0.43	0.65	1.09	na	0.65	2.30	2.50	2.6	5.0
B-SW7	1820.0	93	0.032	Riprap	0.035	0.008	1.61	0	2	6.44	3.26	0.45	0.67	1.10	na	0.67	2.28	2.50	2.9	5.0
B-SW7	1820.0	93	0.032	Riprap	0.035	0.009	1.58	0	2	6.32	3.41	0.48	0.68	1.10	na	0.68	2.26	2.50	3.3	5.0
B-SW7	1820.0	93	0.033	Riprap	0.035	0.010	1.54	0	2	6.16	3.55	0.50	0.70	1.10	na	0.70	2.24	2.50	3.5	5.0
B-SW7	1820.0	93	0.033	Riprap	0.035	0.011	1.52	0	2	6.08	3.67	0.52	0.71	1.11	na	0.71	2.23	2.50	3.8	5.0
B-SW7	1820.0	93	0.033	Riprap	0.035	0.012	1.49	0	2	5.96	3.80	0.55	0.72	1.11	na	0.72	2.21	2.50	4.1	5.0
B-SW7	1820.0	93	0.034	Riprap	0.035	0.013	1.47	0	2	5.88	3.91	0.57	0.74	1.11	na	0.74	2.21	2.50	4.4	5.0
B-SW7	1820.0	93	0.034	Riprap	0.035	0.014	1.45	0	2	5.8	4.02	0.59	0.75	1.11	na	0.75	2.20	2.50	4.6	5.0
B-SW7	1820.0	93	0.034	Riprap	0.035	0.015	1.43	0	2	5.72	4.13	0.61	0.76	1.12	na	0.76	2.19	2.50	4.9	5.0
B-SE1	1587.0	175	0.032	Riprap	0.035	0.005	2.80	0	2	11.2	3.70	0.39	0.71	1.13	na	0.71	3.51	3.50	3.2	6.0
B-SE1	1587.0	175	0.033	Riprap	0.035	0.006	2.71	0	2	10.84	3.96	0.42	0.74	1.14	na	0.74	3.45	3.50	3.7	6.0
B-SE1	1587.0	175	0.034	Riprap	0.035	0.007	2.63	0	2	10.52	4.20	0.46	0.77	1.14	na	0.77	3.40	3.50	4.2	6.0
B-SE1	1587.0	175	0.034	Riprap	0.035	0.008	2.57	0	2	10.28	4.42	0.49	0.80	1.15	na	0.80	3.37	3.50	4.7	6.0
B-SE1	1587.0	175	0.035	Riprap	0.035	0.009	2.51	0	2	10.04	4.61	0.51	0.83	1.16	na	0.83	3.34	3.50	5.2	6.0
B-SE1	1587.0	175	0.035	Riprap	0.035	0.010	2.46	0	2	9.84	4.80	0.54	0.86	1.16	na	0.86	3.32	3.50	5.6	6.0
B-SE1	1587.0	175	0.036	Riprap	0.035	0.011	2.42	0	2	9.68	4.98	0.56	0.89	1.17	na	0.89	3.31	3.50	6.1	6.0
B-SE2	1996.0	219	0.033	Riprap	0.035	0.005	3.05	0	2	12.2	3.91	0.39	0.74	1.14	na	0.74	3.79	3.80	3.5	7.0
B-SE2	1996.0	219	0.033	Riprap	0.035	0.006	2.95	0	2	11.8	4.19	0.43	0.77	1.15	na	0.77	3.72	3.80	4.1	7.0
B-SE2	1996.0	219	0.034	Riprap	0.035	0.007	2.86	0	2	11.44	4.44	0.46	0.81	1.16	na	0.81	3.67	3.80	4.6	7.0
B-SE2	1996.0	219	0.035	Riprap	0.035	0.008	2.79	0	2	11.16	4.67	0.49	0.84	1.16	na	0.84	3.63	3.80	5.1	7.0
B-SE2	1996.0	219	0.035	Riprap	0.035	0.009	2.73	0	2	10.92	4.88	0.52	0.87	1.17	na	0.87	3.60	3.80	5.6	7.0
B-SE2	1996.0	219	0.036	Riprap	0.035	0.010	2.68	0	2	10.72	5.08	0.55	0.90	1.18	na	0.90	3.58	3.80	6.1	7.0
B-SE2	1996.0	219	0.036	Riprap	0.035	0.011	2.63	0	2	10.52	5.26	0.57	0.93	1.18	na	0.93	3.56	3.80	6.6	7.0
B-SE2	1996.0	219	0.037	Riprap	0.035	0.012	2.59	0	2	10.36	5.44	0.60	0.96	1.19	na	0.96	3.55	3.80	7.1	7.0
B-SE3	1450.0	123	0.031	Riprap	0.035	0.005	2.45	0	2	9.8	3.39	0.38	0.68	1.11	na	0.68	3.13	3.10	2.8	6.0



## Sunrise Mountain Landfill Hydraulics Verification - HydroCAD Berms and Channels

Reach	Segment Length (ft)	Clear Q Inflow (cfs)	Manning N Check for Riprap	Lining	Mannings N	Slope (ft/ft)	Flow Depth (ft)	Bottom Width (ft)	Sideslope	Flow Top Width (ft)	Flow Velocity (ft/s)	Froude # Chl	Freeboard if Fr<1	Freeboard if Fr>1	>300cfs min FB (ft)	Controlling FB (ft)	Minimum Required Berm Height (ft)	Design Berm Height (ft)	Required Riprap d50 (inch)	Design Riprap d50
B-SE3	1450.0	123	0.032	Riprap	0.035	0.006	2.37	0	2	9.48	3.63	0.42	0.70	1.12	na	0.70	3.07	3.10	3.3	6.0
B-SE3	1450.0	123	0.033	Riprap	0.035	0.007	2.30	0	2	9.2	3.84	0.45	0.73	1.13	na	0.73	3.03	3.10	3.7	6.0
B-SE3	1450.0	123	0.033	Riprap	0.035	0.008	2.25	0	2	9	4.04	0.47	0.75	1.13	na	0.75	3.00	3.10	4.1	6.0
B-SE3	1450.0	123	0.034	Riprap	0.035	0.009	2.20	0	2	8.8	4.22	0.50	0.78	1.14	na	0.78	2.98	3.10	4.5	6.0
B-SE3	1450.0	123	0.034	Riprap	0.035	0.010	2.15	0	2	8.6	4.39	0.53	0.80	1.14	na	0.80	2.95	3.10	4.9	6.0
B-SE3	1450.0	123	0.035	Riprap	0.035	0.011	2.12	0	2	8.48	4.55	0.55	0.82	1.15	na	0.82	2.94	3.10	5.3	6.0
B-SE3	1450.0	123	0.035	Riprap	0.035	0.012	2.08	0	2	8.32	4.70	0.57	0.84	1.15	na	0.84	2.92	3.10	5.7	6.0
B-SE3	1450.0	123	0.036	Riprap	0.035	0.013	2.05	0	2	8.2	4.85	0.60	0.87	1.15	na	0.87	2.92	3.10	6.1	6.0
B-EP1	971.0	124	0.031	Riprap	0.035	0.005	2.47	0	2	9.88	3.40	0.38	0.68	1.11	na	0.68	3.15	3.10	2.8	6.0
B-EP1	971.0	124	0.032	Riprap	0.035	0.006	2.38	0	2	9.52	3.64	0.42	0.71	1.12	na	0.71	3.09	3.10	3.3	6.0
B-EP1	971.0	124	0.033	Riprap	0.035	0.007	2.32	0	2	9.28	3.86	0.45	0.73	1.13	na	0.73	3.05	3.10	3.7	6.0
B-EP1	971.0	124	0.033	Riprap	0.035	0.008	2.26	0	2	9.04	4.05	0.47	0.75	1.13	na	0.75	3.01	3.10	4.1	6.0
B-EP1	971.0	124	0.034	Riprap	0.035	0.009	2.21	0	2	8.84	4.24	0.50	0.78	1.14	na	0.78	2.99	3.10	4.6	6.0
B-EP1	971.0	124	0.035	Riprap	0.035	0.010	2.17	0	2	8.68	4.41	0.53	0.80	1.14	na	0.80	2.97	3.10	5.0	6.0
B-EP1	971.0	124	0.035	Riprap	0.035	0.011	2.13	0	2	8.52	4.57	0.55	0.82	1.15	na	0.82	2.95	3.10	5.4	6.0
B-EP1	971.0	124	0.035	Riprap	0.035	0.012	2.09	0	2	8.36	4.72	0.58	0.85	1.15	na	0.85	2.94	3.10	5.7	6.0
B-EP1	971.0	124	0.036	Riprap	0.035	0.013	2.06	0	2	8.24	4.86	0.60	0.87	1.15	na	0.87	2.93	3.10	6.1	6.0
B-EP2	661.0	62	0.030	Riprap	0.035	0.005	1.90	0	2	7.6	2.86	0.37	0.63	1.09	na	0.63	2.53	2.50	2.2	4.0
B-EP2	1450.0	62	0.031	Riprap	0.035	0.006	1.84	0	2	7.36	3.06	0.40	0.65	1.09	na	0.65	2.49	2.50	2.5	4.0
B-EP2	1450.0	62	0.031	Riprap	0.035	0.007	1.79	0	2	7.16	3.24	0.43	0.66	1.10	na	0.66	2.45	2.50	2.9	4.0
B-EP2	1450.0	62	0.032	Riprap	0.035	0.008	1.74	0	2	6.96	3.41	0.46	0.68	1.10	na	0.68	2.42	2.50	3.2	4.0
B-EP2	1450.0	62	0.033	Riprap	0.035	0.009	1.70	0	2	6.8	3.56	0.48	0.70	1.11	na	0.70	2.40	2.50	3.5	4.0
B-EP2	1450.0	62	0.033	Riprap	0.035	0.010	1.67	0	2	6.68	3.71	0.51	0.71	1.11	na	0.71	2.38	2.50	3.8	4.0
B-EP2	1450.0	62	0.033	Riprap	0.035	0.011	1.64	0	2	6.56	3.84	0.53	0.73	1.11	na	0.73	2.37	2.50	4.1	4.0
B-EP3	1996.0	13	0.027	Riprap	0.035	0.005	1.06	0	2	4.24	1.94	0.33	0.56	1.05	na	0.56	1.62	2.00	1.2	3.0
B-EP3	1996.0	13	0.028	Riprap	0.035	0.006	1.02	0	2	4.08	2.07	0.36	0.57	1.05	na	0.57	1.59	2.00	1.4	3.0
B-EP3	1996.0	13	0.029	Riprap	0.035	0.007	0.99	0	2	3.96	2.19	0.39	0.57	1.05	na	0.57	1.56	2.00	1.6	3.0
B-EP3	1996.0	13	0.029	Riprap	0.035	0.008	0.97	0	2	3.88	2.31	0.41	0.58	1.06	na	0.58	1.55	2.00	1.8	3.0
B-EP3	1996.0	13	0.030	Riprap	0.035	0.009	0.95	0	2	3.8	2.41	0.44	0.59	1.06	na	0.59	1.54	2.00	2.0	3.0
B-EP3	1996.0	13	0.030	Riprap	0.035	0.010	0.93	0	2	3.72	2.51	0.46	0.60	1.06	na	0.60	1.53	2.00	2.1	3.0
B-EP3	1996.0	13	0.030	Riprap	0.035	0.011	0.91	0	2	3.64	2.60	0.48	0.60	1.06	na	0.60	1.51	2.00	2.3	3.0
B-EP3	1996.0	13	0.031	Riprap	0.035	0.012	0.90	0	2	3.6	2.69	0.50	0.61	1.06	na	0.61	1.51	2.00	2.5	3.0
B-EP3	1996.0	13	0.031	Riprap	0.035	0.013	0.88	0	2	3.52	2.77	0.52	0.62	1.07	na	0.62	1.50	2.00	2.6	3.0
B-EP3	1996.0	13	0.031	Riprap	0.035	0.014	0.87	0	2	3.48	2.85	0.54	0.63	1.07	na	0.63	1.50	2.00	2.8	3.0
B-EP3	1996.0	13	0.032	Riprap	0.035	0.015	0.86	0	2	3.44	2.92	0.55	0.63	1.07	na	0.63	1.49	2.00	3.0	3.0
B-SE5	147.0	135	0.035	Riprap	0.035	0.010	2.24	0	2	8.96	4.50	0.53	0.81	1.15	na	0.81	3.05	3.00	5.1	10.0
B-SE5	147.0	135	0.037	Riprap	0.035	0.015	2.07	0	2	8.28	5.24	0.64	0.93	1.17	na	0.93	3.00	3.00	7.1	10.0
B-SE5	147.0	135	0.038	Riprap	0.035	0.020	1.96	0	2	7.84	5.84	0.74	1.03	1.18	na	1.03	2.99	3.00	9.0	10.0
C-TD1	1022.0	273	0.035	Riprap	0.035	0.010	2.26	10	2	19.04	6.18	0.72	1.09	1.20	na	1.09	3.35	5.00	5.2	6.0
C-SW4	440.0	99	NA	Concrete	0.015	0.050	0.65	10	2	12.60	15.26	3.34	4.12	1.33	na	1.33	1.98	2.00	na	Concrete
C-SW4	440.0	99	NA	Concrete	0.015	0.300	0.6	10	2	12.40	17.81	4.05	5.43	1.38	na	1.38	1.98	2.00	na	Concrete

## ATTACHMENT 3

**Draft** - Channel Junction Design Criteria:

Draft: 08/03/2010, C. Anderson

Junction Condition	Criterion #1 (Q1 + Q2)	Criterion #2 (Q2)	Max. angle of intersection	Uniform junction slopes required	Match flow depths (d1-d2)	Match water surface elev. (WS1-WS2)	Balance momentum equation
#1	>300 cfs (clear) >375 cfs (bulked)	$\leq Q1$	12°	yes	$\pm 0.1$ ft	$\pm 0.1$ ft	Yes
#2	$\leq 300$ cfs (clear) $\leq 375$ cfs bulked	$\leq Q1$	16°	no	$\pm 0.2$ ft	$\pm 0.2$ ft	Yes
#3	$\leq 100$ cfs (clear) $\leq 125$ cfs (bulked)	$\leq Q1$	20°	no	$\pm 0.2$ ft	$\pm 0.2$ ft	Yes
#4	$\leq 300$ cfs (clear) $\leq 375$ cfs bulked	$\leq 20$ cfs (clear) $\leq 25$ cfs (bulked)	24°	no	n/a	$\pm 0.2$ ft	No
#5	n/a	$\leq Q1/10$	24°	no	n/a	$\pm 0.2$ ft	No

## Notes:

- Q1 is the flow rate (discharge) in the main entrance channel, Q2 is the flow rate (discharge) in the side channel, and Q3 is the flow rate (discharge) in the exit channel.  $Q1 \geq Q2$ .
- Junction Condition #1 requires a uniform slope through the junction for all channels
- Junction Condition #4 also applies when  $Q1 + Q2 \leq 300$  cfs (clear) and flow in channel 2 is subcritical ( $Fr < 1.0$ )
- When computing flow depths and momentum equation balance use  $Q3 = Q1 + Q2$
- The angle of intersedtion is measured at the point where the water surface of the side channel first meets the water surface of the main channel (point of confluence). See plate E-2 of USACE EM 1110-2-1601.
- The main and side channels must have the same elevation at the point of confluence for Junction Conditions #1, #2 and #3. For Junctions #4 and #5, the side channel bottom may be above the main channel, with a smooth transition to a combined channel elevation.

## Channel Junctions - Momentum Equation & Transition Analysis

Ref: Equations E-11 and E-14 and Plates E-1 and E-2 in Appendix E of "Hydraulic Design of Flood Control Channels" (1991) by the US Army Corps of Engineers, EM 1110-2-1601, and pages 552-559, "Channel Transitions and Controls" (1949) by A.T. Ippen, in Engineering, Hydraulics", edited by H. Rouse.

