



Subject Sunrise Mountain

Hydrologic Calculations

Made by MSU

Checked by JDP

Approved by AFN

Job No 093-97436

Date 02/25/11

Sheet No 1 of 4

## **OBJECTIVE:**

Evaluate the post-development flow conditions within the Site. The results of this analysis are utilized in designing the stormwater management structures.

## **DESIGN CRITERIA AND ASSUMPTIONS:**

1. Hydrologic parameters used in this analysis are provided in Appendix E.
2. Subbasin delineations are shown in Attachment 1 of this appendix.
3. HEC-HMS was used to calculate the peak flows of each subbasin.

## **CALCULATIONS:**

### **Hydrologic Modeling**

The U.S. Army Corps of Engineers' Hydrologic Modeling System (HEC-HMS) computer program was used for the surface water hydrology analysis of the site. Design rainfall used for the hydrology analysis is based on a 200-year return period, 6-hour duration event.

The site is located in an arid environment flanked by steep hillsides along the east and west boundaries with basically no vegetation coverage. A large upstream watershed north of the site also contributes surface drainage flow to the site. Surface water from this northern watershed will be managed through a proposed detention dam before release to the proposed downstream drainage conveyance system along the eastern perimeter of the landfill. The site is divided into four main sub-watersheds:

- Rockfall
- Southeast
- Southwest
- West

The Rockfall consists of the upstream northern watershed and the subareas north and east of the landfill. The Rockfall sub-watershed is the run-on surface drainage flow to the site. Peak flows from the Rockfall subwatershed will be conveyed through diversion berms and channels to the Rockfall Channel for off-site discharge to Las Vegas Wash. The Rockfall Channel analysis is provided in Appendix K.

The Southeast, Southwest, and West are the runoff watersheds from the landfill. Surface flows from these watersheds will be managed through detention ponds before release from the site.



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Hydrologic parameters used for the analysis are the subbasin area, runoff curve number (CN) and time of concentration. Other parameters that include losses, transform parameters using the National Resources Conservation Service (NRCS), formerly the Soil Conservation Service (SCS), NCRS method were used in the HEC-HMS computer program. Also, the equations used outside of the HEC-HMS model to obtain concentration time, lag time, etc. were obtained from the Clark County Hydrologic Criteria and Drainage Design Manual (HCDDM).

### Subbasin Size

Determining the subbasin size defines the area that produces the surface water flow. Non-developed subareas were delineated based on their natural topographic divides shown on a photogrammetric survey of the Site completed in June 2007. Developed subbasins were delineated using the design contours of the Site. The locations of the subbasins are shown on Attachment 1.

### Curve Number and Ground Condition

The site is located in an area of hydrologic soils A, B, and D. The soil data was obtained from the United States Department of Agriculture (USDA) SCS Web Soil Survey as provided in Appendix D, Attachment 1. Soils with hydrologic soil group D are associated with higher runoff coefficients and lower for soil group B. The flow calculations used hydrologic soil group D.

Field survey and analysis of aerial photography indicated that the current condition of the site consists mainly of non-vegetative rocky soils. A CN of 88 was used for all the subbasins within the site. A CN of 98 was used for impermeable areas such as settling basins. A summary of all hydrologic parameters is provided in Appendix E.

**Time of Concentration.** Time of concentration ( $T_c$ ) is the time for runoff to travel from the most hydraulically distant point in a drainage subarea to the point under consideration. Calculation for time-of-concentration consists of overland flow, shallow concentrated flow, and open channel flow, or some combination, to the collection point of the drainage subarea.

where:

$$T_c = T_i + T_t$$

$T_c$  = Time of concentration (min)  
 $T_i$  = Initial or overland flow time (min)  
 $T_t$  = Travel time in swale, ditch, channel, downdrain, pipe culvert, etc. (min)

**Overland Flow.** The initial or overland flow time ( $t_i$ ) is based on Equation 602, HCDDM.

$$T_i = 1.8 (1.1 - K)L_o^{1/2}/S^{1/3}$$

where:

$T_i$  = Initial or overland flow time (min)  
 $K$  = Flow resistance coefficient  
 $L_o$  = Length of overland flow (feet)  
 $S$  = Average basin slope (%)



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the flow resistance coefficient, K, is based on Equation 603, HCDDM.

$$K = 0.0132 \text{ CN} - 0.39$$

**Shallow Concentrated Flow.** After a maximum 100 feet, overland or sheet flow usually becomes shallow concentrated flow. Flow velocities for undeveloped and developed subareas were calculated based on the following NRCS equation for shallow concentrated flow:

$$V = 16.1345 (S)^{0.5} \text{ (unpaved areas)}$$

where: V = average velocity (fps)  
S = slope of hydraulic gradeline (ft/ft)

**Open Channel Flow.** Open channels are assumed to start where cross section information has been obtained and/or flow paths are visible on the aerial photographs and/or topographic map. The flow times for open channels were estimated based on average flow velocities. Average velocities are calculated using Manning's equation.

Once the average velocity is determined, the flow time can be estimated by the following:

$$T_t = L / (60)(V)$$

where:  $T_t$  = travel time (min)  
L = flow length (feet)  
V = average velocity (fps)

## Lag Time

The subarea lag time used in the HEC-HMS computer program is equal to 0.6  $T_c$  as indicated on Section 606.3, HCDDM. The lag time empirical relationship to the time of concentration is based on small watersheds that are less than 1 square miles.


HEC-HMS data input which include subarea designation and sizes and lag times are presented in Attachment 2 of this appendix.

## Reach

HEC-HMS data input for reaches between junction points were modeled as trapezoidal channels, rectangular channels, or v berms and assumed to be lined with riprap, grouted riprap or concrete. Size and shapes are based on existing ground condition and proposed grading plan for the site.

## Sediment Bulking Factor

To account for the potential of sediment inflow in the storm water, a sediment bulking factor was applied to the peak in-flow to all stormwater structures. A bulking factor of 30% and 10% was applied for undeveloped and developed areas, respectively. All areas within the limits of waste were

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considered developed.

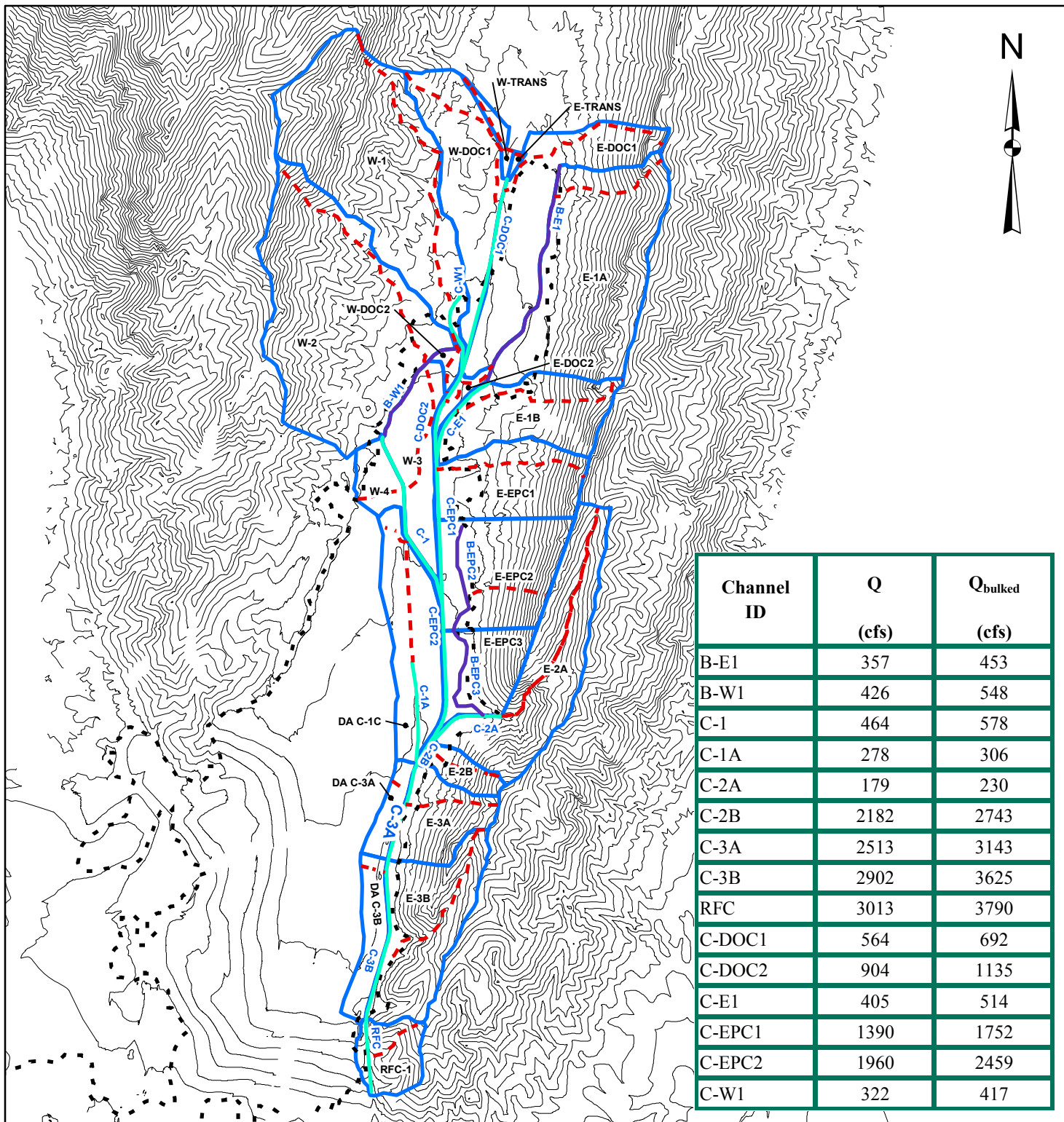
### Detention Basins

Four detention basins are proposed for the site, shown on Attachment 1 of this appendix. These detention basins are proposed at the downstream end of the Southeast, Southwest, and West sub-watersheds. Appendix I describes the design procedures for these basins.

### Conclusions

Results of the HEC-HMS hydrologic analysis are presented in Attachment 3 of this appendix. Peak flows from this analysis were used for determining the bulked flow rates, presented in Attachment 4, and used in the HEC-RAS modeling for designing the conveyance structures for the site.

## ATTACHMENT 1



#### LEGEND

- Subbasins    — Channels     25-ft  
- - - Flow Paths    — Channels  
— Berms

#### REFERENCE

Topography provided by Shaw (2007).

0 750 1,500 3,000 Feet

PROJECT

REPUBLIC SERVICES INC.  
SUNRISE MOUNTAIN LANDFILL  
LAS VEGAS, NEVADA

TITLE

### ROCKFALL BASIN - DRAINAGE AREAS



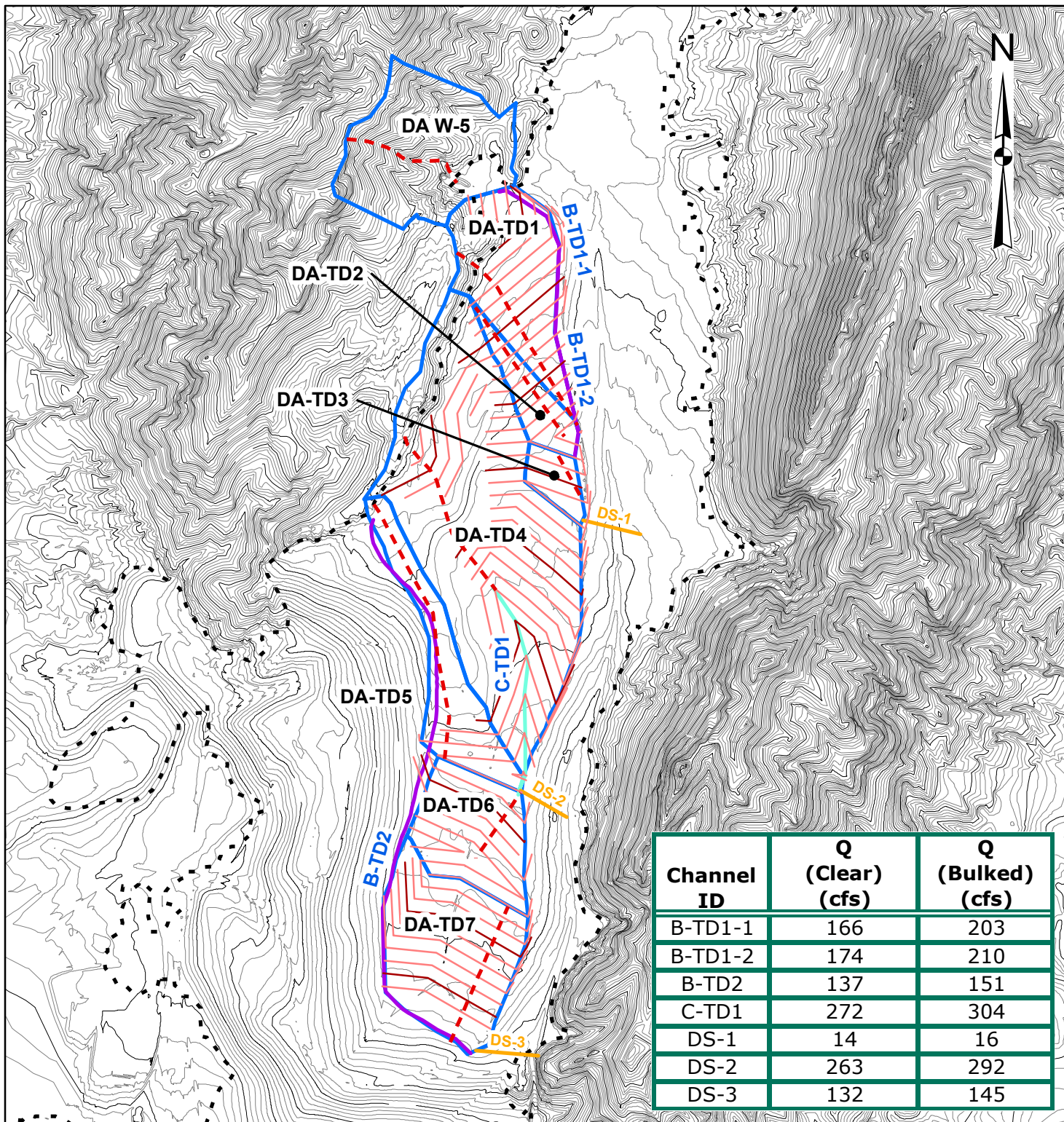
PROJECT No.	0939743611
DESIGN	XX XX
GIS	ENN 06/16/2011
CHECK	XXX XXXX
REVIEW	XXX XXXX

SCALE AS SHOWN REV. 1

FIGURE: 1-1



Project: Q:\GIS\Republic\09397436\PROJECT\SHMS\_Modeling\Figure2\_Topdeck\_Hydrology.mxd Plot: Q:\GIS\Republic\09397436\PROJECT\SHMS\_Modeling\Figure2\_Topdeck\_Hydrology.pdf



#### LEGEND

Subbasins	Channels	Elevation	Proposed Grading
		5-ft	2-ft
		25-ft	10-ft

#### REFERENCE

Topography provided by Shaw (2007).