Rev: April 7, 2011

### 1. Enter Junction flow conditions

	Flow rate Q (cfs)	Velocity V (ft/s)	Side slope Z (ft/ft)	Angle of Inter-section (degrees)	Froude Number
Main Channel:	Q1 = 692.0	V1 = 23.60	Z1 = 2.00	Theta2 = 12.00	3.281733
Side Channel:	Q2 = 417.0	V2 = 18.92	Z1 = 2.00		2.728183
Combined (Exit) Channel :	Q3 = 1109.0	V3 = 21.68	Z1 = 2.00		2.863065
	V3 initial = 19.25			Intersection angle: OK	

$$-0.16 = M1 = (Q3*V3/g)-(Q1*V1/g)-((Q2*V2/g)*\cos(\text{Theta2}))$$

### 2. Enter entrance flow depth

	Flow depth y (ft)	
Main Channel:	y1 = 2.08	y3 (est. rectangular channels) = $(-x2 + (x2^2 - 4 * x1 * x3)^{0.5}) / (2 * x1)$
Side Channel:	y2 = 2.08	x1 = 1.00
		x2 = -0.006 = $M1 * 2 * V3 / Q3$
		x3 = -4.326 = $-1.0 * (y1^2)$

### 3. An approximate exit depth will be computed based on a rectangular section

Approximate exit depth: y3 (est.) = 2.08  
(based only on rectangular channels)

$$b = (Q / V) / y - (Z * y)$$

### 4. Enter guess for y3 and use the excel solver to obtain a solution to y3

Computed exit depth:	y3 = 2.08	= Cell that the Excel Solver will change
$-0.16 = M2 = (Q3/(2*V3*y3))*(y1^2-y3^2) + (Z1*(y1^3)/3)-(Z3*(y3^3)/3)$		
Test: M1 - M2 =	0.00	= target cell (should be 0.0 after using the Excel solver)

	Computed bottom width b (ft)		Equiv. rectangular width (ft)
Main Channel:	b1 = 9.94	at side slope = 2.00 horiz to 1.00 vert	14.10
Side Channel:	b2 = 6.44	at side slope = 2.00 horiz to 1.00 vert	10.60
Combined (Exit) Channel :	b3 = 20.39	at side slope = 2.00 horiz to 1.00 vert	24.56

### 5. Compute the length of the downstream transition (begin transition at 100 ft min. below junction)

Est. junction elev 49.00

Upstream main channel n:	n1 =	0.015	Hyd R1 = 1.52408
Upstream main channel slope:	S1 =	3.24% at normal depth	
Upstream side channel n:	n1 =	0.015	Hyd R1 = 1.400418
Upstream side channel slope:	S1 =	2.33% at normal depth	
Downstream channel n:	n1 =	0.015	Hyd R1 = 1.721798
Min. Downstream channel slope:	S1 =	2.32% at normal depth	

Estimated downstream channel: b3 (est) = 20.39 Compare to F33 = 20.39

Slope through junction: Sj = 3.24%

Est. normal downstream depth: y4(est) = 1.8926 Determine flow depth so cell F48=0

Computed flow at y4: Q4 at y4 = 1109.0

Compare computed and Target Qs: Q3 - Q4 = 0.0 should be less than ±0.5

Velocity downstream of confluence: Vj = 24.233

Equiv. rect. Width downstream: b4 = 24.180

Froude equiv. rect. downstream: Fr4 = 3.104

Flow rate for contraction:	Q5 =	1109.0
Chan. bottom below Contraction:	b5 =	10 ft
Chan. Side slope below contr.:	z5 =	2.00
Chan Vel below contr.:	V5 =	25.64 Input from HEC-RAS
Comp. Chan. Depth below contr.:	y5 =	2.780 ft
Equiv. rect width below contr.:	b5 =	15.559
Froude equiv. rect. Below contr.:	Fr5 =	2.710

target y5/y4 : y3/y1 = 1.469

estimated: y2/y1 = 1.2240 Set value so cell F73=0

Computed beta-1: beta-1 = 22.076

Computed Theta: theta = 3.744

Comp Fr middle: Fr-mid = 2.739

Computed Theta: theta = 3.744 test using equation 52 of Ippen

enter test for beta-2: beta-2 = 24.804 Set value so cell F70=0  
 Computed Theta: theta-2 = 3.745 Using equation 52 of Ippen, & equ 744 of Clark Co.  
 Theta1-theta-2 = 0.0012573 Should be less than  $\pm 0.002$   
 computed  $y_3/y_2$ :  $y_3/y_2$  = 1.200 Using equation 53 of Ippen  
 computed  $y_3/y_1$ :  $y_3/y_1$  = 1.469  
 $y_5/y_4 - y_3/y_1$  = -0.000372 Should be less than  $\pm 0.002$   
 length of Transition (at bottom): L5 = 79.43

6. Compute the length of the upstream side-chan. transition (end transition at 50 ft min. above junction)  
 Est. junction elev 49.00

Upstream main channel n: n1 = 0.015 Hyd R1 = 1.52408  
 Upstream main channel slope: S1 = 3.24% at normal depth  
 Upstream side channel n: n1 = 0.015 Hyd R1 = 1.400418  
 Upstream side channel slope: S1 = 2.33% at normal depth  
 Downstream channel n: n1 = 0.015 Hyd R1 = 1.721798  
 Min. Downstream channel slope: S1 = 2.32% at normal depth

Est. Upstream side channel: b3 (est) = 8 Compare to F33 = 6.44  
 Slope through junction: Sj = 3.24%  
 Est. normal upstream depth: y4(est) = 1.741 Determine flow depth so cell F89 = 0  
 Computed flow at y4: Q4 at y4 = 417.0  
 Compare computed and Target Qs: Q3 - Q4 = 0.0 should be less than  $\pm 0.5$   
 Velocity upstream of contraction: Vj = 18.82 Input from Hec-RAS  
 Comp. Chan. Depth above contr.: y4 = 1.883  
 Equiv. rect. Width side upstream: b4 = 11.766  
 Froude equiv. rect. Side upstream: Fr4 = 2.417

Flow rate for contraction: Q5 = 417.0  
 Chan. bottom below Contraction: b5 = 6.44 ft  
 Chan. Side slope below contr.: z5 = 2.00  
 Est. normal downstream depth: y5(est) = 1.9089 Determine flow depth so cell F100 = 0  
 Compare cflow at y5: Q5 at y5 = 417.0  
 Compare computed to target Qs: Q5 - Q4 = 0.0 Should be less than  $\pm 0.5$   
 Chan Vel below contr.: V5 = 21.305  
 Comp. Chan. Depth below contr.: y5 = 1.909 ft  
 Equiv. rect width below contr.: b5 = 10.254  
 Froude equiv. rect. Below contr.: Fr5 = 2.718

target  $y_5/y_4$ :  $y_3/y_1$  = 1.096  
 estimated:  $y_2/y_1$  = 1.0480 Set value so cell F118 = 0  
 Computed beta-1: beta-1 = 25.379  
 Computed Theta: theta = 1.025  
 Comp Fr middle: Fr-mid = 2.341  
 Computed Theta: theta = 1.025 Using equation 52 of Ippen, & equ 744 of Clark Co.

enter test for beta-2: beta-2 = 26.235 Set value so cell F115 = 0  
 Computed Theta: theta-2 = 1.025 Using equation 52 of Ippen  
 Theta1-theta-2 = 0.0007524 Should be less than  $\pm 0.002$   
 computed  $y_3/y_2$ :  $y_3/y_2$  = 1.047 Using equation 53 of Ippen  
 computed  $y_3/y_1$ :  $y_3/y_1$  = 1.097  
 $y_5/y_4 - y_3/y_1$  = -0.000794 Should be less than  $\pm 0.002$   
 length of Transition (at bottom): L5 = 43.71

#### Supercritical Junction Summary:

Slope through all junction & transition channels = 3.24%  
 Main inflow width = 9.94 ft at Z = 2.00  
 Side inflow width = 6.44 ft at Z = 2.00  
 Combined channel width = 20.39 ft at Z = 2.00  
 Dist junction to start downstream transition = 100.00 ft  
 length of downstream transition = 79.43 ft  
 Dist junction to end downstream transition = 179.43 ft  
 Channel width at end downstream transition = 10 ft at Z = 2.00  
 Length uniform slope & width upstream of main channel = 50 ft  
 Length uniform slope & width upstream of side channel = 50 ft  
 Dist from downstream end of side transition to junction = 50 ft  
 Length of side channel transition = 43.71 ft  
 Dist from upstream end of side transition to junction = 93.71 ft  
 Channel width at beginning of side channel transition = 8 ft at Z = 2.00  
 Recommended width tolerance = 0.25  $\pm$ ft  
 Recommended longitudinal length (station) tolerance = 2.0  $\pm$ ft

## Channel Junctions - Momentum Equation & Transition Analysis

Ref: Equations E-11 and E-14 and Plates E-1 and E-2 in Appendix E of "Hydraulic Design of Flood Control Channels" (1991) by the US Army Corps of Engineers, EM 1110-2-1601, and pages 552-559, "Channel Transitions and Controls" (1949) by A.T. Ippen, in Engineering, Hydraulics", edited by H. Rouse.

Rev: April 7, 2011

### 1. Enter Junction flow conditions

	Flow rate Q (cfs)	Velocity V (ft/s)	Side slope Z (ft/ft)	Angle of Inter-section (degrees)	Froude Number
Main Channel:	Q1 = 1135.0	V1 = 21.87	Z1 = 2.00	Theta2 = 12.00	2.54782
Side Channel:	Q2 = 515.0	V2 = 18.74	Z1 = 2.00		2.440037
Combined (Exit) Channel :	Q3 = 1650.0	V3 = 20.76	Z1 = 2.00		2.297237
		V3 initial = 18.01		Intersection angle: OK	

$$-0.27 = M1 = (Q3*V3/g)-(Q1*V1/g)-((Q2*V2/g)*\cos(\text{Theta2}))$$

### 2. Enter entrance flow depth

	Flow depth y (ft)	
Main Channel:	y1 = 3.18	y3 (est. rectangular channels) = $(-x2 + (x2^2 - 4 * x1 * x3)^{0.5}) / (2 * x1)$
Side Channel:	y2 = 3.18	x1 = 1.00
		x2 = -0.007 = $M1 * 2 * V3 / Q3$
		x3 = -10.112 = $-1.0 * (y1^2)$

### 3. An approximate exit depth will be computed based on a rectangular section

Approximate exit depth: y3 (est.) = 3.18  
(based only on rectangular channels)

$$b = (Q / V) / y - (Z * y)$$

### 4. Enter guess for y3 and use the excel solver to obtain a solution to y3

Computed exit depth:	y3 = 3.18	= Cell that the Excel Solver will change
$-0.27 = M2 = (Q3/(2*V3*y3))*(y1^2-y3^2) + (Z1*(y1^3)/3)-(Z3*(y3^3)/3)$		
Test: M1 - M2 =	0.00	= target cell (should be 0.0 after using the Excel solver)

	Computed bottom width b (ft)		Equiv. rectangular width (ft)
Main Channel:	b1 = 9.96	at side slope = 2.00 horiz to 1.00 vert	16.32
Side Channel:	b2 = 2.28	at side slope = 2.00 horiz to 1.00 vert	8.64
Combined (Exit) Channel :	b3 = 18.61	at side slope = 2.00 horiz to 1.00 vert	24.97

### 5. Compute the length of the downstream transition (begin transition at 100 ft min. below junction)

Est. junction elev 49.00

Upstream main channel n:	n1 =	0.015	Hyd R1= 2.146179
Upstream main channel slope:	S1 =	1.76% at normal depth	
Upstream side channel n:	n1 =	0.015	Hyd R1= 1.6652
Upstream side channel slope:	S1 =	1.81% at normal depth	
Downstream channel n:	n1 =	0.015	Hyd R1= 2.420173
Min. Downstream channel slope:	S1 =	1.35% at normal depth	

Estimated downstream channel:	b3 (est)=	18.61	Compare to F33 = 18.61
Slope through junction:	Sj =	1.76%	
Est. normal downstream depth:	y4(est) =	2.957	Determine flow depth so cell F48=0
Computed flow at y4:	Q4 at y4 =	1650.0	
Compare computed and Target Qs:	Q3 - Q4 =	0.0	should be less than ±0.5
Velocity downstream of confluence:	Vj =	22.756	
Equiv. rect. Width downstream:	b4 =	24.521	
Froude equiv. rect. downstream:	Fr4 =	2.332	

Flow rate for contraction:	Q5 =	1650.0
Chan. bottom below Contraction:	b5 =	10 ft
Chan. Side slope below contr.:	z5 =	2.00
Chan Vel below contr.:	V5 =	16.41 Input from HEC-RAS
Comp. Chan. Depth below contr.:	y5 =	5.018 ft
Equiv. rect width below contr.:	b5 =	20.036
Froude equiv. rect. Below contr.:	Fr5 =	1.291

target y5/y4 :	y3/y1 =	1.697
estimated:	y2/y1 =	1.3240 Set value so cell F73=0
Computed beta-1:	beta-1 =	32.132
Computed Theta:	theta =	6.753
Comp Fr middle:	Fr-mid =	1.900
Computed Theta:	theta =	6.753 test using equation 52 of Ippen

enter test for beta-2: beta-2 = 39.533 Set value so cell F70=0  
 Computed Theta: theta-2 = 6.753 Using equation 52 of Ippen, & equ 744 of Clark Co.  
 Theta1-theta-2 = -0.000336 Should be less than  $\pm 0.002$   
 computed  $y_3/y_2$ :  $y_3/y_2$  = 1.282 Using equation 53 of Ippen  
 computed  $y_3/y_1$ :  $y_3/y_1$  = 1.697  
 $y_5/y_4 - y_3/y_1$  = 0.0002192 Should be less than  $\pm 0.002$   
 length of Transition (at bottom): L5 = 36.34

6. Compute the length of the upstream side-chan. transition (end transition at 50 ft min. above junction)  
 Est. junction elev 49.00

Upstream main channel n:	n1 =	0.015	Hyd R1 =	2.146179
Upstream main channel slope:	S1 =	1.76% at normal depth		
Upstream side channel n:	n1 =	0.015	Hyd R1 =	1.6652
Upstream side channel slope:	S1 =	1.81% at normal depth		
Downstream channel n:	n1 =	0.015	Hyd R1 =	2.420173
Min. Downstream channel slope:	S1 =	1.35% at normal depth		

Est. Upstream side channel:	b3 (est) =	10.00	Compare to F33 =	2.28
Slope through junction:	Sj =	1.76%		
Est. normal upstream depth:	y4(est) =	2.084	Determine flow depth so cell F89 = 0	
Computed flow at y4:	Q4 at y4 =	514.9		
Compare computed and Target Qs:	Q3 - Q4 =	0.1	should be less than $\pm 0.5$	
Velocity upstream of contraction:	Vj =	18.82	Input from Hec-RAS	
Comp. Chan. Depth above contr.:	y4 =	1.964		
Equiv. rect. Width side upstream:	b4 =	13.929		
Froude equiv. rect. Side upstream:	Fr4 =	2.366		

Flow rate for contraction:	Q5 =	514.9		
Chan. bottom below Contraction:	b5 =	2.28 ft		
Chan. Side slope below contr.:	z5 =	2.00		
Est. normal downstream depth:	y5(est) =	3.2003	Determine flow depth so cell F100 = 0	
Compare cflow at y5:	Q5 at y5 =	515.0		
Compare computed to target Qs:	Q5 - Q4 =	0.0	Should be less than $\pm 0.5$	
Chan Vel below contr.:	V5 =	18.535		
Comp. Chan. Depth below contr.:	y5 =	3.200 ft		
Equiv. rect width below contr.:	b5 =	8.682		
Froude equiv. rect. Below contr.:	Fr5 =	1.826		

target $y_5/y_4$ :	$y_3/y_1$ =	1.535		
estimated:	$y_2/y_1$ =	1.2540	Set value so cell F118 = 0	
Computed beta-1:	beta-1 =	30.157		
Computed Theta:	theta =	5.298		
Comp Fr middle:	Fr-mid =	2.014		
Computed Theta:	theta =	5.298	Using equation 52 of Ippen, & equ 744 of Clark Co.	

enter test for beta-2:	beta-2 =	35.448	Set value so cell F115 = 0	
Computed Theta:	theta-2 =	5.299	Using equation 52 of Ippen	
Theta1-theta-2:	theta1-theta-2 =	0.0010198	Should be less than $\pm 0.002$	
computed $y_3/y_2$ :	$y_3/y_2$ =	1.226	Using equation 53 of Ippen	
computed $y_3/y_1$ :	$y_3/y_1$ =	1.537		
$y_5/y_4 - y_3/y_1$ :	$y_5/y_4 - y_3/y_1$ =	-0.001543	Should be less than $\pm 0.002$	
length of Transition (at bottom):	L5 =	41.62		

#### Supercritical Junction Summary:

Slope through all junction & transition channels =	1.76%		
Main inflow width =	9.96 ft at Z =	2.00	
Side inflow width =	2.28 ft at Z =	2.00	
Combined channel width =	18.61 ft at Z =	2.00	
Dist junction to start downstream transition =	100.00 ft		
length of downstream transition =	36.34 ft		
Dist junction to end downstream transition =	136.34 ft		
Channel width at end downstream transition =	10 ft at Z =	2.00	
Length uniform slope & width upstream of main channel =	50 ft		
Length uniform slope & width upstream of side channel =	50 ft		
Dist from downstream end of side transition to junction =	50 ft		
Length of side channel transition =	41.62 ft		
Dist from upstream end of side transition to junction =	91.62 ft		
Channel width at beginning of side channel transition =	10 ft at Z =	2.00	
Recommended width tolerance =	0.25 $\pm$ ft		
Recommended longitudinal length (station) tolerance =	2.0 $\pm$ ft		

## Channel Junctions - Momentum Equation & Transition Analysis

Ref: Equations E-11 and E-14 and Plates E-1 and E-2 in Appendix E of "Hydraulic Design of Flood Control Channels" (1991) by the US Army Corps of Engineers, EM 1110-2-1601, and pages 552-559, "Channel Transitions and Controls" (1949) by A.T. Ippen, in Engineering, Hydraulics", edited by H. Rouse.