0 750 1,500  
Feet

PROJECT

REPUBLIC SERVICES INC.  
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TOPDECK BASIN - DRAINAGE AREAS



PROJECT No.	0939743611
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SCALE AS SHOWN

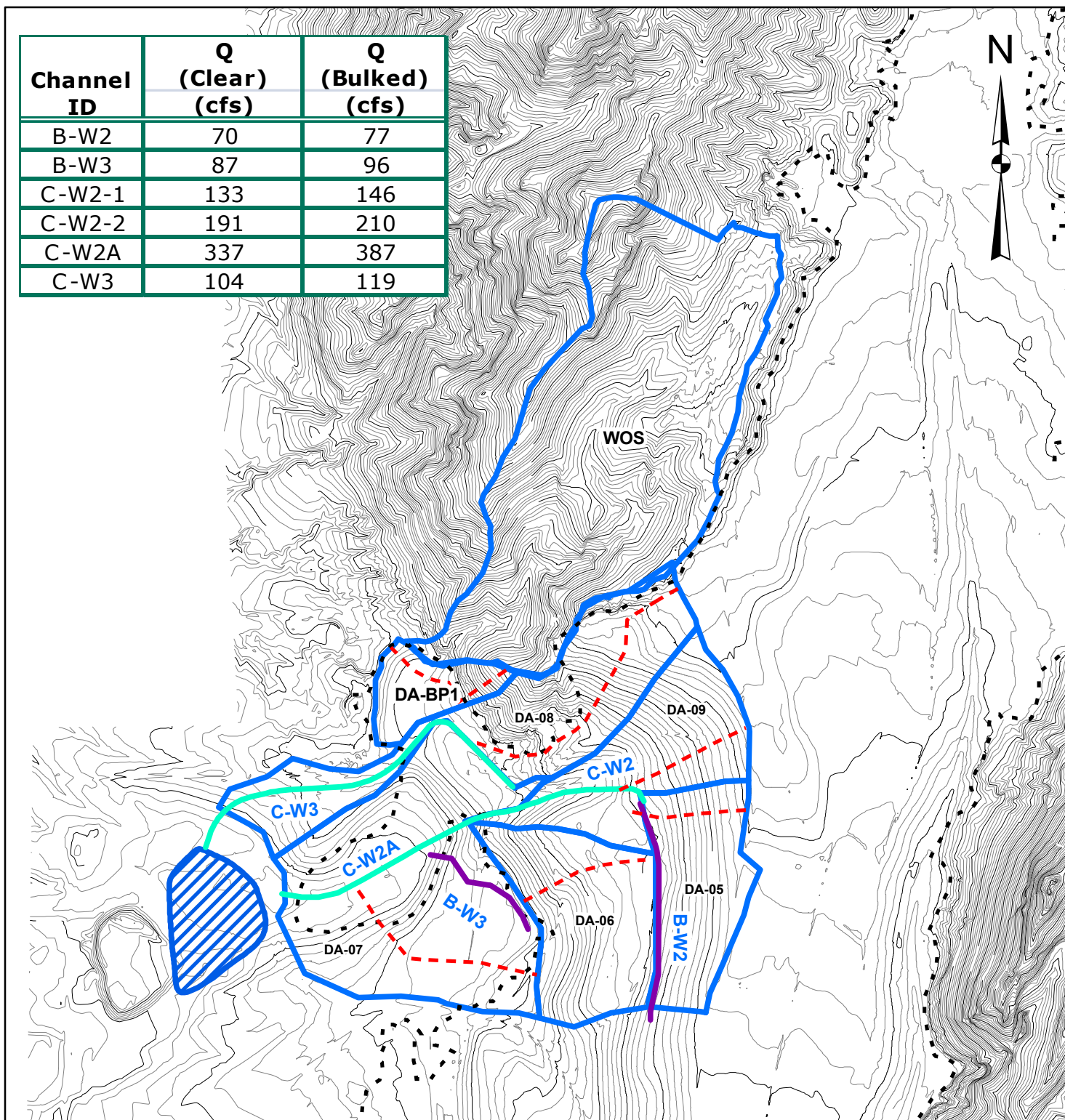
REV. 1

FIGURE: 1-2










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Channel ID	Q (Clear) (cfs)	Q (Bulked) (cfs)
B-W2	70	77
B-W3	87	96
C-W2-1	133	146
C-W2-2	191	210
C-W2A	337	387
C-W3	104	119



#### LEGEND

	Subbasins		Flow Paths	<b>Channels</b>	<b>Elevation</b>
	Detention Basin		Berms		Channels
			5-ft		
			25-ft		

#### REFERENCE

Topography provided by Shaw (2007).

0 250 500 1,000 1,500  
Feet

PROJECT

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SUNRISE MOUNTAIN LANDFILL  
LAS VEGAS, NEVADA

TITLE

**WEST BASIN - DRAINAGE AREAS**



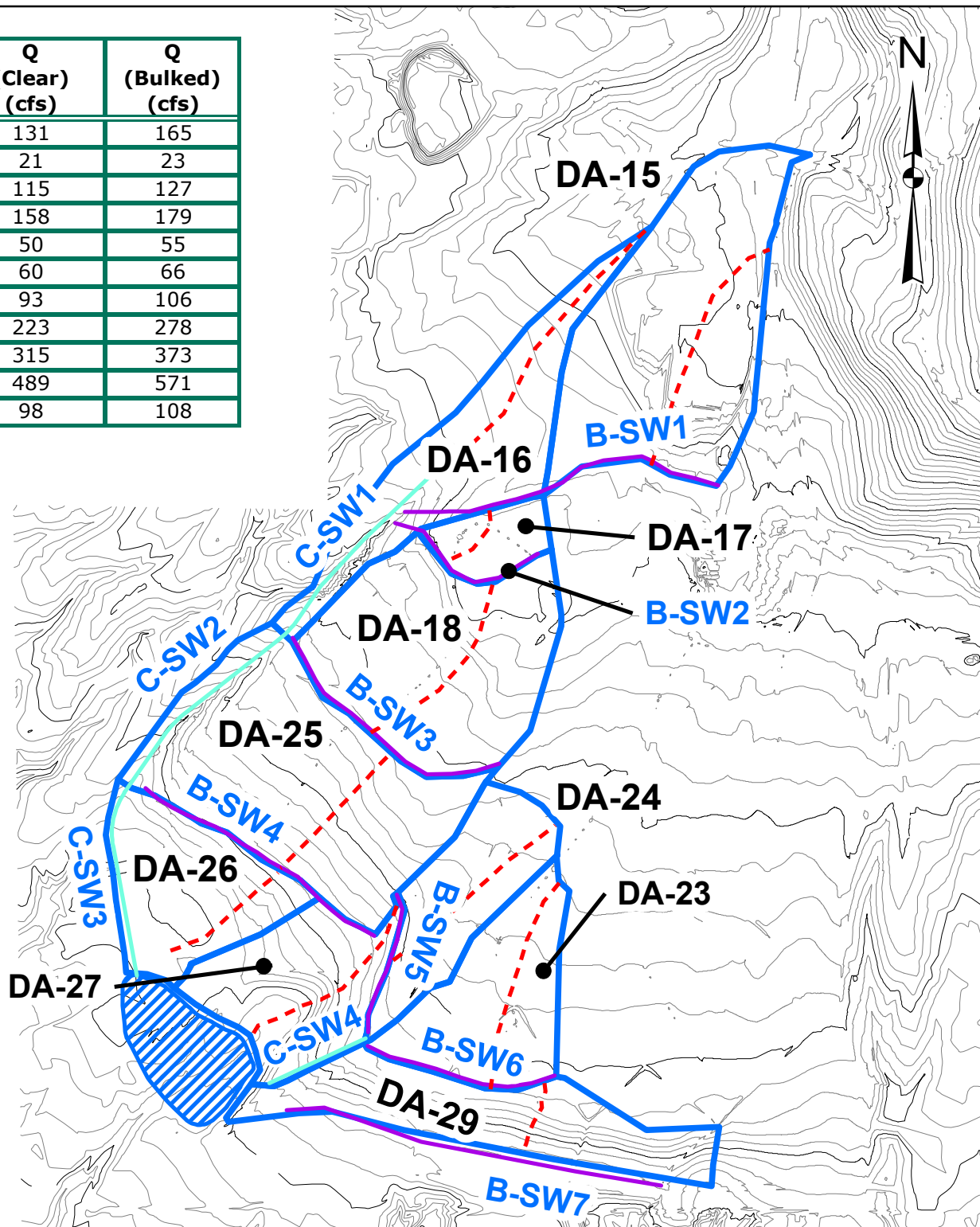
PROJECT No.	0939743611
DESIGN	XX XX
GIS	ENN 02/23/2011
CHECK	XXX XXXX
REVIEW	XXX XXXX