Rev: April 7, 2011

1. Enter Junction flow conditions

	Flow rate Q (cfs)	Velocity V (ft/s)	Side slope Z (ft/ft)	Angle of Inter-section (degrees)	Froude Number
Main Channel:	Q1 = 1852.0	V1 = 24.58	Z1 = 2.00	Theta2 = 12.00	2.72356
Side Channel:	Q2 = 578.0	V2 = 13.91	Z1 = 2.00		1.671686
Combined (Exit) Channel :	Q3 = 2430.0	V3 = 22.42	Z1 = 2.00		2.471202
		V3 initial = 17.17		Intersection angle: OK	

$$33.98 = M1 = (Q3*V3/g) - (Q1*V1/g) - ((Q2*V2/g)*\cos(\text{Theta2}))$$

	Flow depth y (ft)	
2. Enter entrance flow depth		
Main Channel:	y1 = 3.23	y3 (est. rectangular channels) = $(-x2 + (x2^2 - 4 * x1 * x3)^{0.5}) / (2 * x1)$
Side Channel:	y2 = 3.23 = y1	x1 = 1.00
		x2 = 0.627 = $M1 * 2 * V3 / Q3$
		x3 = -10.433 = $-1.0 * (y1^2)$

3. An approximate exit depth will be computed based on a rectangular section

Approximate exit depth:  $y3 \text{ (est.)} = 2.93$   
(based only on rectangular channels)

$$b = (Q / V) / y - (Z * y)$$

4. Enter guess for y3 and use the excel solver to obtain a solution to y3

Computed exit depth:	y3 = 2.97	= Cell that the Excel Solver will change
$33.98 = M2 = (Q3/(2*V3*y3)) * (y1^2 - y3^2) + (Z1*(y1^3)/3) - (Z3*(y3^3)/3)$		
Test: M1 - M2 =	0.00	= target cell (should be 0.0 after using the Excel solver)

	Computed bottom width b (ft)			Equiv. rectangular width (ft)
Main Channel:	b1 = 16.87	at side slope =	2.00 horiz to 1.00 vert	23.33
Side Channel:	b2 = 6.40	at side slope =	2.00 horiz to 1.00 vert	12.86
Combined (Exit) Channel :	b3 = 30.51	at side slope =	2.00 horiz to 1.00 vert	36.45

5. Compute the length of the downstream transition (begin transition at 100 ft min. below junction)

Est. junction elev 49.00

Upstream main channel n:	n1 =	0.015	Hyd R1=	2.406301
Upstream main channel slope:	S1 =	1.91% at normal depth		
Upstream side channel n:	n1 =	0.015	Hyd R1=	1.992975
Upstream side channel slope:	S1 =	0.79% at normal depth		
Downstream channel n:	n1 =	0.015	Hyd R1=	2.474307
Min. Downstream channel slope:	S1 =	1.53% at normal depth		

Estimated downstream channel: b3 (est) = 30.51 Compare to F33 = 30.51

Slope through junction: Sj = 1.91%

Est. normal downstream depth: y4(est) = 2.8179599 Determine flow depth so cell F48=0

Computed flow at y4: Q4 at y4 = 2473.1

Compare computed and Target Qs: Q3 - Q4 = -43.1 should be less than ±0.5

Velocity downstream of confluence: Vj = 24.281

Equiv. rect. Width downstream: b4 = 36.144

Froude equiv. rect. downstream: Fr4 = 2.549

Flow rate for contraction: Q5 = 2473.1

Chan. bottom below Contraction: b5 = 10 ft

Chan. Side slope below contr.: z5 = 2.00

Chan Vel below contr.: V5 = 17.52 Input from HEC-RAS

Comp. Chan. Depth below contr.: y5 = 6.265 ft

Equiv. rect width below contr.: b5 = 22.530

Froude equiv. rect. Below contr.: Fr5 = 1.234

target y5/y4 : y3/y1 = 2.223

estimated: y2/y1 = 1.4964 Set value so cell F73=0

Computed beta-1: beta-1 = 32.423

Computed Theta: theta = 9.424

Comp Fr middle: Fr-mid = 1.911

Computed Theta: theta = 9.424 test using equation 52 of Ippen



enter test for beta-2: beta-2 = 42.99 Set value so cell F70=0  
 Computed Theta: theta-2 = 9.506 Using equation 52 of Ippen, & equ 744 of Clark Co.  
 Theta1-theta-2 = 0.082788 Should be less than  $\pm 0.002$   
 computed  $y_3/y_2$ :  $y_3/y_2$  = 1.409 Using equation 53 of Ippen  
 computed  $y_3/y_1$ :  $y_3/y_1$  = 2.109  
 $y_5/y_4 - y_3/y_1$  = 0.1143998 Should be less than  $\pm 0.002$   
 length of Transition (at bottom): L5 = 61.78

6. Compute the length of the upstream side-chan. transition (end transition at 50 ft min. above junction)  
 Est. junction elev 49.00

Upstream main channel n: n1 = 0.015 Hyd R1 = 2.406301  
 Upstream main channel slope: S1 = 1.91% at normal depth  
 Upstream side channel n: n1 = 0.015 Hyd R1 = 1.992975  
 Upstream side channel slope: S1 = 0.79% at normal depth  
 Downstream channel n: n1 = 0.015 Hyd R1 = 2.474307  
 Min. Downstream channel slope: S1 = 1.53% at normal depth

Est. Upstream side channel: b3 (est) = 10.00 Compare to F33 = 6.40  
 Slope through junction: Sj = 1.91%  
 Est. normal upstream depth: y4(est) = 2.171 Determine flow depth so cell F89 = 0  
 Computed flow at y4: Q4 at y4 = 578.1  
 Compare computed and Target Qs: Q3 - Q4 = -0.1 should be less than  $\pm 0.5$   
 Velocity upstream of contraction: Vj = 18.82 Input from Hec-RAS  
 Comp. Chan. Depth above contr.: y4 = 2.149  
 Equiv. rect. Width side upstream: b4 = 14.297  
 Froude equiv. rect. Side upstream: Fr4 = 2.263

Flow rate for contraction: Q5 = 578.1  
 Chan. bottom below Contraction: b5 = 6.40 ft  
 Chan. Side slope below contr.: z5 = 2.00  
 Est. normal downstream depth: y5(est) = 2.5903 Determine flow depth so cell F100 = 0  
 Compare cflow at y5: Q5 at y5 = 577.8  
 Compare computed to target Qs: Q5 - Q4 = 0.2 Should be less than  $\pm 0.5$   
 Chan Vel below contr.: V5 = 19.254  
 Comp. Chan. Depth below contr.: y5 = 2.591 ft  
 Equiv. rect width below contr.: b5 = 11.587  
 Froude equiv. rect. Below contr.: Fr5 = 2.108

target  $y_5/y_4$ :  $y_3/y_1$  = 1.194  
 estimated:  $y_2/y_1$  = 1.1460 Set value so cell F118 = 0  
 Computed beta-1: beta-1 = 29.346  
 Computed Theta: theta = 3.213  
 Comp Fr middle: Fr-mid = 2.052  
 Computed Theta: theta = 3.213 Using equation 52 of Ippen, & equ 744 of Clark Co.

enter test for beta-2: beta-2 = 32.46 Set value so cell F115 = 0  
 Computed Theta: theta-2 = 3.212 Using equation 52 of Ippen  
 Theta1-theta-2 = -0.001086 Should be less than  $\pm 0.002$   
 computed  $y_3/y_2$ :  $y_3/y_2$  = 1.136 Using equation 53 of Ippen  
 computed  $y_3/y_1$ :  $y_3/y_1$  = 1.302  
 $y_5/y_4 - y_3/y_1$  = -0.108164 Should be less than  $\pm 0.002$   
 length of Transition (at bottom): L5 = 32.02 NOTE: GOLDR APPLIED A 70-FT TRANSITION

#### Supercritical Junction Summary:

Slope through all junction & transition channels = 1.91%  
 Main inflow width = 16.87 ft at Z = 2.00  
 Side inflow width = 6.40 ft at Z = 2.00  
 Combined channel width = 30.51 ft at Z = 2.00  
 Dist junction to start downstream transition = 100.00 ft  
 length of downstream transition = 70.00 ft  
 Dist junction to end downstream transition = 161.78 ft  
 Channel width at end downstream transition = 10 ft at Z = 2.00  
 Length uniform slope & width upstream of main channel = 50 ft  
 Length uniform slope & width upstream of side channel = 50 ft  
 Dist from downstream end of side transition to junction = 50 ft  
 Length of side channel transition = 32.02 ft  
 Dist from upstream end of side transition to junction = 82.02 ft  
 Channel width at beginning of side channel transition = 10 ft at Z = 2.00

Recommended width tolerance = 0.25  $\pm$ ft  
 Recommended longitudinal length (station) tolerance = 2.0  $\pm$ ft

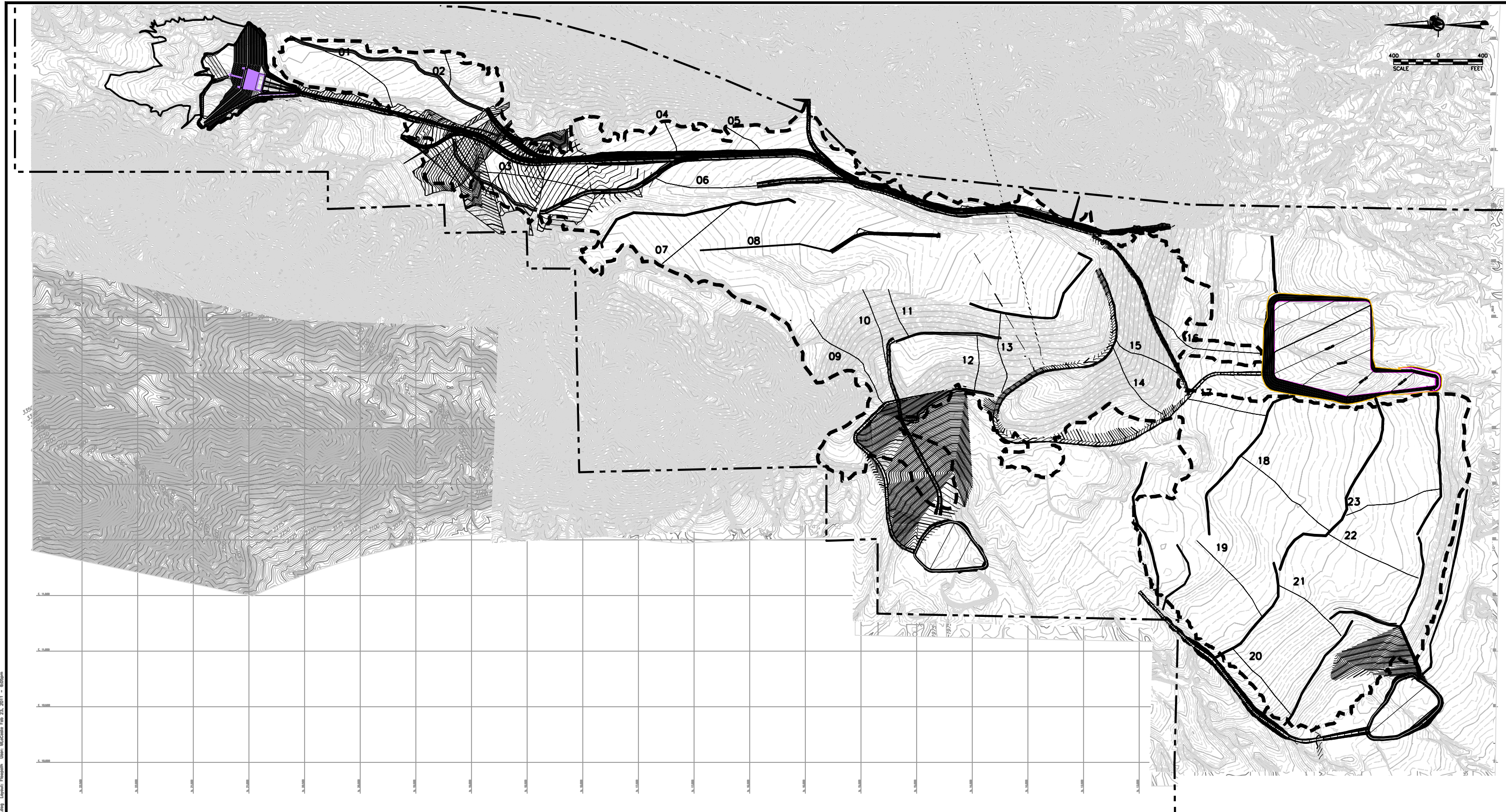
## ATTACHMENT 4

LANDFILL STORMWATER CONTROL PLAN - EXISTING CONCRETE STRUCTURE


Channel ID	Station	Q	Q <sub>b</sub>	Base	Lt Z	Rt Z	z (ave)	So	n	D	A	V	Dtc	Act. FB	Fr	FB Fr<1	FB Fr>1	Req FB	Excess FB	Riprap
		(cfs)	(cfs)	(ft)	(H:V)	(H:V)	(H:V)	(ft/ft)		(ft)	(sf)	(fps)								D50 (inches)
Existing Concrete Structure	na	283	368	0.0	6	6	6.0	0.130	0.032	1.94	22.6	16.3	4.0	2.1	2.1	4.61	1.51	1.51	0.6	na

## ATTACHMENT 5





File: H:\CADD\Shimizu\Sunrise Mountain LULU\Golden\Consulting\Golden\FlowPaths.dwg User: MacGowan Feb 23, 2011 - 6:05pm




**REPUBLIC**  
SERVICES, INC.

PROJECT

REPUBLIC SERVICES, INC.  
SUNRISE MOUNTAIN LANDFILL  
LAS VEGAS, NEVADA

TITLE

**FLOW PATHS**



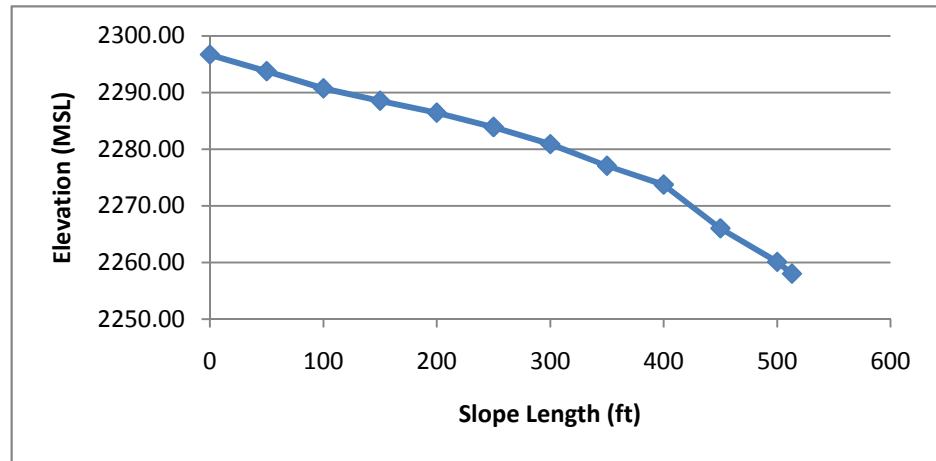
**Golder**  
**Associates**  
Sacramento, California

PROJECT No.	093-97432		FILE No.	093-97432	
DESIGN	JP	2/24/11	SCALE	AS SHOWN	REV. 3
CADD	ML	2/24/11	1		
CHECK	AN	2/24/11			
REVIEW	RW	2/24/11			