SCALE AS SHOWN REV. 1

**FIGURE: 1-3**



Channel ID	Q (Clear) (cfs)	Q (Bulked) (cfs)
B-SW1	131	165
B-SW2	21	23
B-SW3	115	127
B-SW4	158	179
B-SW5	50	55
B-SW6	60	66
B-SW7	93	106
C-SW1	223	278
C-SW2	315	373
C-SW3	489	571
C-SW4	98	108



#### LEGEND

	Subbasins		Flow Paths		Berms		Elevation
	Detention Basin				Channels		5-ft
							25-ft

#### REFERENCE

Topography provided by Shaw (2007).

0 250 500 1,000 1,500  
Feet

PROJECT

REPUBLIC SERVICES INC.  
SUNRISE MOUNTAIN LANDFILL  
LAS VEGAS, NEVADA

TITLE

**SOUTHWEST BASIN - DRAINAGE AREAS**



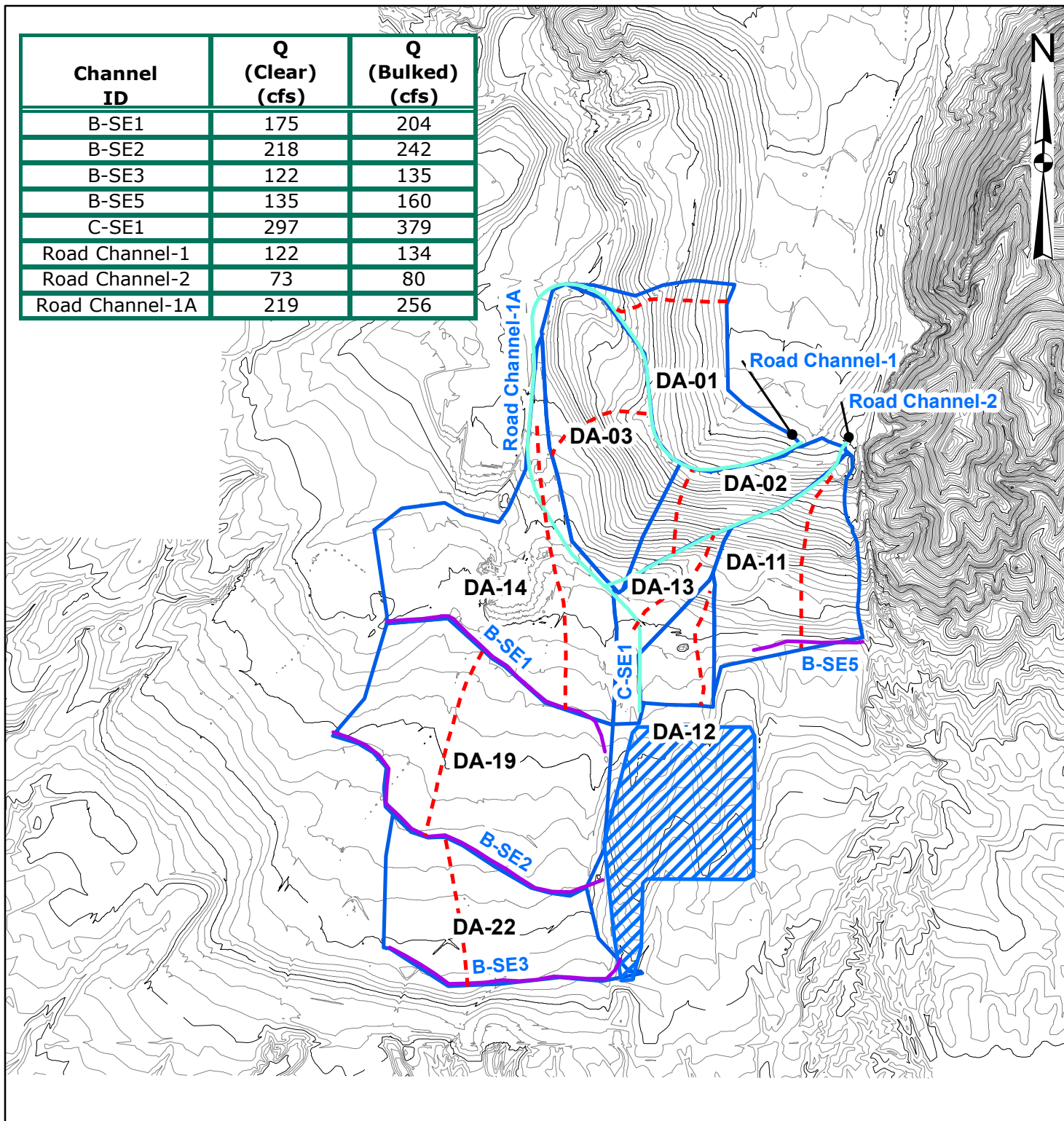
PROJECT No.	0939743611
DESIGN	XX XX
GIS	ENN 02/23/2011
CHECK	XXX XXXX
REVIEW	XXX XXXX

SCALE AS SHOWN REV. 1







**FIGURE: 1-4**

Project: Q:\GIS\Republic\09397436\PROJECTS\HMS\_Modeling\Figure5\_Southeast Hydrology.mxd Plot: Q:\GIS\Republic\09397436\PROJECTS\HMS\_Modeling\Figure5\_Southeast Hydrology.pdf

Channel ID	Q (Clear) (cfs)	Q (Bulked) (cfs)
B-SE1	175	204
B-SE2	218	242
B-SE3	122	135
B-SE5	135	160
C-SE1	297	379
Road Channel-1	122	134
Road Channel-2	73	80
Road Channel-1A	219	256



#### LEGEND

	Subbasins		Flow Paths	<b>Channels</b>	<b>Elevation</b>
	Detention Basin		Berms		Channels
			5-ft		25-ft

#### REFERENCE

Topography provided by Shaw (2007).