# FLOWPATH 1

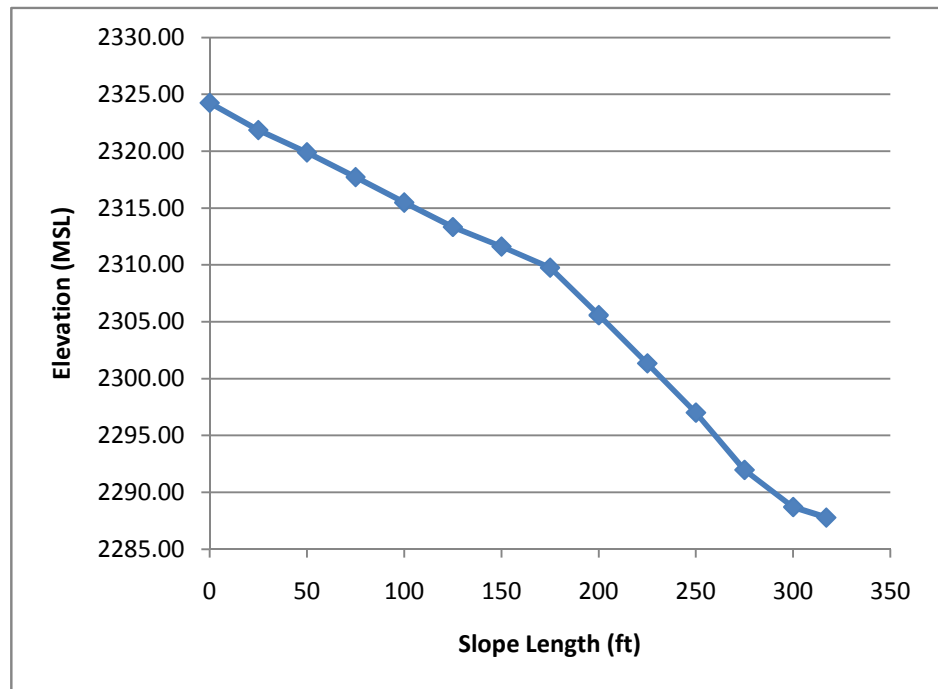
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2296.66			
50	2293.74	5.84%	13	<b>763</b>
100	2290.70	6.08%	13	<b>739</b>
150	2288.53	4.34%	13	<b>969</b>
200	2286.41	4.24%	13	<b>988</b>
250	2283.89	5.04%	13	<b>859</b>
300	2280.86	6.06%	13	<b>741</b>
350	2277.04	7.64%	13	<b>615</b>
400	2273.73	6.62%	13	<b>690</b>
450	2266.02	15.42%	14	<b>863</b>
500	2260.09	11.86%	14	<b>1055</b>
513	2258.02	15.92%	14	<b>842</b>



# FLOWPATH

2

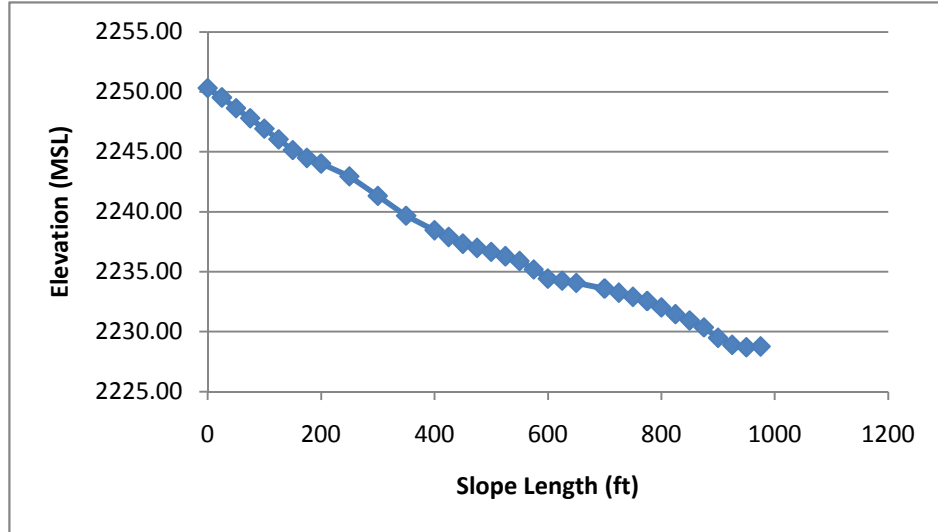
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2324.24			
25	2321.85	9.56%	14	<b>1244</b>
50	2319.89	7.84%	14	<b>1448</b>
75	2317.72	8.68%	14	<b>1339</b>
100	2315.48	8.96%	14	<b>1307</b>
125	2313.33	8.60%	14	<b>1349</b>
150	2311.61	6.88%	14	<b>1599</b>
175	2309.76	7.40%	14	<b>1513</b>
200	2305.58	16.72%	14	<b>812</b>
225	2301.34	16.96%	14	<b>803</b>
250	2297.01	17.32%	14	<b>790</b>
275	2291.98	20.12%	14	<b>705</b>
300	2288.71	13.08%	14	<b>979</b>
317	2287.79	5.41%	14	<b>1921</b>



# FLOWPATH

3

Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2250.30			
25	2249.52	3.12%	13	<b>1264</b>
50	2248.62	3.60%	13	<b>1127</b>
75	2247.79	3.32%	13	<b>1203</b>
100	2246.92	3.48%	13	<b>1158</b>
125	2246.03	3.56%	13	<b>1137</b>
150	2245.13	3.60%	13	<b>1127</b>
175	2244.48	2.60%	13	<b>1464</b>
200	2244.01	1.88%	13	<b>1901</b>
250	2242.94	2.14%	13	<b>1713</b>
300	2241.31	3.26%	13	<b>1220</b>
350	2239.66	3.30%	13	<b>1208</b>
400	2238.45	2.42%	13	<b>1551</b>
425	2237.89	2.24%	13	<b>1651</b>
450	2237.33	2.24%	13	<b>1651</b>
475	2236.98	1.40%	13	<b>2410</b>
500	2236.64	1.36%	13	<b>2467</b>
525	2236.28	1.44%	13	<b>2356</b>
550	2235.88	1.60%	13	<b>2164</b>
575	2235.18	2.80%	13	<b>1379</b>
600	2234.42	3.04%	13	<b>1291</b>
625	2234.24	0.72%	13	<b>4117</b>
650	2234.06	0.72%	13	<b>4117</b>
700	2233.59	0.94%	13	<b>3322</b>
725	2233.24	1.40%	13	<b>2410</b>
750	2232.90	1.36%	13	<b>2467</b>
775	2232.55	1.40%	13	<b>2410</b>
800	2232.01	2.16%	13	<b>1700</b>
825	2231.45	2.24%	13	<b>1651</b>
850	2230.93	2.08%	13	<b>1752</b>
875	2230.35	2.32%	13	<b>1605</b>
900	2229.48	3.48%	13	<b>1158</b>
925	2228.89	2.36%	13	<b>1583</b>
950	2228.70	0.76%	13	<b>3942</b>
975	2228.76	0.24%	13	<b>9971</b>

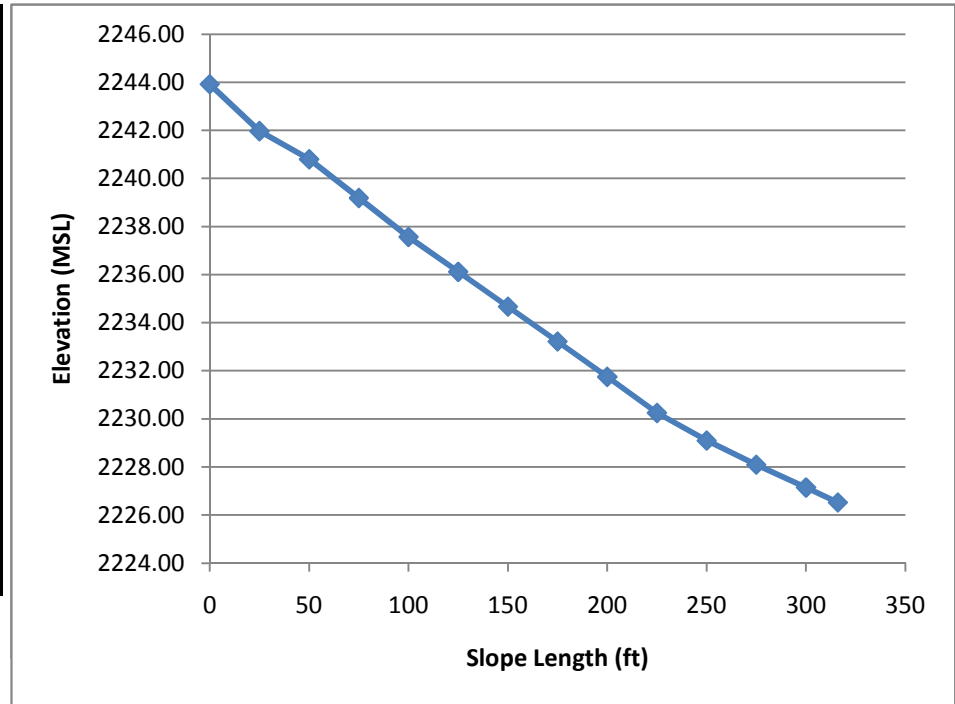




# FLOWPATH

4

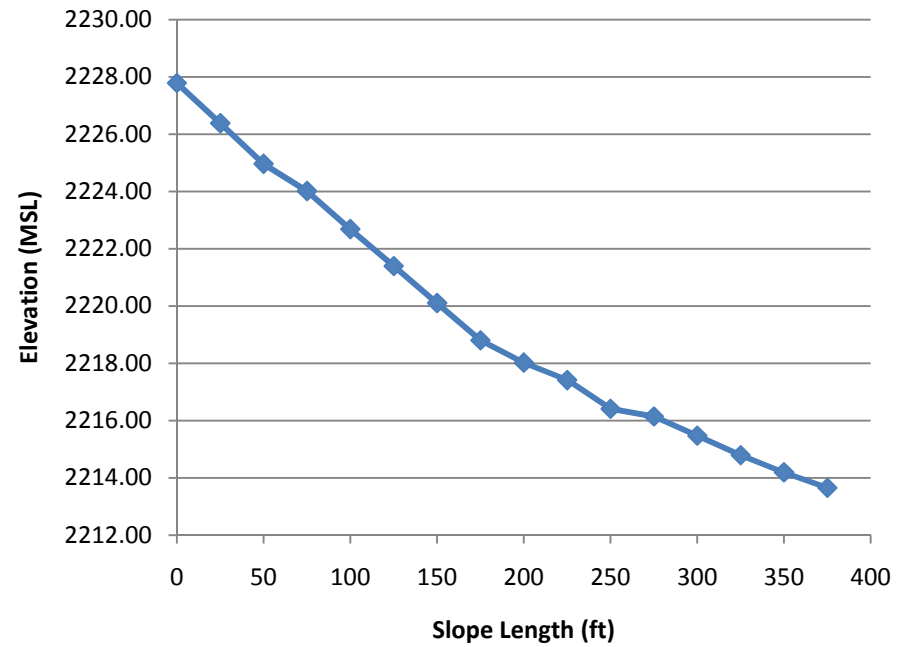
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2243.92			
25	2241.97	7.80%	14	<b>1453</b>
50	2240.80	4.68%	14	<b>2147</b>
75	2239.19	6.44%	14	<b>1682</b>
100	2237.57	6.48%	14	<b>1674</b>
125	2236.12	5.80%	14	<b>1822</b>
150	2234.67	5.80%	14	<b>1822</b>
175	2233.22	5.80%	14	<b>1822</b>
200	2231.75	5.88%	14	<b>1803</b>
225	2230.25	6.00%	14	<b>1776</b>
250	2229.10	4.60%	14	<b>2175</b>
275	2228.10	4.00%	14	<b>2420</b>
300	2227.15	3.80%	14	<b>2517</b>
316	2226.53	3.87%	14	<b>2480</b>



# FLOWPATH

5

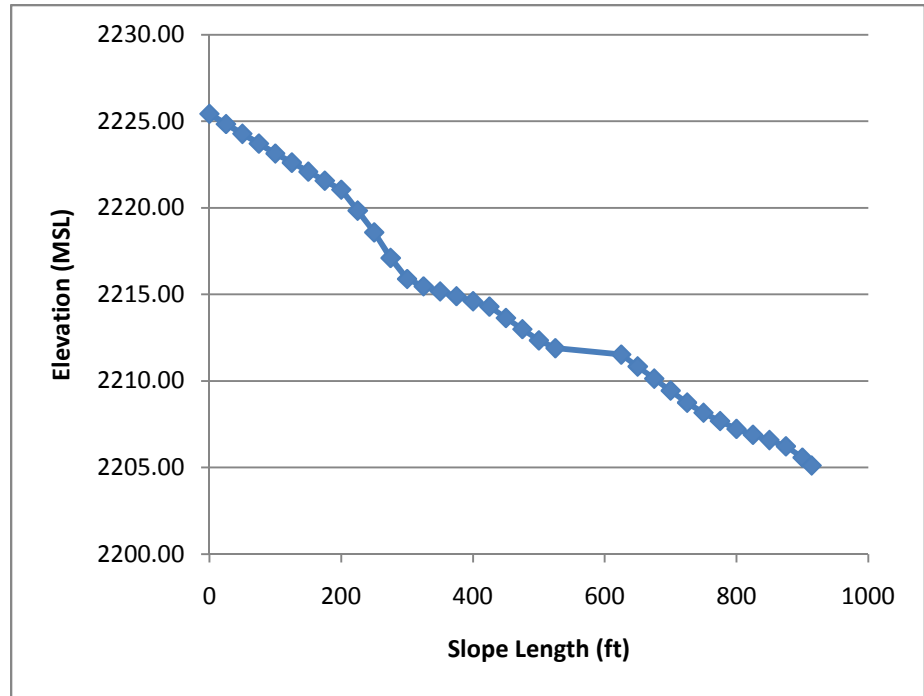
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2227.78			
25	2226.38	5.60%	14	<b>1872</b>
50	2224.96	5.68%	14	<b>1852</b>
75	2224.01	3.80%	14	<b>2517</b>
100	2222.68	5.32%	14	<b>1947</b>
125	2221.39	5.16%	14	<b>1992</b>
150	2220.10	5.16%	14	<b>1992</b>
175	2218.80	5.20%	14	<b>1981</b>
200	2218.02	3.12%	14	<b>2926</b>
225	2217.41	2.44%	14	<b>3531</b>
250	2216.41	4.00%	14	<b>2420</b>
275	2216.14	1.08%	14	<b>6580</b>
300	2215.47	2.68%	14	<b>3287</b>
325	2214.79	2.72%	14	<b>3250</b>
350	2214.19	2.40%	14	<b>3576</b>
375	2213.65	2.16%	14	<b>3875</b>



# FLOWPATH

6

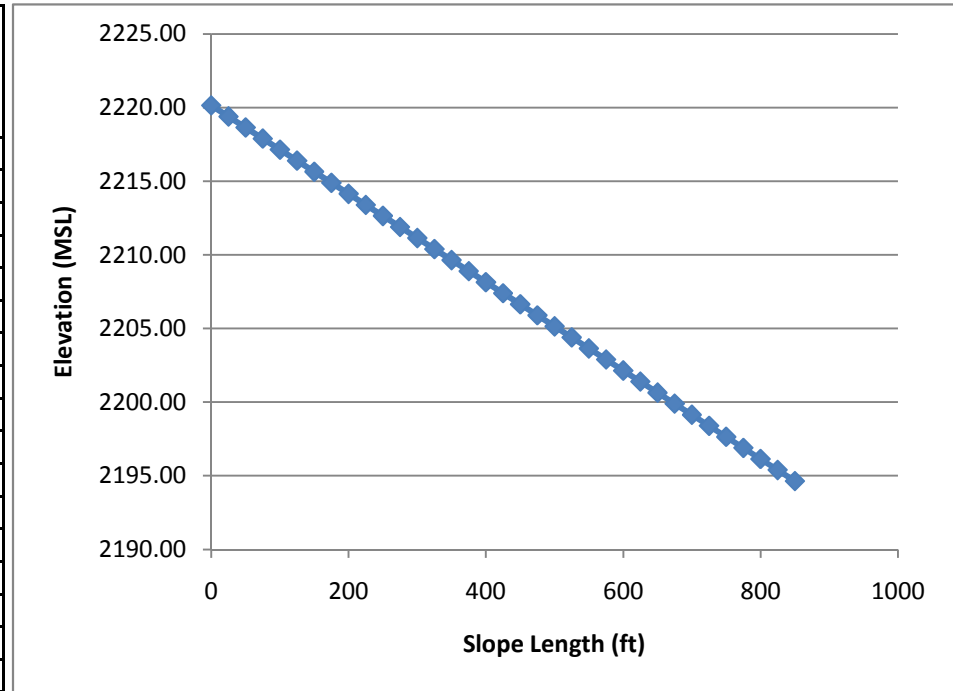
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2225.43			
25	2224.84	2.36%	13	1583
50	2224.28	2.24%	13	1651
75	2223.71	2.28%	13	1627
100	2223.14	2.28%	13	1627
125	2222.61	2.12%	13	1726
150	2222.09	2.08%	13	1752
175	2221.57	2.08%	13	1752
200	2221.05	2.08%	13	1752
225	2219.84	4.84%	13	888
250	2218.58	5.04%	13	859
275	2217.10	5.92%	13	755
300	2215.89	4.84%	13	888
325	2215.46	1.72%	13	2042
350	2215.17	1.16%	13	2804
375	2214.89	1.12%	13	2885
400	2214.60	1.16%	13	2804
425	2214.29	1.24%	13	2658
450	2213.63	2.64%	13	1446
475	2212.99	2.56%	13	1483
500	2212.34	2.60%	13	1464
525	2211.89	1.80%	13	1969
625	2211.52	0.37%	13	7037
650	2210.83	2.76%	13	1395
675	2210.13	2.80%	13	1379
700	2209.44	2.76%	13	1395
725	2208.74	2.80%	13	1379
750	2208.16	2.32%	13	1605
775	2207.68	1.92%	13	1869
800	2207.22	1.84%	13	1934
825	2206.88	1.36%	13	2467
850	2206.58	1.20%	13	2729
875	2206.22	1.44%	13	2356
900	2205.57	2.60%	13	1464
914	2205.11	3.29%	13	1213