0 250 500 1,000 1,500 2,000  
Feet

PROJECT

REPUBLIC SERVICES INC.  
SUNRISE MOUNTAIN LANDFILL  
LAS VEGAS, NEVADA

TITLE

**SOUTHEAST BASIN - DRAINAGE AREAS**



PROJECT No.	0939743611
DESIGN	XX XX
GIS	ENN 02/23/2011
CHECK	XXX XXXX
REVIEW	XXX XXXX

SCALE AS SHOWN REV. 1

**FIGURE: 1-5**

## ATTACHMENT 2





CALCULATIONS

Date:	2/21/2011	Made by:	ENN
Project No.:	0939743611	Checked by:	SSH
Project Short Title:	Sunrise Mountain Landfill Detention Dam	Reviewed by:	GWH
Subject:	Calculation of the Time of Concentration for the Rockfall Channel		

ROCKFALL BASIN  
HMS DATA INPUT - TIME OF CONCENTRATION CALCULATIONS

DA ID	CN	K	AREA	AREA	LENGTH	S	Flow Type	Ti	V	Tt	Tc	Lag
			(ac)	(sqmi)	(ft)	(%)		(min)	(fps)	(min)	(min)	(min)
DA C-1A	88	0.7716	18.27	0.02855	100	14	Overland	2.45				
					1191	2	Shallow		2.2	8.85	11.31	6.8
DA C-3A	88	0.7716	3.71	0.00580	100	13	Overland	2.51				
					48	6	Shallow		4.0	0.20	2.71	1.6
DA C-3B	88	0.7716	6.81	0.01064	100	10	Overland	2.74				
					111	14	Shallow		6.1	0.30	3.05	1.8
E-1A	88	0.7716	41.72	0.06519	100	65	Overland	1.47				
					993	41	Shallow		10.4	1.59	3.06	1.8
E-1B	88	0.7716	18.44	0.02881	100	65	Overland	1.47				
					872	49	Shallow		11.3	1.29		
					1184	3	Shallow		2.9	6.92	9.68	5.8
E-2A	88	0.7716	29.79	0.04655	100	20	Overland	2.18				
					2136	17	Shallow		6.6	5.43		
					2010	16	Shallow		6.5	5.16	12.77	7.7
E-2B	88	0.7716	4.21	0.00658	100	60	Overland	1.51				
					552	45	Shallow		10.8	0.85	2.36	1.4
E-3A	88	0.7716	11.44	0.01788	100	42	Overland	1.70				
					730	39	Shallow		10.1	1.21	2.91	1.7
E-3B	88	0.7716	22.04	0.03444	100	50	Overland	1.60				
					1458	21	Shallow		7.3	3.31	4.92	3.0
E-DOC1	88	0.7716	26.07	0.04073	100	95	Overland	1.30				
					1595	26	Shallow		8.3	3.20	4.50	2.7
E-DOC2	88	0.7716	2.22	0.00347	100	3	Overland	4.10				
					488	6	Shallow		3.9	2.10	6.20	3.7
E-EPC1	88	0.7716	17.88	0.02794	100	70	Overland	1.43				
					1270	31	Shallow		9.0	2.36	3.79	2.3
E-EPC2	88	0.7716	22.29	0.03483	100	95	Overland	1.30				
					1900	20	Shallow		7.2	4.39	5.68	3.4
E-EPC3	88	0.7716	11.82	0.01847	100	95	Overland	1.30				
					1200	20	Shallow		7.2	2.77	4.07	2.4
E-TRANS	88	0.7716	0.35	0.00055	91	10	Overland	2.63			2.63	1.6
RFC-1	88	0.7716	7.57	0.01183	100	65	Overland	1.47				
					464	33	Shallow		9.3	0.83	2.30	1.4
W-1	88	0.7716	49.47	0.07730	100	55	Overland	1.55				
					2702	18	Shallow		6.9	6.55	8.11	4.9
W-2	88	0.7716	56.16	0.08775	99	70	Overland	1.43				
					2105	24	Shallow		7.9	4.42	5.85	3.5
W-3	88	0.7716	12.25	0.01914	100	2	Overland	4.69				
					1071	2	Shallow		2.1	8.53	13.23	7.9
W-4	88	0.7716	5.27	0.00823	100	9	Overland	2.84				
					323	4	Shallow		3.4	1.60	4.44	2.7
W-DOC1	88	0.7716	21.10	0.03297	100	35	Overland	1.81				
					723	20	Shallow		7.2	1.67		
					397	4	Shallow		3.3	1.98		
					391	4	Shallow		3.3	2.00	7.45	4.5
W-DOC2	88	0.7716	1.36	0.00213	100	2	Overland	4.69				
					466	4	Shallow		3.1	2.52	7.22	4.3
W-TRANS	88	0.7716	1.65	0.00258	100	6	Overland	3.25				
					700	8	Shallow		4.6	2.53	5.79	3.5



CALCULATIONS

Date:	2/21/2011	Made by:	ENN
Project No.:	0939743611	Checked by:	SSH
Project Short Title:	Sunrise Mountain Landfill Detention Dam	Reviewed by:	GWH
Subject:	Calculation of the Time of Concentration for the Rockfall Channel		

TOP DECK BASIN  
HMS DATA INPUT - TIME OF CONCENTRATION CALCULATIONS

DA ID	CN	K	AREA	AREA	LENGTH	S	Flow Type	Ti	V	Tt	Tc	Lag
			(ac)	(sqmi)	(ft)	(%)		(min)	(fps)	(min)	(min)	(min)
DA-W5	88	0.7716	12.40	0.01938	100	50	Overland	1.60				
					556	44	Shallow		10.7	0.87	2.47	1.5
DA-TD1	88	0.7716	9.45	0.01477	100	25	Overland	2.02				
					1000	3	Shallow		2.8	5.96	7.99	4.8
DA-TD2	88	0.7716	2.89	0.00452	100	3	Overland	4.10				
					715	3	Shallow		2.8	4.26		
					273	2	Channel		4.6	1.00	9.36	5.6
DA-TD3	88	0.7716	1.77	0.00277	100	3	Overland	4.10				
					140	3	Shallow		2.8	0.83	4.93	3.0
DA-TD4	88	0.7716	31.88	0.04981	100	30	Overland	1.90				
					854	60	Shallow		12.5	1.14	3.04	1.8
DA-TD5	88	0.7716	6.94	0.01084	100	7	Overland	3.09				
					1335	3	Shallow		2.8	7.96	11.05	6.6
DA-TD6	88	0.7716	7.42	0.01159	100	3	Overland	4.10				
					310	3	Shallow		2.8	1.85	5.95	3.6
DA-TD7	88	0.7716	12.08	0.01888	100	3	Overland	4.10				
					662	3	Shallow		2.8	3.95	8.05	4.8



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Subject:	Calculation of the Time of Concentration for the Rockfall Channel		

WEST BASIN  
HMS DATA INPUT - TIME OF CONCENTRATION CALCULATIONS

DA ID	CN	K	AREA	AREA	LENGTH	S	Flow Type	Ti	V	Tt	Tc	Lag
			(ac)	(sqmi)	(ft)	(%)		(min)	(fps)	(min)	(min)	(min)
DA-09	88	0.7716	10.02	0.01566	100	18	Overland	2.27				
					525	17	Shallow		6.7	1.30	3.57	2.1
DA-05	88	0.7716	8.20	0.01281	100	19	Overland	2.24				
					416	19	Shallow		6.9	1.00	3.23	1.9
DA-06	88	0.7716	10.30	0.01609	100	6	Overland	3.27				
					468	20	Shallow		7.2	1.08	4.35	2.6
DA-07	88	0.7716	21.83	0.03411	100	6	Overland	3.27				
					816	10	Shallow		5.1	2.67	5.94	3.6
DA-BP1	88	0.7716	2.90	0.00453	100	25	Overland	2.02				
					520	20	Shallow		7.2	1.21		
					235	6	Shallow		5.3	0.74	3.97	2.4
W-OS1	88	0.7716	37.40	0.05844	100	10	Overland	2.74				
					350	44	Shallow		10.7	0.54		
					2570	11	Shallow		8.6	4.98		
					150	11	Shallow		16.4	0.15	8.42	5.1





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SOUTHWEST BASIN  
HMS DATA INPUT - TIME OF CONCENTRATION CALCULATIONS

DA ID	CN	K	AREA	AREA	LENGTH	S	Flow Type	Ti	V	Tt	Tc	Lag
			(ac)	(sqmi)	(ft)	(%)		(min)	(fps)	(min)	(min)	(min)
DA-15	88	0.7716	20.09	0.03139	100	2	Overland	4.69				
					900	7	Shallow		4.3	3.46	8.16	4.9
DA-16	88	0.7716	11.85	0.01852	100	4	Overland	3.72				
					1253	4	Shallow		3.0	6.92	10.64	6.4
DA-17	88	0.7716	2.83	0.00442	100	2	Overland	4.69				
					200	2	Shallow		2.3	1.46	6.15	3.7
DA-18	88	0.7716	16.73	0.02614	100	5	Overland	3.53				
					740	5	Shallow		3.6	3.42	6.95	4.2
DA-25	88	0.7716	20.52	0.03206	100	6	Overland	3.35				
					541	6	Shallow		3.8	2.38	5.73	3.4
DA-26	88	0.7716	9.33	0.01458	100	6	Overland	3.35				
					482	2	Shallow		2.3	3.52	6.87	4.1
DA-29	88	0.7716	10.84	0.01694	100	10	Overland	2.74				
					230	10	Shallow		5.1	0.75	3.50	2.1
DA-24	88	0.7716	7.72	0.01206	100	2	Overland	4.48				
					790	2	Shallow		2.4	5.38	9.86	5.9
DA-23	88	0.7716	9.35	0.01461	100	2	Overland	4.48				
					910	2	Shallow		2.4	6.20	10.68	6.4
DA-27	88	0.7716	9.17	0.01433	100	5.0	Overland	3.46				
					335	4.8	Shallow		3.5	1.58		
					121	20.7	Shallow		7.3	0.27		
					294	0.7	Shallow		1.3	3.68	8.99	5.4
DA-BP1	88	0.7716	3.30	0.00516	100	36	Overland	1.79				
					542	17	Shallow		6.7	1.36	3.15	1.9



CALCULATIONS

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SOUTHEAST BASIN  
HMS DATA INPUT - TIME OF CONCENTRATION CALCULATIONS

DA ID	CN	K	AREA	AREA	LENGTH	S	Flow Type	Ti	V	Tt	Tc	Lag
			(ac)	(sqmi)	(ft)	(%)		(min)	(fps)	(min)	(min)	(min)
DA-01	88	0.7716	14.29	0.02233	100	15	Overland	2.40				
					529	15	Shallow		6.2	1.41	3.81	2.3
DA-02	88	0.7716	8.50	0.01328	100	22	Overland	2.10				
					390	22	Shallow		7.6	0.85	2.95	1.8
DA-03	88	0.7716	19.55	0.03055	100	17	Overland	2.31				
					552	13	Shallow		5.8	1.58	3.89	2.3
DA-13	88	0.7716	6.30	0.00984	100	23	Overland	2.08				
					668	14	Shallow		6.0	1.84	3.92	2.4
DA-11	88	0.7716	16.14	0.02522	100	19	Overland	2.22				
					990	19	Shallow		7.0	2.36	4.58	2.7
DA-14	88	0.7716	28.14	0.04397	100	7	Overland	3.09				
					1544	3	Shallow		2.9	8.78	11.87	7.1
DA-19	88	0.7716	35.04	0.05475	100	2	Overland	4.69				
					1013	2	Shallow		2.4	7.05	11.75	7.0
DA-12	88	0.7716	5.07	0.00792	100	19	Overland	2.22				
					650	4	Shallow		3.1	3.49	5.71	3.4
DA-22	88	0.7716	18.76	0.02931	100	2.3	Overland	4.48				
					760	2.3	Shallow		2.4	5.18	9.65	5.8

## ATTACHMENT 3





## CALCULATIONS

<b>Date:</b>	2/14/2011	<b>Made by:</b>	ENN
<b>Project No.:</b>	09397436	<b>Checked by:</b>	SSH
<b>Project Short Title:</b>	Sunrise Mountain Landfill Detention Dam	<b>Reviewed by:</b>	GWH
<b>Subject:</b>	Rockfall Basin HEC-HMS Inputs and Results		

### ROCKFALL BASIN HEC-HMS INPUTS AND RESULTS

#### 1.0 OBJECTIVE:

To estimate the runoff volume predicted for the 200-yr rainfall event to each of the proposed channels

#### 2.0 METHODS:

The U.S. Army Corps of Engineer's (USACE) Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) was used to predict runoff volumes to each of the proposed channels within the Rockfall basin. Hydrologic inputs included time of concentration, curve number, drainage area for the watersheds, and channel geometries for the channel reaches. Golder calculated these various inputs as described below. The model was run using the 200-yr design storm depths presented in Exponent (2003). The hydrologic parameters for subbasins N-1, N-2, and N-3, reach "Reach to Rsvr", and junctions Jct N1, N2 and Jct N3 were all taken from Golder's HMS model of the Sunrise Detention Dam submitted in the Hydrology and Hydraulics Report (2011). The stage-area-discharge relationship for the Sunrise Detention Dam (Sunrise DD) was taken from the calculations presented in Golder's Hydrology and Hydraulics Report (2011) for the sediment-accumulation condition.

#### Sub-Basins:

- Lag Time (TL):** Calculated using the methods described in the HCDDM Section 602.
- Curve Number (CN):** Previously determined to be 88 for all areas within the site boundaries.
- Drainage Area:** Delineated and calculated in ESRI's ArcGIS using topography provided by Shaw (2007).
- Loss Method:** SCS Curve Number
- Transform Method:** SCS Unit Hydrograph

#### Rockfall Channel Reaches:

- Length:**
- Channel Slope:** Determined based on Golder's proposed design.
- Channel Geometry:**
  - Mannings N:** Determined to be 0.015 for all concrete-lined channels, 0.030 for all grouted rip-rap channels, and 0.040 for all loose rip-rap channels.
- Routing Method:** Kinematic Wave



## CALCULATIONS

<b>Date:</b>	2/14/2011	<b>Made by:</b>	ENN
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### ROCKFALL BASIN