# FLOWPATH

7

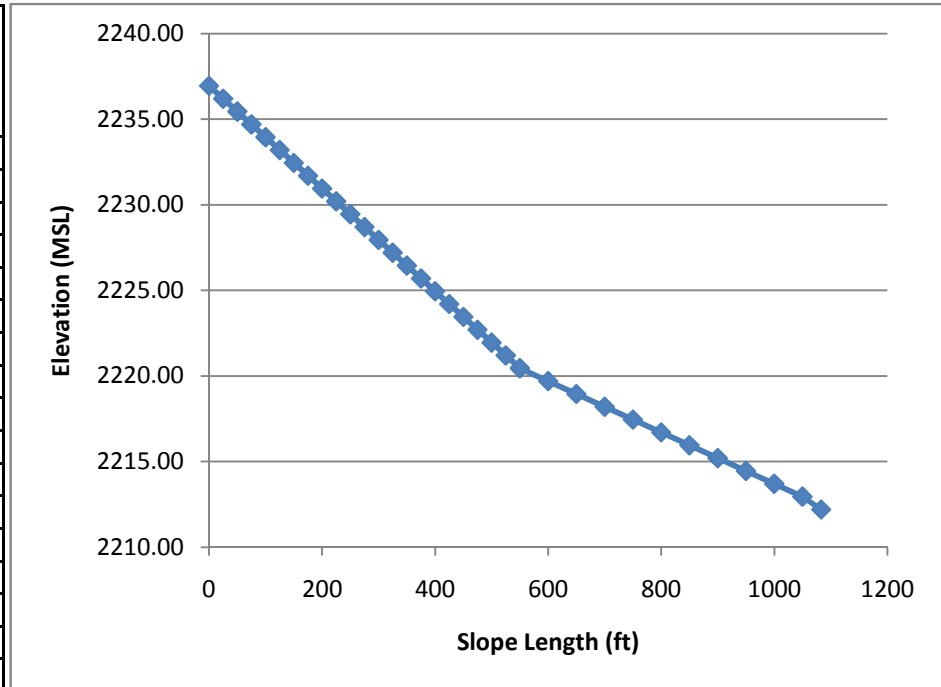
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2220.14			
25	2219.39	3.00%	13	1305
50	2218.64	3.00%	13	1305
75	2217.89	3.00%	13	1305
100	2217.14	3.00%	13	1305
125	2216.39	3.00%	13	1305
150	2215.64	3.00%	13	1305
175	2214.89	3.00%	13	1305
200	2214.14	3.00%	13	1305
225	2213.39	3.00%	13	1305
250	2212.64	3.00%	13	1305
275	2211.89	3.00%	13	1305
300	2211.14	3.00%	13	1305
325	2210.39	3.00%	13	1305
350	2209.64	3.00%	13	1305
375	2208.89	3.00%	13	1305
400	2208.14	3.00%	13	1305
425	2207.39	3.00%	13	1305
450	2206.64	3.00%	13	1305
475	2205.89	3.00%	13	1305
500	2205.14	3.00%	13	1305
525	2204.39	3.00%	13	1305
550	2203.64	3.00%	13	1305
575	2202.89	3.00%	13	1305
600	2202.14	3.00%	13	1305
625	2201.39	3.00%	13	1305
650	2200.64	3.00%	13	1305
675	2199.89	3.00%	13	1305
700	2199.14	3.00%	13	1305
725	2198.39	3.00%	13	1305
750	2197.64	3.00%	13	1305
775	2196.89	3.00%	13	1305
800	2196.14	3.00%	13	1305
825	2195.39	3.00%	13	1305
850	2194.64	3.00%	13	1305



# FLOWPATH

8

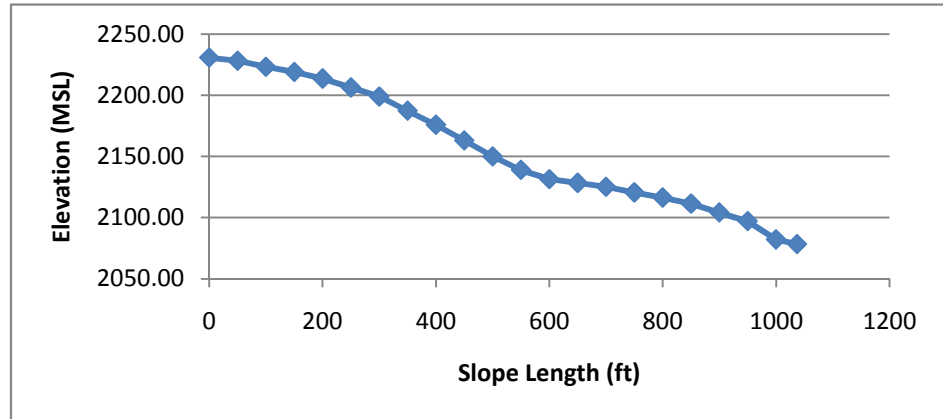
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2236.95			
25	2236.20	3.00%	13	1305
50	2235.45	3.00%	13	1305
75	2234.70	3.00%	13	1305
100	2233.95	3.00%	13	1305
125	2233.20	3.00%	13	1305
150	2232.45	3.00%	13	1305
175	2231.70	3.00%	13	1305
200	2230.95	3.00%	13	1305
225	2230.20	3.00%	13	1305
250	2229.45	3.00%	13	1305
275	2228.70	3.00%	13	1305
300	2227.95	3.00%	13	1305
325	2227.20	3.00%	13	1305
350	2226.45	3.00%	13	1305
375	2225.70	3.00%	13	1305
400	2224.95	3.00%	13	1305
425	2224.20	3.00%	13	1305
450	2223.45	3.00%	13	1305
475	2222.70	3.00%	13	1305
500	2221.95	3.00%	13	1305
525	2221.20	3.00%	13	1305
550	2220.45	3.00%	13	1305
600	2219.70	3.00%	13	1305
650	2218.95	3.00%	13	1305
700	2218.20	3.00%	13	1305
750	2217.45	3.00%	13	1305
800	2216.70	3.00%	13	1305
850	2215.95	3.00%	13	1305
900	2215.20	3.00%	13	1305
950	2214.45	3.00%	13	1305
1000	2213.70	3.00%	13	1305
1050	2212.95	3.00%	13	1305
1083	2212.20	3.00%	13	1305



# FLOWPATH

9

Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2230.63			
50	2228.07	5.12%	13	<b>848</b>
100	2223.14	9.86%	13	<b>501</b>
150	2218.94	8.40%	13	<b>570</b>
200	2213.51	10.86%	14	<b>1129</b>
250	2206.21	14.60%	14	<b>900</b>
300	2198.78	14.86%	14	<b>888</b>
350	2187.25	23.06%	14	<b>635</b>
400	2175.73	23.04%	14	<b>635</b>
450	2163.02	25.42%	14	<b>589</b>
500	2149.92	26.20%	14	<b>576</b>
550	2138.88	22.08%	14	<b>656</b>
600	2131.35	15.06%	14	<b>879</b>
650	2128.28	6.14%	13	<b>733</b>
700	2125.10	6.36%	13	<b>713</b>
750	2120.57	9.06%	14	<b>1296</b>
800	2116.34	8.46%	14	<b>1366</b>
850	2111.35	9.98%	14	<b>1204</b>
900	2104.12	14.46%	14	<b>907</b>
950	2097.06	14.12%	14	<b>923</b>
1000	2082.11	12.00%	14	<b>1046</b>
1037	2078.33	10.22%	14	<b>1182</b>

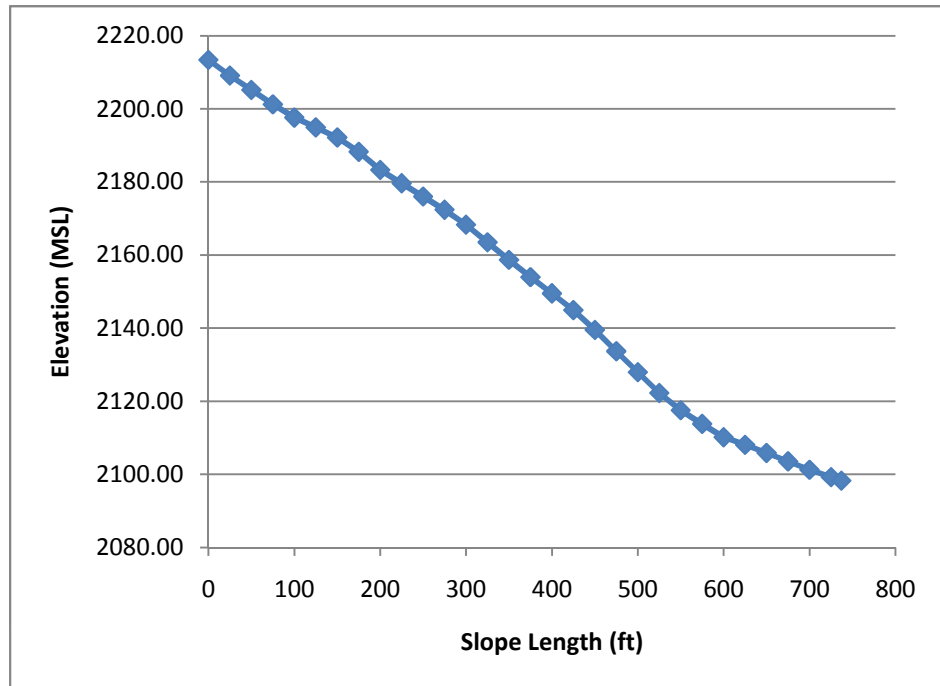




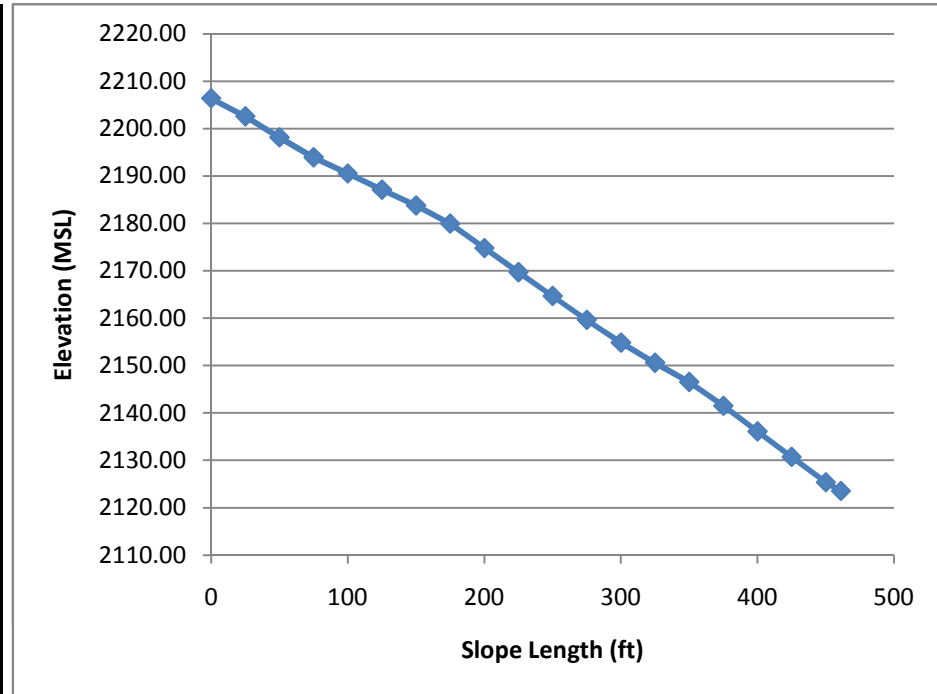
# FLOWPATH

10

Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2213.35			
25	2209.09	17.04%	14	<b>800</b>
50	2205.15	15.76%	14	<b>849</b>
75	2201.20	15.80%	14	<b>847</b>
100	2197.59	14.44%	14	<b>908</b>
125	2194.88	10.84%	14	<b>1130</b>
150	2192.14	10.96%	14	<b>1121</b>
175	2188.22	15.68%	14	<b>852</b>
200	2183.27	19.80%	14	<b>713</b>
225	2179.61	14.64%	14	<b>898</b>
250	2175.99	14.48%	14	<b>906</b>
275	2172.37	14.48%	14	<b>906</b>
300	2168.28	16.36%	14	<b>825</b>
325	2163.47	19.24%	14	<b>729</b>
350	2158.66	19.24%	14	<b>729</b>
375	2153.93	18.92%	14	<b>738</b>
400	2149.50	17.72%	14	<b>776</b>
425	2144.91	18.36%	14	<b>756</b>
450	2139.48	21.72%	14	<b>665</b>
475	2133.67	23.24%	14	<b>631</b>
500	2127.95	22.88%	14	<b>639</b>
525	2122.23	22.88%	14	<b>639</b>
550	2117.52	18.84%	14	<b>741</b>
575	2113.80	14.88%	14	<b>887</b>
600	2110.15	14.60%	14	<b>900</b>
625	2108.06	8.36%	14	<b>1378</b>
650	2105.86	8.80%	14	<b>1325</b>
675	2103.54	9.28%	14	<b>1273</b>
700	2101.24	9.20%	14	<b>1281</b>
725	2099.24	8.00%	14	<b>1425</b>
737	2098.28	8.00%	14	<b>1425</b>



Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2206.36			
25	2202.57	15.16%	14	<b>875</b>
50	2198.12	17.80%	14	<b>774</b>
75	2193.91	16.84%	14	<b>807</b>
100	2190.50	13.64%	14	<b>948</b>
125	2187.10	13.60%	14	<b>950</b>
150	2183.75	13.40%	14	<b>961</b>
175	2179.92	15.32%	14	<b>868</b>
200	2174.77	20.60%	14	<b>692</b>
225	2169.69	20.32%	14	<b>699</b>
250	2164.66	20.12%	14	<b>705</b>
275	2159.63	20.12%	14	<b>705</b>
300	2154.82	19.24%	14	<b>729</b>
325	2150.58	16.96%	14	<b>803</b>
350	2146.51	16.28%	14	<b>828</b>
375	2141.50	20.04%	14	<b>707</b>
400	2136.10	21.60%	14	<b>667</b>
425	2130.70	21.60%	14	<b>667</b>
450	2125.34	21.44%	14	<b>671</b>
461	2123.54	16.36%	14	<b>825</b>

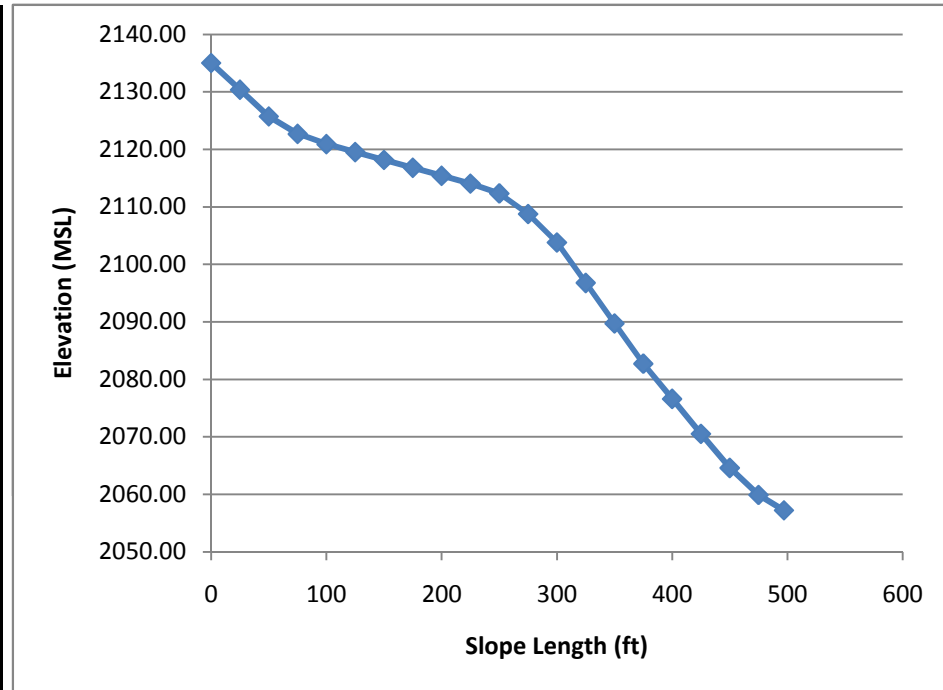


# FLOWPATH

12

Total Slope Length = 325  
 Max. Slope = 28%  
 Min. Slope = 5%  
 Average Slope = 15.63%