#### 3.0 RESULTS:

Hydrologic Element	Drainage Area sq. mi.	Peak Discharge cfs	Peak Inflow cfs	Time of Peak	Volume ac-ft
W-TRANS	0.00	13		01Jan2011, 03:06	0.4
E-TRANS	0.00	3		01Jan2011, 03:06	0.1
N-1	0.71	1,308		01Jan2011, 03:16	65.8
N-2	0.23	829		01Jan2011, 03:11	31.5
Jct N1,N2	0.94	1,977		01Jan2011, 03:16	97.3
Reach To Rsv	0.94	1,935		01Jan2011, 03:16	97.4
N-3	0.19	610		01Jan2011, 03:11	21.9
Jct N3	1.13	2,356		01Jan2011, 03:16	119.3
Sunrise DD	1.13	330		01Jan2011, 03:56	119.3
R-TRANS	1.14	330		01Jan2011, 03:51	119.8
E-DOC1	0.04	218		01Jan2011, 03:06	6.3
W-DOC1	0.03	139		01Jan2011, 03:06	5.1
R-DOC1	1.21	562	564	01Jan2011, 03:11	131.3
W-1	0.08	322		01Jan2011, 03:11	12
R-CW1	0.08	320	322	01Jan2011, 03:11	12.1
Jct-DOC2	1.29	882		01Jan2011, 03:11	143.4
E-DOC2	0.00	16		01Jan2011, 03:06	0.5
W-DOC2	0.00	9		01Jan2011, 03:06	0.3
R-DOC2	1.29	892	904	01Jan2011, 03:11	144.4
E1A	0.07	356		01Jan2011, 03:06	10.1
B-E1	0.07	285		01Jan2011, 03:11	10.1
E-1B	0.03	120		01Jan2011, 03:11	4.5
R-CE1	0.09	401	405	01Jan2011, 03:11	14.6
Jct-EPC1	1.39	1,292		01Jan2011, 03:11	159
E-EPC1	0.03	153		01Jan2011, 03:06	4.3
R-EPC1	1.42	1,369	1390	01Jan2011, 03:11	163.5
W-2	0.09	426		01Jan2011, 03:06	13.6
B-W1	0.09	363		01Jan2011, 03:11	13.7
W-3	0.02	73		01Jan2011, 03:11	3
W-4	0.01	44		01Jan2011, 03:06	1.3
R-C1	0.12	460	464	01Jan2011, 03:11	17.8
E-EPC2	0.03	172		01Jan2011, 03:06	5.4
Jct-EPC2	1.57	1,960		01Jan2011, 03:11	186.7
R-EPC2	1.57	1,924	1960	01Jan2011, 03:11	186.9
E-2A	0.05	179		01Jan2011, 03:11	7.2
R-C2A	0.05	171	179	01Jan2011, 03:11	7.3
E-EPC3	0.02	101		01Jan2011, 03:06	2.9
Jct-E2B	1.63	2,159		01Jan2011, 03:11	197
E-2B	0.01	36		01Jan2011, 03:06	1
R-C2B	1.64	2,173	2182	01Jan2011, 03:11	198.1
DA-W5	0.02	106		01Jan2011, 03:06	3
DA-TD1	0.01	61		01Jan2011, 03:11	2.3
B-TD1-1	0.03	155		01Jan2011, 03:11	5.3
DA-TD2	0.00	19		01Jan2011, 03:11	0.7
B-TD1-2	0.04	153		01Jan2011, 03:11	6
DA C-1A	0.03	115		01Jan2011, 03:11	4.4



## CALCULATIONS

<b>Date:</b>	2/14/2011	<b>Made by:</b>	ENN
<b>Project No.:</b>	09397436	<b>Checked by:</b>	SSH
<b>Project Short Title:</b>	Sunrise Mountain Landfill Detention Dam	<b>Reviewed by:</b>	GWH
<b>Subject:</b>	Rockfall Basin HEC-HMS Inputs and Results		

### ROCKFALL BASIN

DA-TD3	0.00	14		01Jan2011, 03:06	0.4
DS-1	0.00	14		01Jan2011, 03:06	0.4
R-C1A	0.07	255	278	01Jan2011, 03:16	10.9
Jct-C3	1.71	2,425		01Jan2011, 03:11	209
E-3A	0.02	88		01Jan2011, 03:06	2.8
DA C-3A	0.01	32		01Jan2011, 03:06	0.9
R-C3A	1.73	2,477	2513	01Jan2011, 03:11	212.8
DA-TD4	0.05	272		01Jan2011, 03:06	7.7
C-TD1	0.05	219		01Jan2011, 03:11	7.7
DA-TD5	0.01	44		01Jan2011, 03:11	1.7
Jct-DS2	0.06	263		01Jan2011, 03:11	9.4
DS-2	0.06	262		01Jan2011, 03:11	9.4
E-3B	0.03	178		01Jan2011, 03:06	5.4
DA C-3B	0.01	58		01Jan2011, 03:06	1.7
R-C3B	1.84	2,843	2902	01Jan2011, 03:11	229.5
DA-TD7	0.02	84		01Jan2011, 03:11	3.1
DA-TD6	0.01	56		01Jan2011, 03:06	1.8
B-TD2-3	0.03	132		01Jan2011, 03:11	4.9
DS-3	0.03	129		01Jan2011, 03:11	4.9
RFC-1	0.01	65		01Jan2011, 03:06	1.8
R-RFC1	1.88	2,999	3013	01Jan2011, 03:11	236.4

## ATTACHMENT 4





# CALCULATIONS

<b>Date:</b>	6/16/2011	<b>Made by:</b>	ENN
<b>Project No.:</b>	0939743611	<b>Checked by:</b>	SSH
<b>Project Short Title:</b>	Sunrise Mountain Landfill Detention Dam	<b>Reviewed by:</b>	GWH
<b>Subject:</b>	Calculation of the Bulkied Flows for the Rockfall Channel		

## ROCKFALL DRAINAGE BASIN BULKED FLOW CALCULATIONS

Channel ID	Drainage Area (sq. mi)	Q (cfs)	Time to Peak	Drainage Area			Bulkied Flow (Developed)	Bulkied Flow (Undeveloped)	Q <sub>bulkied</sub> (cfs)
				Total <sup>1</sup>	Developed <sup>2</sup>	Undeveloped			
				(ac)	(ac)	(ac)			
B-E1	0.0652	357	01Jan2011, 03:11	41.72	6.44	35.28	1.1	1.3	453
B-W1	0.0878	426	01Jan2011, 03:11	56.16	3.91	52.25	1.1	1.3	548
C-1	0.1151	464	01Jan2011, 03:11	73.64	20.11	53.53	1.1	1.3	578
C-1A	0.0286	278	01Jan2011, 03:11	42.99	29.64	13.35	1.1	1.3	323
C-2A	0.0466	179	01Jan2011, 03:11	29.79	2.42	27.37	1.1	1.3	230
C-2B	1.6337	2182	01Jan2011, 03:11	319.44	68.35	251.09	1.1	1.3	2743
C-3A	1.7273	2513	01Jan2011, 03:11	638.29	156.83	481.46	1.1	1.3	3143
C-3B	1.8331	2902	01Jan2011, 03:11	645.03	163.57	481.46	1.1	1.3	3625
RFC	1.8766	3013	01Jan2011, 03:11	327.01	68.63	258.38	1.1	1.3	3790
C-DOC1	1.2108	564	01Jan2011, 03:11	48.88	17.96	30.92	1.1	1.3	692
C-DOC2	1.2937	904	01Jan2011, 03:11	101.92	22.47	79.45	1.1	1.3	1135
C-E1	0.0940	405	01Jan2011, 03:11	60.16	8.97	51.19	1.1	1.3	514
C-EPC1	1.4388	1390	01Jan2011, 03:11	194.78	38.84	155.94	1.1	1.3	1752
C-EPC2	1.5805	1960	01Jan2011, 03:11	285.44	64.86	220.58	1.1	1.3	2459
C-W1	0.0773	322	01Jan2011, 03:11	49.47	0.94	48.53	1.1	1.3	417

\*Flows of B-EPC-2 and B-EPC-3 are included in flows shown in table above for C-EPC2 and C-2A, respectively.

B-EPC-2	0.03483	172	01Jan2011, 03:06	22.29	6.03	16.26	1.1	1.3	214
B-EPC-3	0.01847	101	01Jan2011, 03:06	11.82	4.94	6.88	1.1	1.3	123



CALCULATIONS

Date:	2/16/2011	Made by:	ENN
Project No.:	0939743611	Checked by:	SSH
Project Short Title:	Sunrise Mountain Landfill Detention Dam	Reviewed by:	GWH
Subject:	Calculation of the Bulkied Flows for the Top Deck		

TOP DECK DRAINAGE BASIN  
BULKED FLOW CALCULATIONS

Channel ID	Drainage Area	Q	Time to Peak	Drainage Area			Bulkied Flow (Developed)	Bulkied Flow (Undeveloped)	Q <sub>bulkied</sub>
				Total <sup>1</sup>	Developed <sup>2</sup>	Undeveloped			
	(sq. mi)	(cfs)		(ac)	(ac)	(ac)			(cfs)
B-TD1-1	0.0194	165.8000	01Jan2011, 03:11	21.85	8.50	13.35	1.1	1.3	203
B-TD1-2	0.0342	173.8000	01Jan2011, 03:11	24.72	11.37	13.35	1.1	1.3	210
B-TD2-3	0.0317	137.3000	01Jan2011, 03:11	19.50	19.50	0.00	1.1	1.3	151
C-TD1	0.0498	272.3000	01Jan2011, 03:11	31.88	29.55	2.33	1.1	1.3	304
DS-1	0.0414	14.3000	01Jan2011, 03:16	1.75	1.75	0.00	1.1	1.3	16
DS-2	0.0607	262.7000	01Jan2011, 03:11	38.72	36.39	2.33	1.1	1.3	292
DS-3	0.0317	132.2000	01Jan2011, 03:11	19.50	19.50	0.00	1.1	1.3	145



CALCULATIONS

Date:	2/16/2011	Made by:	ENN
Project No.:	0939743611	Checked by:	SSH
Project Short Title:	Sunrise Mountain Landfill Detention Dam	Reviewed by:	GWH
Subject:	Calculation of the Bulkied Flows for the West Basin		

WEST DRAINAGE BASIN  
BULKED FLOW CALCULATIONS

Channel ID	Drainage Area	Q	Time to Peak	Drainage Area			Bulkied Flow (Developed)	Bulkied Flow (Undeveloped)	Q <sub>bulkied</sub>
				Total <sup>1</sup>	Developed <sup>2</sup>	Undeveloped			
	(sq. mi)	(cfs)		(ac)	(ac)	(ac)			(cfs)
B-W1	0.0878	426.1000	01Jan2011, 03:11	56.16	3.91	52.25	1.1	1.3	548
B-W2	0.0128	70.0000	01Feb2011, 03:10	8.20	8.20	0.00	1.1	1.3	77
B-W3	0.0161	86.9000	01Feb2011, 03:10	10.15	10.15	0.00	1.1	1.3	96
C-W2-1	0.0285	132.9000	01Feb2011, 03:05	18.18	18.18	0.00	1.1	1.3	146
C-W2-2	0.0446	190.9000	01Feb2011, 03:10	28.33	28.33	0.00	1.1	1.3	210
C-W2A	0.0787	337.0000	01Feb2011, 03:10	50.16	38.11	12.05	1.1	1.3	387
C-W3	0.0226	103.9000	01Feb2011, 03:10	50.16	38.11	12.05	1.1	1.3	119



# CALCULATIONS

<b>Date:</b>	2/16/2011	<b>Made by:</b>	ENN
<b>Project No.:</b>	0939743611	<b>Checked by:</b>	SSH
<b>Project Short Title:</b>	Sunrise Mountain Landfill Detention Dam	<b>Reviewed by:</b>	GWH
<b>Subject:</b>	Calculation of the Bulkied Flows for the Southwest Drainage Basin		

## SOUTHWEST DRAINAGE BASIN BULKED FLOW CALCULATIONS

Channel ID	Drainage Area	Q	Time to Peak	Drainage Area			Bulkied Flow (Developed)	Bulkied Flow (Undeveloped)	Q <sub>bulkied</sub>
				Total <sup>1</sup>	Developed <sup>2</sup>	Undeveloped			
	(sq. mi)	(cfs)		(ac)	(ac)	(ac)			(cfs)
B-SW1	0.0314	130.7000	01Feb2011, 03:10	20.09	3.76	16.33	1.1	1.3	165
B-SW2	0.0044	20.9000	01Feb2011, 03:10	2.83	2.83	0.00	1.1	1.3	23
B-SW3	0.0261	114.8000	01Feb2011, 03:10	16.73	16.41	0.32	1.1	1.3	127
B-SW4	0.0321	157.9000	01Feb2011, 03:10	20.52	16.90	3.62	1.1	1.3	179
B-SW5	0.0121	50.1000	01Feb2011, 03:10	7.72	7.72	0.00	1.1	1.3	55
B-SW6	0.0146	59.9000	01Feb2011, 03:15	9.35	9.35	0.00	1.1	1.3	66
B-SW7	0.0169	92.6000	01Feb2011, 03:15	10.84	8.23	2.61	1.1	1.3	106
C-SW1	0.0543	223.4000	01Feb2011, 03:10	22.92	6.59	16.33	1.1	1.3	278
C-SW2	0.0805	314.8000	01Feb2011, 03:15	39.65	23.00	16.65	1.1	1.3	373
C-SW3	0.1271	488.7000	01Feb2011, 03:15	69.50	45.83	23.67	1.1	1.3	571
C-SW4	0.0267	98.3000	01Feb2011, 03:15	17.07	17.07	0.00	1.1	1.3	108



CALCULATIONS

Date:	2/16/2011	Made by:	ENN
Project No.:	0939743611	Checked by:	SSH
Project Short Title:	Sunrise Mountain Landfill Detention Dam	Reviewed by:	GWH
Subject:	Calculation of the Bulkied Flows for the Southeast		

SOUTHEAST DRAINAGE BASIN  
BULKED FLOW CALCULATIONS

Channel ID	Drainage Area	Q	Time to Peak	Drainage Area			Bulkied Flow (Developed)	Bulkied Flow (Undeveloped)	Q <sub>bulkied</sub>
				Total <sup>1</sup>	Developed <sup>2</sup>	Undeveloped			
	(sq. mi)	(cfs)		(ac)	(ac)	(ac)			(cfs)
B-SE1	0.0440	174.5000	01Feb2011, 03:15	28.14	18.45	9.69	1.1	1.3	204
B-SE2	0.0548	218.4000	01Feb2011, 03:15	35.04	33.52	1.52	1.1	1.3	242
B-SE3	0.0293	122.0000	01Feb2011, 03:15	18.76	18.47	0.29	1.1	1.3	135
B-SE5	0.0252	134.8000	01Feb2011, 03:05	16.14	8.98	7.16	1.1	1.3	160
C-SE1	0.0760	297.4000	01Feb2011, 03:10	21.44	2.73	18.71	1.1	1.3	379
Road Channel-1	0.0223	122.1000	01Feb2011, 03:10	14.29	14.29	0.00	1.1	1.3	134
Road Channel-2	0.0133	72.6000	01Feb2011, 03:05	8.41	8.41	0.00	1.1	1.3	80
Road Channel-1A	0.0529	219.2000	01Feb2011, 03:10	27.12	18.00	9.12	1.1	1.3	256