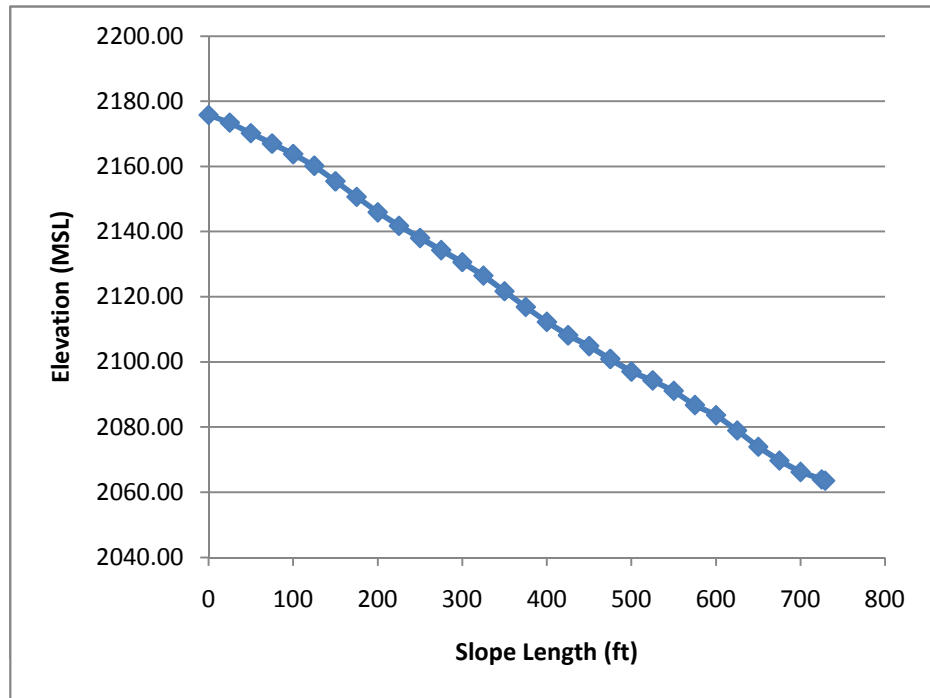
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2135.03			
25	2130.38	18.60%	14	748
50	2125.74	18.56%	14	749
75	2122.70	12.16%	14	1035
100	2120.92	7.12%	13	651
125	2119.54	5.52%	13	799
150	2118.18	5.44%	13	808
175	2116.82	5.44%	13	808
200	2115.41	5.64%	13	785
225	2114.05	5.44%	13	808
250	2112.34	6.84%	13	672
275	2108.76	14.32%	14	914
300	2103.80	19.84%	14	712
325	2096.78	28.08%	14	546
350	2089.72	28.24%	14	544
375	2082.73	27.96%	14	548
400	2076.61	24.48%	14	607
425	2070.52	24.36%	14	609
450	2064.60	23.68%	14	622
475	2059.89	18.84%	14	741
497	2057.23	12.09%	14	1040



# FLOWPATH

13

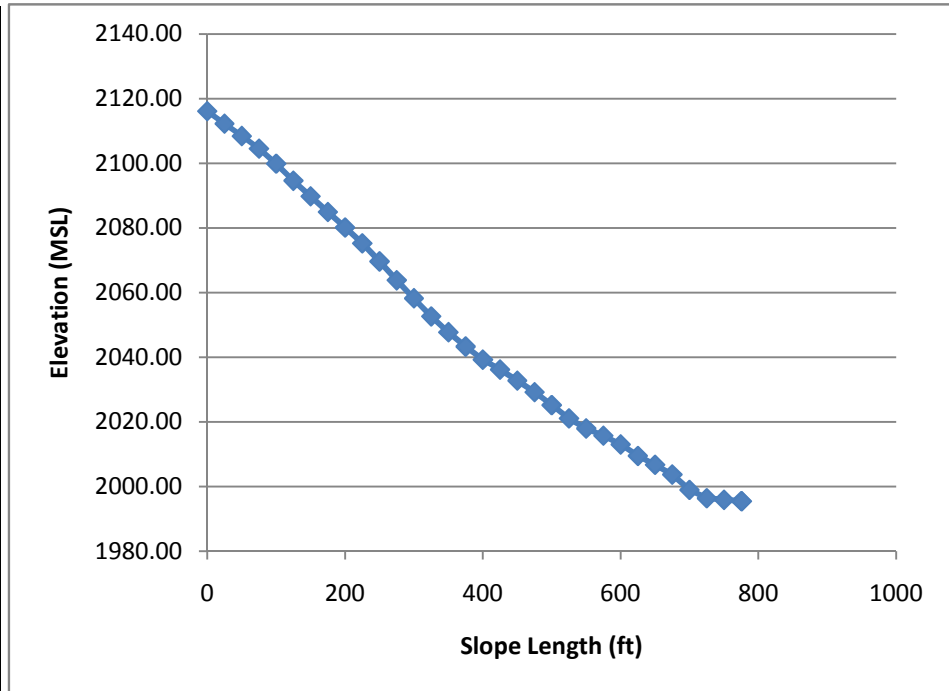
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2175.80			
25	2173.45	9.40%	14	<b>1260</b>
50	2170.23	12.88%	14	<b>991</b>
75	2167.02	12.84%	14	<b>993</b>
100	2163.80	12.88%	14	<b>991</b>
125	2160.22	14.32%	14	<b>914</b>
150	2155.45	19.08%	14	<b>734</b>
175	2150.68	19.08%	14	<b>734</b>
200	2145.91	19.08%	14	<b>734</b>
225	2141.77	16.56%	14	<b>818</b>
250	2138.04	14.92%	14	<b>885</b>
275	2134.31	14.92%	14	<b>885</b>
300	2130.64	14.68%	14	<b>896</b>
325	2126.51	16.52%	14	<b>819</b>
350	2121.70	19.24%	14	<b>729</b>
375	2116.88	19.28%	14	<b>728</b>
400	2112.28	18.40%	14	<b>754</b>
425	2108.18	16.40%	14	<b>824</b>
450	2104.85	13.32%	14	<b>966</b>
475	2100.90	15.80%	14	<b>847</b>
500	2097.03	15.48%	14	<b>861</b>
525	2094.32	10.84%	14	<b>1130</b>
550	2091.13	12.76%	14	<b>998</b>
575	2086.74	17.56%	14	<b>782</b>
600	2083.62	12.48%	14	<b>1015</b>
625	2078.93	18.76%	14	<b>743</b>
650	2073.95	19.92%	14	<b>710</b>
675	2069.69	17.04%	14	<b>800</b>
700	2066.20	13.96%	14	<b>932</b>
725	2063.92	9.12%	14	<b>1290</b>
729	2063.53	9.75%	14	<b>1225</b>



# FLOWPATH

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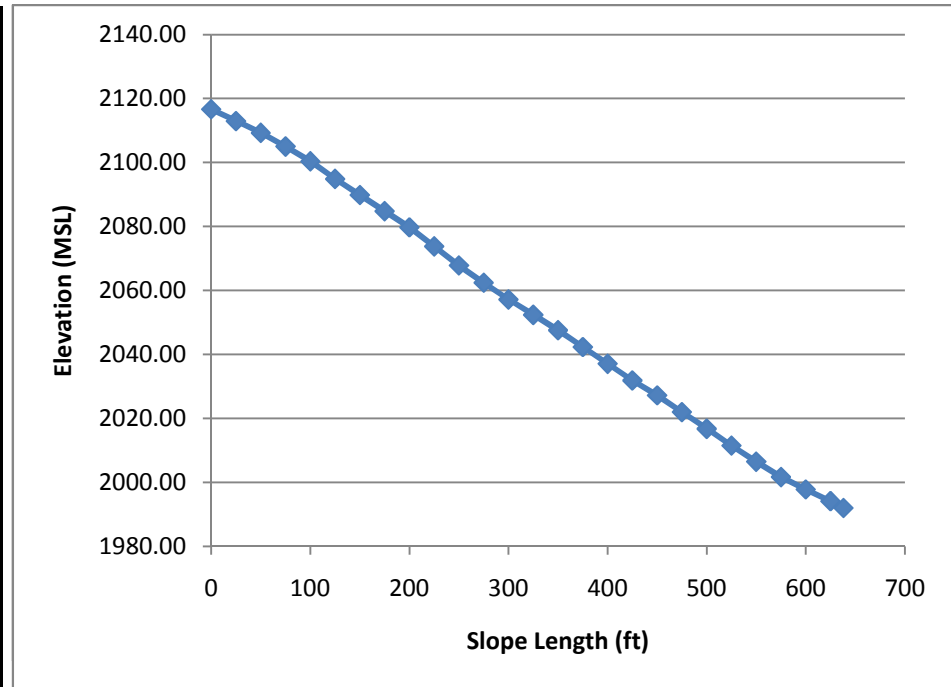
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2116.09			
25	2112.26	15.32%	14	868
50	2108.42	15.36%	14	866
75	2104.54	15.52%	14	859
100	2099.87	18.68%	14	746
125	2094.59	21.12%	14	679
150	2089.76	19.32%	14	727
175	2084.94	19.28%	14	728
200	2080.12	19.28%	14	728
225	2075.23	19.56%	14	720
250	2069.62	22.44%	14	648
275	2063.80	23.28%	14	630
300	2058.22	22.32%	14	651
325	2052.62	22.40%	14	649
350	2047.73	19.56%	14	720
375	2043.30	17.72%	14	776
400	2039.24	16.24%	14	830
425	2036.15	12.36%	14	1022
450	2032.73	13.68%	14	946
475	2029.17	14.24%	14	918
500	2025.17	16.00%	14	839
525	2021.07	16.40%	14	824
550	2017.94	12.52%	14	1012
575	2015.71	8.92%	14	1312
600	2013.00	10.84%	14	1130
625	2009.46	14.16%	14	921
650	2006.70	11.04%	14	1114
675	2003.70	12.00%	14	1046
700	1998.94	19.04%	14	735
725	1996.36	10.32%	14	1173
750	1995.88	1.92%	13	1869
775	1995.47	1.64%	13	2122
776	1995.44	3.00%	13	1305



# FLOWPATH

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Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2116.66			
25	2112.99	14.68%	14	896
50	2109.30	14.76%	14	893
75	2105.03	17.08%	14	799
100	2100.40	18.52%	14	751
125	2094.89	22.04%	14	657
150	2089.85	20.16%	14	704
175	2084.81	20.16%	14	704
200	2079.75	20.24%	14	701
225	2073.80	23.80%	14	620
250	2067.85	23.80%	14	620
275	2062.45	21.60%	14	667
300	2057.17	21.12%	14	679
325	2052.37	19.20%	14	730
350	2047.57	19.20%	14	730
375	2042.32	21.00%	14	682
400	2037.08	20.96%	14	683
425	2031.86	20.88%	14	685
450	2027.21	18.60%	14	748
475	2021.98	20.92%	14	684
500	2016.74	20.96%	14	683
525	2011.49	21.00%	14	682
550	2006.46	20.12%	14	705
575	2001.66	19.20%	14	730
600	1997.79	15.48%	14	861
625	1994.11	14.72%	14	895
638	1992.00	16.23%	14	830

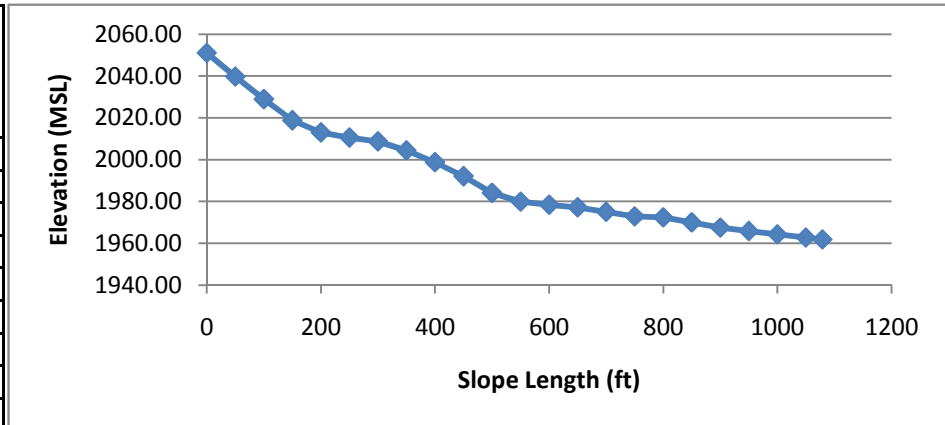




# FLOWPATH

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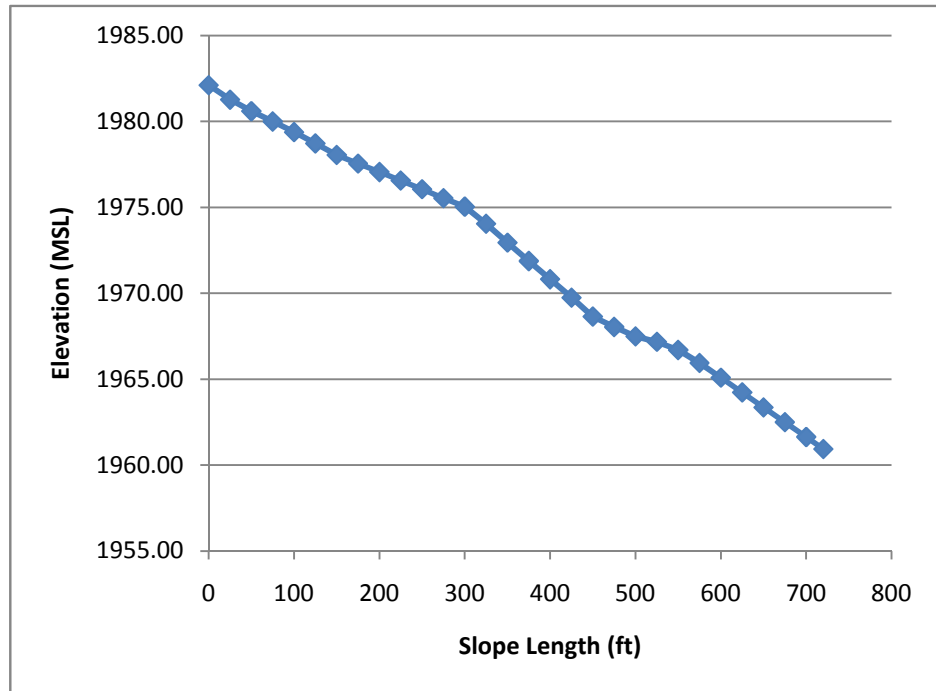
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	2050.99			
50	2039.67	22.64%	14	<b>644</b>
100	2028.90	21.54%	14	<b>669</b>
150	2018.77	20.26%	14	<b>701</b>
200	2012.99	11.56%	14	<b>1076</b>
250	2010.54	4.90%	14	<b>2073</b>
300	2008.71	3.66%	14	<b>2590</b>
350	2004.37	8.68%	14	<b>1339</b>
400	1998.74	11.26%	14	<b>1098</b>
450	1992.04	13.40%	14	<b>961</b>
500	1984.05	15.98%	14	<b>840</b>
550	1979.87	8.36%	13	<b>572</b>
600	1978.39	2.96%	13	<b>1319</b>
650	1977.18	2.42%	13	<b>1551</b>
700	1975.00	4.36%	13	<b>966</b>
750	1972.78	4.44%	13	<b>952</b>
800	1972.36	0.84%	13	<b>3636</b>
850	1969.93	4.86%	13	<b>885</b>
900	1967.44	4.98%	13	<b>868</b>
950	1965.81	3.26%	13	<b>1220</b>
1000	1964.25	3.12%	13	<b>1264</b>
1050	1962.69	3.12%	13	<b>1264</b>
1079	1961.81	3.03%	13	<b>1293</b>



# FLOWPATH

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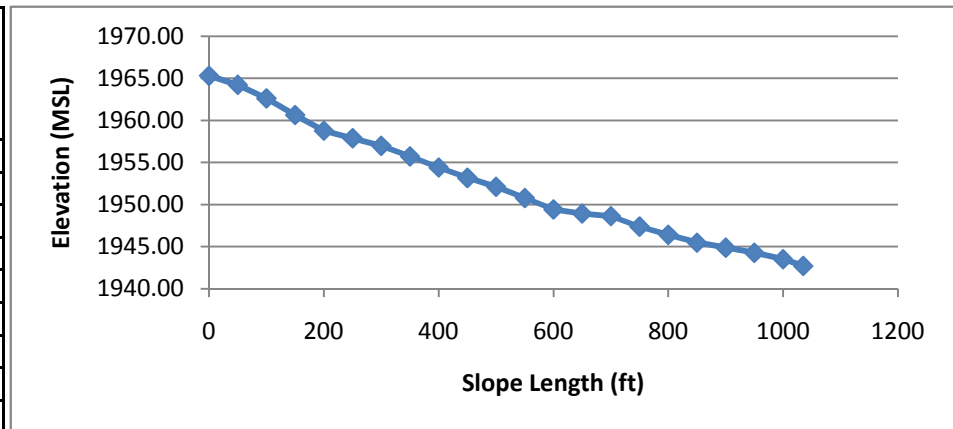
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	1982.11			
25	1981.27	3.36%	13	<b>1191</b>
50	1980.60	2.68%	13	<b>1429</b>
75	1980.00	2.40%	13	<b>1562</b>
100	1979.38	2.48%	13	<b>1521</b>
125	1978.72	2.64%	13	<b>1446</b>
150	1978.05	2.68%	13	<b>1429</b>
175	1977.55	2.00%	13	<b>1809</b>
200	1977.06	1.96%	13	<b>1838</b>
225	1976.56	2.00%	13	<b>1809</b>
250	1976.06	2.00%	13	<b>1809</b>
275	1975.54	2.08%	13	<b>1752</b>
300	1975.04	2.00%	13	<b>1809</b>
325	1974.05	3.96%	13	<b>1043</b>
350	1972.95	4.40%	13	<b>959</b>
375	1971.88	4.28%	13	<b>980</b>
400	1970.82	4.24%	13	<b>988</b>
425	1969.75	4.28%	13	<b>980</b>
450	1968.65	4.40%	13	<b>959</b>
475	1968.04	2.44%	13	<b>1541</b>
500	1967.49	2.20%	13	<b>1675</b>
525	1967.18	1.24%	13	<b>2658</b>
550	1966.70	1.92%	13	<b>1869</b>
575	1965.95	3.00%	13	<b>1305</b>
600	1965.09	3.44%	13	<b>1169</b>
625	1964.23	3.44%	13	<b>1169</b>
650	1963.36	3.48%	13	<b>1158</b>
675	1962.50	3.44%	13	<b>1169</b>
700	1961.64	3.44%	13	<b>1169</b>
720	1960.94	3.50%	13	<b>1153</b>



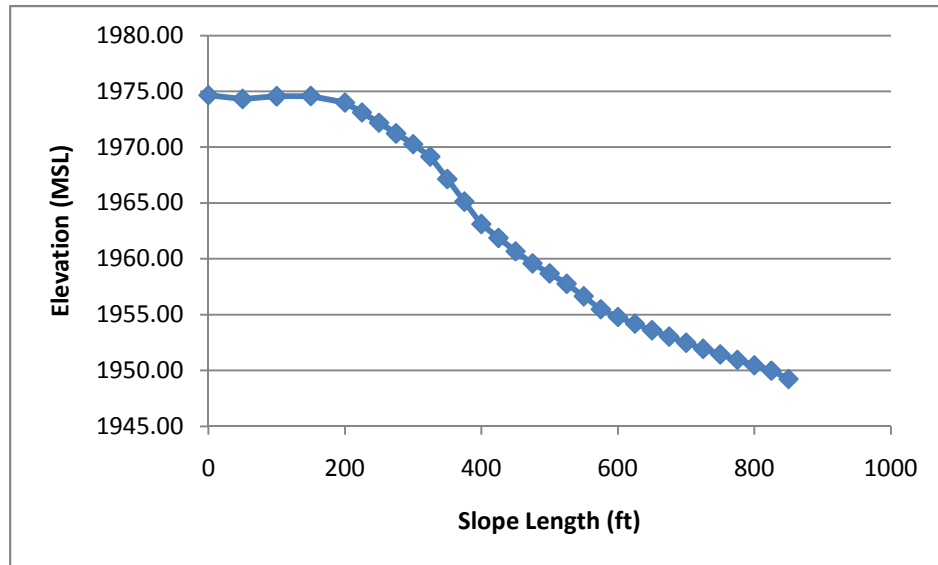
# FLOWPATH

**18** 12-Inch Erosion Layer, Slopes <10%

Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	1965.29			
50	1964.21	2.16%	13	<b>1700</b>
100	1962.60	3.22%	13	<b>1233</b>
150	1960.62	3.96%	13	<b>1043</b>
200	1958.76	3.72%	13	<b>1097</b>
250	1957.87	1.78%	13	<b>1986</b>
300	1956.97	1.80%	13	<b>1969</b>
350	1955.72	2.50%	13	<b>1511</b>
400	1954.40	2.64%	13	<b>1446</b>
450	1953.16	2.48%	13	<b>1521</b>
500	1952.11	2.10%	13	<b>1739</b>
550	1950.78	2.66%	13	<b>1437</b>
600	1949.43	2.70%	13	<b>1420</b>
650	1948.93	1.00%	13	<b>3160</b>
700	1948.62	0.62%	13	<b>4644</b>
750	1947.38	2.48%	13	<b>1521</b>
800	1946.41	1.94%	13	<b>1853</b>
850	1945.48	1.86%	13	<b>1917</b>
900	1944.88	1.20%	13	<b>2729</b>
950	1944.27	1.22%	13	<b>2693</b>
1000	1943.51	1.52%	13	<b>2256</b>
1035	1942.71	2.29%	13	<b>1624</b>



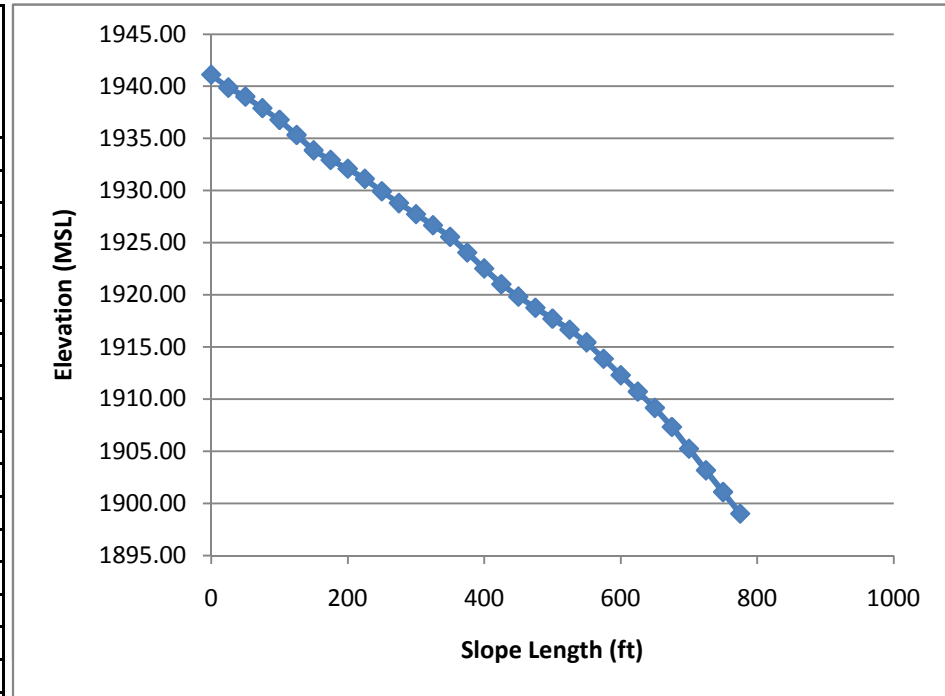
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	1974.65			
50	1974.32	0.66%	13	<b>4416</b>
100	1974.56	0.48%	13	<b>5706</b>
150	1974.58	0.04%	13	<b>42194</b>
200	1974.00	1.16%	13	<b>2804</b>
225	1973.11	3.56%	13	<b>1137</b>
250	1972.19	3.68%	13	<b>1107</b>
275	1971.23	3.84%	13	<b>1070</b>
300	1970.27	3.84%	13	<b>1070</b>
325	1969.16	4.44%	13	<b>952</b>
350	1967.14	8.08%	13	<b>588</b>
375	1965.12	8.08%	13	<b>588</b>
400	1963.11	8.04%	13	<b>590</b>
425	1961.87	4.96%	13	<b>870</b>
450	1960.67	4.80%	13	<b>894</b>
475	1959.59	4.32%	13	<b>973</b>
500	1958.69	3.60%	13	<b>1127</b>
525	1957.76	3.72%	13	<b>1097</b>
550	1956.64	4.48%	13	<b>945</b>
575	1955.48	4.64%	13	<b>918</b>
600	1954.79	2.76%	13	<b>1395</b>
625	1954.18	2.44%	13	<b>1541</b>
650	1953.60	2.32%	13	<b>1605</b>
675	1953.03	2.28%	13	<b>1627</b>
700	1952.48	2.20%	13	<b>1675</b>
725	1951.93	2.20%	13	<b>1675</b>
750	1951.43	2.00%	13	<b>1809</b>
775	1950.94	1.96%	13	<b>1838</b>
800	1950.46	1.92%	13	<b>1869</b>
825	1949.97	1.96%	13	<b>1838</b>
850	1949.23	2.96%	13	<b>1319</b>



# FLOWPATH

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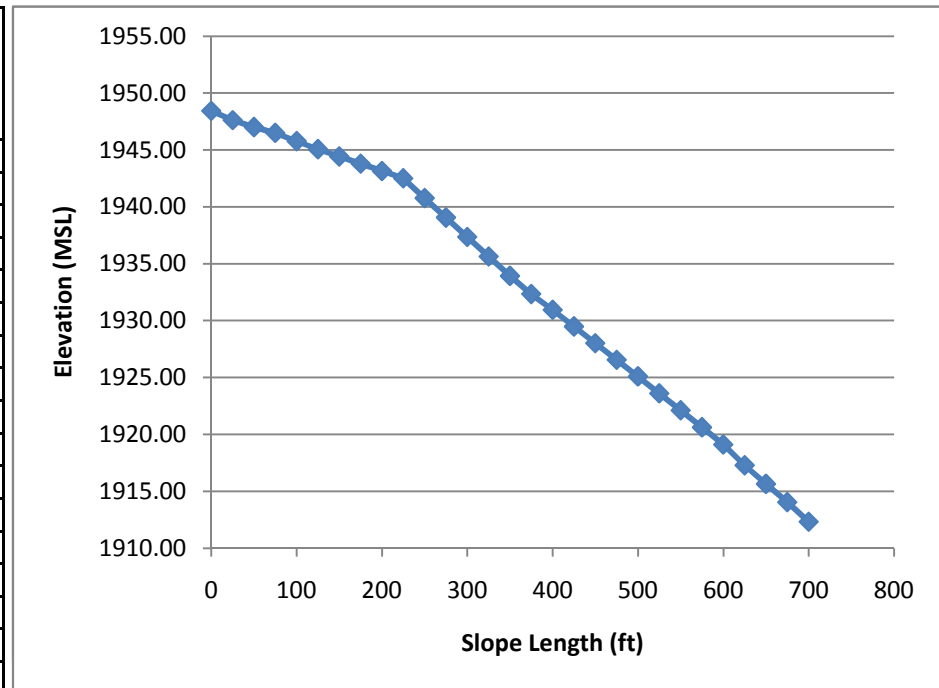
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	1941.10			
25	1939.86	4.96%	13	<b>870</b>
50	1939.00	3.44%	13	<b>1169</b>
75	1937.89	4.44%	13	<b>952</b>
100	1936.77	4.48%	13	<b>945</b>
125	1935.32	5.80%	13	<b>767</b>
150	1933.85	5.88%	13	<b>759</b>
175	1932.92	3.72%	13	<b>1097</b>
200	1932.08	3.36%	13	<b>1191</b>
225	1931.12	3.84%	13	<b>1070</b>
250	1929.92	4.80%	13	<b>894</b>
275	1928.79	4.52%	13	<b>938</b>
300	1927.73	4.24%	13	<b>988</b>
325	1926.66	4.28%	13	<b>980</b>
350	1925.55	4.44%	13	<b>952</b>
375	1924.04	6.04%	13	<b>743</b>
400	1922.52	6.08%	13	<b>739</b>
425	1921.00	6.08%	13	<b>739</b>
450	1919.82	4.72%	13	<b>906</b>
475	1918.75	4.28%	13	<b>980</b>
500	1917.70	4.20%	13	<b>995</b>
525	1916.65	4.20%	13	<b>995</b>
550	1915.44	4.84%	13	<b>888</b>
575	1913.86	6.32%	13	<b>716</b>
600	1912.28	6.32%	13	<b>716</b>
625	1910.71	6.28%	13	<b>720</b>
650	1909.15	6.24%	13	<b>724</b>
675	1907.32	7.32%	14	<b>1525</b>
700	1905.23	8.36%	14	<b>1378</b>
725	1903.16	8.28%	14	<b>1388</b>
750	1901.08	8.32%	14	<b>1383</b>
775	1899.01	8.28%	14	<b>1388</b>



# FLOWPATH

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Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	1948.42			
25	1947.61	3.24%	13	<b>1226</b>
50	1947.00	2.44%	13	<b>1541</b>
75	1946.49	2.04%	13	<b>1780</b>
100	1945.77	2.88%	13	<b>1348</b>
125	1945.06	2.84%	13	<b>1364</b>
150	1944.42	2.56%	13	<b>1483</b>
175	1943.78	2.56%	13	<b>1483</b>
200	1943.14	2.56%	13	<b>1483</b>
225	1942.50	2.56%	13	<b>1483</b>
250	1940.76	6.96%	13	<b>663</b>
275	1939.05	6.84%	13	<b>672</b>
300	1937.34	6.84%	13	<b>672</b>
325	1935.63	6.84%	13	<b>672</b>
350	1933.92	6.84%	13	<b>672</b>
375	1932.33	6.36%	13	<b>713</b>
400	1930.94	5.56%	13	<b>794</b>
425	1929.48	5.84%	13	<b>763</b>
450	1928.01	5.88%	13	<b>759</b>
475	1926.55	5.84%	13	<b>763</b>
500	1925.09	5.84%	13	<b>763</b>
525	1923.60	5.96%	13	<b>751</b>
550	1922.11	5.96%	13	<b>751</b>
575	1920.62	5.96%	13	<b>751</b>
600	1919.10	6.08%	13	<b>739</b>
625	1917.28	7.28%	13	<b>639</b>
650	1915.64	6.56%	13	<b>695</b>
675	1914.04	6.40%	13	<b>709</b>
700	1912.32	6.88%	13	<b>669</b>

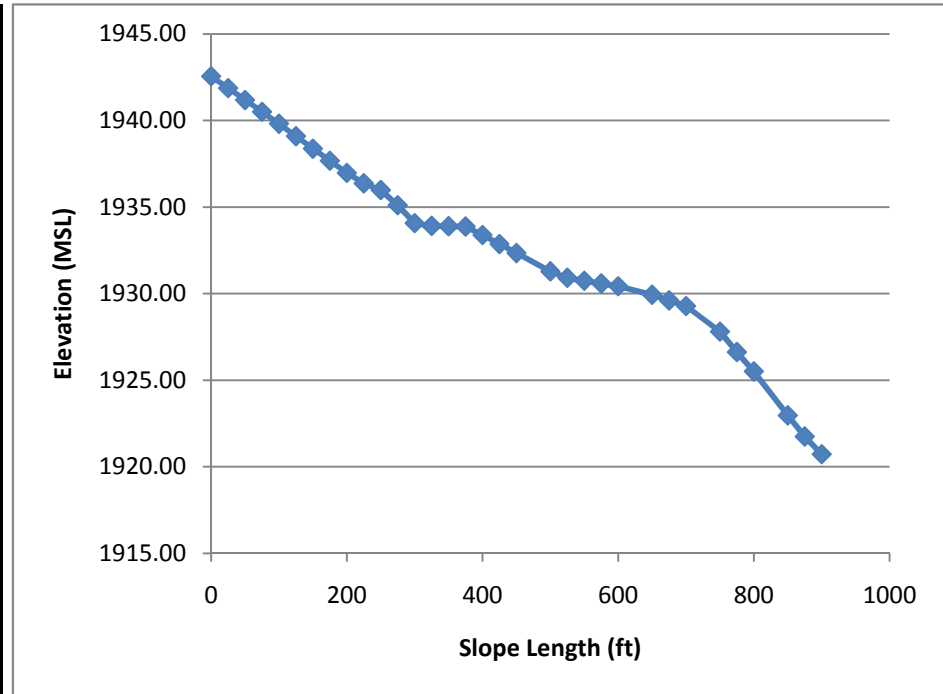




# FLOWPATH

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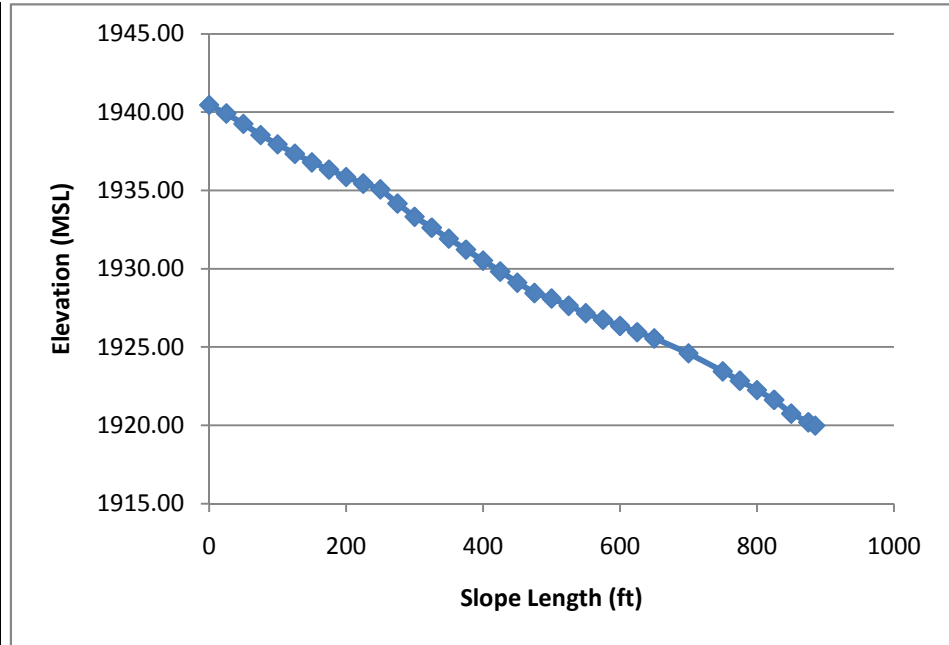
Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	1942.55			
25	1941.87	2.72%	13	1412
50	1941.18	2.76%	13	1395
75	1940.50	2.72%	13	1412
100	1939.81	2.76%	13	1395
125	1939.09	2.88%	13	1348
150	1938.37	2.88%	13	1348
175	1937.67	2.80%	13	1379
200	1936.97	2.80%	13	1379
225	1936.37	2.40%	13	1562
250	1935.98	1.56%	13	2209
275	1935.10	3.52%	13	1147
300	1934.07	4.12%	13	1011
325	1933.91	0.64%	13	4526
350	1933.89	0.08%	13	24148
375	1933.87	0.08%	13	24148
400	1933.38	1.96%	13	1838
425	1932.86	2.08%	13	1752
450	1932.34	2.08%	13	1752
500	1931.28	2.12%	13	1726
525	1930.91	1.48%	13	2305
550	1930.74	0.68%	13	4311
575	1930.58	0.64%	13	4526
600	1930.42	0.64%	13	4526
650	1929.93	0.98%	13	3212
675	1929.60	1.32%	13	2527
700	1929.28	1.28%	13	2590
750	1927.80	2.96%	13	1319
775	1926.62	4.72%	13	906
800	1925.50	4.48%	13	945
850	1922.96	5.08%	13	854
875	1921.74	4.88%	13	882
900	1920.72	4.08%	13	1019



# FLOWPATH

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Slope Length (ft)	Elevation (MSL)	Slope (%)	Erosion Layer (inch)	Max Slope Length (ft)
0	1940.45			
25	1939.91	2.16%	13	1700
50	1939.25	2.64%	13	1446
75	1938.53	2.88%	13	1348
100	1937.94	2.36%	13	1583
125	1937.34	2.40%	13	1562
150	1936.79	2.20%	13	1675
175	1936.33	1.84%	13	1934
200	1935.86	1.88%	13	1901
225	1935.44	1.68%	13	2081
250	1935.07	1.48%	13	2305
275	1934.16	3.64%	13	1117
300	1933.32	3.36%	13	1191
325	1932.62	2.80%	13	1379
350	1931.92	2.80%	13	1379
375	1931.22	2.80%	13	1379
400	1930.52	2.80%	13	1379
425	1929.82	2.80%	13	1379
450	1929.11	2.84%	13	1364
475	1928.45	2.64%	13	1446
500	1928.10	1.40%	13	2410
525	1927.64	1.84%	13	1934
550	1927.16	1.92%	13	1869
575	1926.75	1.64%	13	2122
600	1926.35	1.60%	13	2164
625	1925.95	1.60%	13	2164
650	1925.55	1.60%	13	2164
700	1924.60	1.90%	13	1885
750	1923.45	2.30%	13	1616
775	1922.85	2.40%	13	1562
800	1922.25	2.40%	13	1562
825	1921.63	2.48%	13	1521
850	1920.75	3.52%	13	1147
875	1920.20	2.20%	13	1675
885	1919.99	2.10%	13	1739



## ATTACHMENT 6

## Channel Transitions - Contracting Transition Analysis

Ref: pages 552-559, "Channel Transitions and Controls" (1949) by A.T. Ippen, in Engineering, Hydraulics", edited by H. Rouse, and Section 706.2.1.1 of the Clark County "Hydrologic Criteria and Drainage Design Manual"

Rev: April 9, 2011

### 1. Enter channel flow conditions

	Flow rate Q (cfs)	Velocity V (ft/s)	Side slope Z (ft/ft)	Froude Number
Upstream Channel:	Q1 = 578.0	V1 = 15.24	Z1 = 0.00	2.136626
Downstream Channel:	Q2 = 578.0	V2 = 15.82	Z1 = 2.00	1.932637

### 2. Enter channel flow depth

	Flow depth y (ft)
Upstream Channel:	y1 = 1.58
Downstream Channel:	y2 = 3.39

Note: For Expanding transitions use:  $L_t = 1.5 (Tw) Fr_1$   
 Where: Tw = difference in top widths of normal water surface  
 Fr1 = Froude number at upstream section

	Computed bottom width b (ft)			Equiv. rectangular width (ft)
Main Channel:	b1 = 24.004	at side slope =	0.00	24.004
Side Channel:	b2 = 3.998	at side slope =	2.00	10.778

### 3. Compute the length of the contracting transition

Upstream main channel n:	n1 =	0.015	Hyd R1=	1.396199
Upstream main channel slope:	S1 =	1.52% at normal depth		
Downstream channel n:	n1 =	0.015	Hyd R1=	1.907077
Downstream side channel slope:	S3 =	1.08% at normal depth		

Estimated upstream channel:	b1-actual=	24.004
Est. channel depth upstream:	y1(est) =	1.58
Velocity at upstream end:	V1=	15.240
Equiv. rect. width upstream:	b1-rect =	24.004
Froude equiv. rect. upstream:	Fr1-rect =	2.137

Flow rate for contraction:	Q1 = Q3 =	578.0
Chan. bottom below Contraction:	b3-actual =	3.998 ft
Chan. Side slope below contr.:	z3 =	2.00
Chan Vel below contr.:	V3 =	15.82
Comp. Chan. Depth below contr.:	y3 =	3.390 ft
Equiv. rect width below contr.:	b3-rect =	10.777
Froude equiv. rect. Below contr.:	Fr3-rect =	1.514

target y5/y4 :	y3/y1 =	2.146
estimated:	y2/y1 =	1.4720 Set value so cell F53=0
Computed beta-1:	beta-1 =	39.146
Computed Theta:	theta =	10.204
Comp Fr middle:	Fr-mid =	1.561
Computed Theta:	theta =	10.204 test using equation 52 of Ippen

enter test for beta-2:	beta-2 =	59.023 Set value so cell F50=0
Computed Theta:	theta-2 =	10.204 Using equation 52 of Ippen, & equ 744 of Clark Co.
Theta1-theta-2 =	0.0001307	Should be less than ±0.002
computed y3/y2:	y3/y2 =	1.457 Using equation 53 of Ippen
computed y3/y1:	y3/y1 =	2.145
y5/y4 - y3/y1 =	0.0003839	Should be less than ±0.002
length of Transition (longitudinal):	Lt= L1+L2 =	55.58 ft

## Channel Transitions - Contracting Transition Analysis

Ref: pages 552-559, "Channel Transitions and Controls" (1949) by A.T. Ippen, in Engineering, Hydraulics", edited by H. Rouse, and Section 706.2.1.1 of the Clark County "Hydrologic Criteria and Drainage Design Manual"

Rev: April 9, 2011

### 1. Enter channel flow conditions

	Flow rate Q (cfs)	Velocity V (ft/s)	Side slope Z (ft/ft)	Froude Number
Upstream Channel:	Q1 = 417.0	V1 = 15.92	Z1 = 0.00	2.451204
Downstream Channel:	Q2 = 417.0	V2 = 18.82	Z1 = 2.00	2.778048

### 2. Enter channel flow depth

	Flow depth y (ft)
Upstream Channel:	y1 = 1.31
Downstream Channel:	y2 = 1.88

Note: For Expanding transitions use:  $L_t = 1.5 (Tw) Fr_1$   
 Where: Tw = difference in top widths of normal water surface  
 Fr1 = Froude number at upstream section

	Computed bottom width b (ft)			Equiv. rectangular width (ft)
Main Channel:	b1 = 19.995	at side slope =	0.00	19.995
Side Channel:	b2 = 8.026	at side slope =	2.00	11.786

### 3. Compute the length of the contracting transition

Upstream main channel n:	n1 =	0.015	Hyd R1=	1.158234
Upstream main channel slope:	S1 =	2.12% at normal depth		
Downstream channel n:	n1 =	0.015	Hyd R1=	1.348307
Downstream side channel slope:	S3 =	2.42% at normal depth		

Estimated upstream channel:	b1-actual=	19.995
Est. channel depth upstream:	y1(est) =	1.31
Velocity at upstream end:	V1=	15.920
Equiv. rect. width upstream:	b1-rect =	19.995
Froude equiv. rect. upstream:	Fr1-rect =	2.451

Flow rate for contraction:	Q1 = Q3 =	417.0
Chan. bottom below Contraction:	b3-actual =	8.026 ft
Chan. Side slope below contr.:	z3 =	2.00
Chan Vel below contr.:	V3 =	18.82
Comp. Chan. Depth below contr.:	y3 =	1.880 ft
Equiv. rect width below contr.:	b3-rect =	11.786
Froude equiv. rect. Below contr.:	Fr3-rect =	2.419

target y5/y4 :	y3/y1 =	1.435
estimated:	y2/y1 =	1.2080 Set value so cell F53=0
Computed beta-1:	beta-1 =	28.108
Computed Theta:	theta =	4.255
Comp Fr middle:	Fr-mid =	2.151
Computed Theta:	theta =	4.255 test using equation 52 of Ippen

enter test for beta-2:	beta-2 =	32.005 Set value so cell F50=0
Computed Theta:	theta-2 =	4.255 Using equation 52 of Ippen, & equ 744 of Clark Co.
Theta1-theta-2 =	0.0001223	Should be less than $\pm 0.002$
computed y3/y2:	y3/y2 =	1.188 Using equation 53 of Ippen
computed y3/y1:	y3/y1 =	1.435
y5/y4 - y3/y1 =	0.0001023	Should be less than $\pm 0.002$
length of Transition (longitudinal):	Lt= L1+L2 =	80.44 ft

## Channel Transitions - Contracting Transition Analysis

Ref: pages 552-559, "Channel Transitions and Controls" (1949) by A.T. Ippen, in Engineering, Hydraulics", edited by H. Rouse, and Section 706.2.1.1 of the Clark County "Hydrologic Criteria and Drainage Design Manual"

Rev: April 9, 2011

### 1. Enter channel flow conditions

	Flow rate Q (cfs)	Velocity V (ft/s)	Side slope Z (ft/ft)	Froude Number
Upstream Channel:	Q1 = 692.0	V1 = 21.23	Z1 = 0.00	2.930409
Downstream Channel:	Q2 = 692.0	V2 = 22.52	Z1 = 2.00	3.087003

### 2. Enter channel flow depth

	Flow depth y (ft)
Upstream Channel:	y1 = 1.63
Downstream Channel:	y2 = 2.15

Note: For Expanding transitions use:  $L_t = 1.5 (Tw) Fr_1$   
 Where: Tw = difference in top widths of normal water surface  
 Fr1 = Froude number at upstream section

	Computed bottom width b (ft)			Equiv. rectangular width (ft)
Main Channel:	b1 = 19.997	at side slope =	0.00	19.997
Side Channel:	b2 = 9.992	at side slope =	2.00	14.292

### 3. Compute the length of the contracting transition

Upstream main channel n:	n1 =	0.015	Hyd R1 =	1.40152
Upstream main channel slope:	S1 =	2.93% at normal depth		
Downstream channel n:	n1 =	0.015	Hyd R1 =	1.567184
Downstream side channel slope:	S3 =	2.84% at normal depth		

Estimated upstream channel:	b1-actual =	19.997
Est. channel depth upstream:	y1(est) =	1.63
Velocity at upstream end:	V1 =	21.230
Equiv. rect. width upstream:	b1-rect =	19.997
Froude equiv. rect. upstream:	Fr1-rect =	2.930

Flow rate for contraction:	Q1 = Q3 =	692.0
Chan. bottom below Contraction:	b3-actual =	9.992 ft
Chan. Side slope below contr.:	z3 =	2.00
Chan Vel below contr.:	V3 =	22.52
Comp. Chan. Depth below contr.:	y3 =	2.150 ft
Equiv. rect width below contr.:	b3-rect =	14.292
Froude equiv. rect. Below contr.:	Fr3-rect =	2.707

target y5/y4 :	y3/y1 =	1.319
estimated:	y2/y1 =	1.1550 Set value so cell F53=0
Computed beta-1:	beta-1 =	22.376
Computed Theta:	theta =	2.758
Comp Fr middle:	Fr-mid =	2.677
Computed Theta:	theta =	2.758 test using equation 52 of Ippen

enter test for beta-2:	beta-2 =	24.424 Set value so cell F50=0
Computed Theta:	theta-2 =	2.759 Using equation 52 of Ippen, & equ 744 of Clark Co.
Theta1-theta-2 =	0.0003897	Should be less than $\pm 0.002$
computed y3/y2:	y3/y2 =	1.143 Using equation 53 of Ippen
computed y3/y1:	y3/y1 =	1.320
y5/y4 - y3/y1 =	-0.00137	Should be less than $\pm 0.002$
length of Transition (longitudinal):	Lt = L1+L2 =	103.83 ft



## Channel Transitions - Contracting Transition Analysis

Ref: pages 552-559, "Channel Transitions and Controls" (1949) by A.T. Ippen, in Engineering, Hydraulics", edited by H. Rouse, and Section 706.2.1.1 of the Clark County "Hydrologic Criteria and Drainage Design Manual"

Rev: April 9, 2011

### 1. Enter channel flow conditions

	Flow rate Q (cfs)	Velocity V (ft/s)	Side slope Z (ft/ft)	Froude Nur
Upstream Channel:	Q1 = 452.0	V1 = 10.26	Z1 = 6.00	1.553368
Downstream Channel:	Q2 = 514.0	V2 = 25.80	Z1 = 2.00	4.2037

### 2. Enter channel flow depth

	Flow depth y (ft)
Upstream Channel:	y1 = 2.71
Downstream Channel:	y2 = 1.40

Note: For Expanding transitions use:  $L_t = 1.5 (Tw) Fr_1$   
Where: Tw = difference in top widths of normal water surface  
Fr1 = Froude number at upstream section

	Computed bottom width b (ft)			Equiv. rectangular width (ft)
Main Channel:	b1 = -0.004	at side slope =	6.00 horiz to 1.00 vert	16.256
Side Channel:	b2 = 11.430	at side slope =	2.00 horiz to 1.00 vert	14.230

### 3. Compute the length of the contracting transition

Upstream main channel n:	n1 =	0.03	Hyd R1 =	1.33641
Upstream main channel slope:	S1 =	2.91% at normal depth		
Downstream channel n:	n1 =	0.015	Hyd R1 =	1.126115
Downstream side channel slope:	S3 =	5.79% at normal depth		

Estimated upstream channel:	b1-actual =	-0.004
Est. channel depth upstream:	y1(est) =	2.71
Velocity at upstream end:	V1 =	10.260
Equiv. rect. width upstream:	b1-rect =	16.256
Froude equiv. rect. upstream:	Fr1-rect =	1.098

Flow rate for contraction:	Q1 = Q3 =	452.0
Chan. bottom below Contraction:	b3-actual =	11.430 ft
Chan. Side slope below contr.:	z3 =	2.00
Chan Vel below contr.:	V3 =	25.80
Comp. Chan. Depth below contr.:	y3 =	1.256 ft
Equiv. rect width below contr.:	b3-rect =	13.943
Froude equiv. rect. Below contr.:	Fr3-rect =	4.056

target y5/y4 :	y3/y1 =	0.464
estimated:	y2/y1 =	0.2787 Set value so cell F53=0
Computed beta-1:	beta-1 =	22.603
Computed Theta:	theta =	-33.595
Comp Fr middle:	Fr-mid =	3.452
Computed Theta:	theta =	-33.595 test using equation 52 of Ippen

enter test for beta-2:	beta-2 =	3.4443887 Set value so cell F50=0
Computed Theta:	theta-2 =	-33.618 Using equation 52 of Ippen, & equ 744 of Clark Co.
Theta1-theta-2 =	-0.02261	Should be less than ±0.002
computed y3/y2:	y3/y2 =	0.080 Using equation 53 of Ippen
computed y3/y1:	y3/y1 =	0.022
y5/y4 - y3/y1 =	0.4414278	Should be less than ±0.002

length of Transition (longitudinal):  $L_t = L_1 + L_2 =$  8.61 ft

**NOTE: EQUATION COULD NOT BE BALANCED WITH LOW UPSTREAM FR NUMBER  
APPLIED A 50-FT MINIMUM TRANSITION**