APPENDIX H – STORMWATER BALANCE MODEL

FINAL FEASIBILITY STUDY
CASMALIA RESOURCES SUPERFUND SITE
CASMALIA, CALIFORNIA

PREPARED BY: CSC

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1.0 Stormwater Balance Spreadsheet Model

1.1 Introduction

A simple "stormwater balance" spreadsheet was used to estimate the volumes of stormwater that are expected to remain in the two stormwater ponds (A-Series and RCF) in the years preceding and during remedy construction at the site. The model is only intended to provide a rough estimate of the ponds' volumes of stormwater and is only being used to assist in defining a ROD or remedy construction sequence for the site and identify possible short term pond water management activities that might be used in order to sufficiently reduce the volume stored in the two ponds to allow remedy construction to proceed. The model is not intended to be rigorous and is only an approximation of the stormwater volumes sufficient to provide some guidance for management planning purposes.

1.2 Stormwater Balance Spreadsheet Assumptions

The stormwater balance spreadsheet (presented in Attachment H-1) is based on several assumptions or calculated inputs which we have discussed in the bullets below.

i. Annual Precipitation or Rainfall
The model uses a Monte Carlo approach to simulate annual precipitation or rainfall at the site. The model sets a "minimum" and a "maximum" rainfall and then randomly selects a rainfall rate between these two limits. This "random" rainfall closely simulates the actual rainfall at the site based on the last 15 years of rainfall data (producing an "average" precipitation of 15.5" per year). The last 15 years of rainfall data is plotted and included in Attachment H-1 (i.e., the model). Using the Monte Carlo approach, the model was run approximately 100 times to produce a rainfall rate for years 2016 through 2020 which is provided as the "Monte Carlo" case.

ii. Evaporation
The model uses the historical average evaporation rate of 44" per year. These evaporation rates have not changed significantly over the last 15 years and therefore this rate is set in the model as a constant.

iii. Stormwater Runoff Coefficient
Review of the past 15 years of rainfall and pond water level data indicates that the stormwater runoff coefficient for the site varies with rainfall rate (the higher the annual rainfall the higher the average runoff coefficient) and to some extent when the rainfall occurs (when the site experienced years where the rain all fell in one short period of time the runoff coefficient is higher than it might typically be). The historical data set was used to estimate a runoff coefficient for both the area up gradient of the RCF Pond and the area up gradient of the A-Series Pond. Please note that the simplified approach that the model uses (which estimates the runoff coefficient based on a linear relationship to rainfall that varies between 0.10 for low rainfall years and 0.35 for high rainfall years) is not rigorous or

necessarily calibrated. The last 15 years of pond levels, rainfall data, and the estimated coefficient that were used to create the correlation are plotted and included in Attachment H-1(i.e., the model). The linear approach, while not rigorous, does correspond well with previous hydrologic evaluation of landfill performance (HELP) model simulations for the site, which indicated that the runoff coefficient was approximately 0.20 to 0.25 depending on the input used for soil conditions.

iv. Pond Water Management

The model assumes that the certain pre-construction activities will continue, as defined in the Pond Water Management Plan previously approved by EPA.

v. PSCT and PCT Extraction Rates

Historical data suggests that both the PSCT and PCT extraction rates vary with rainfall. Higher rainfall years have higher extraction rates. As was the case for stormwater runoff, historical data set was used to estimate PSCT and PCT rates based on a linear relationship to rainfall. The last 7 years of PSCT and PCT extraction rates and rainfall data that was used to create the correlation are plotted and included in Attachment H-1. The model calculates extraction rates for these two features based on the projected rainfall for the years until the site capping remedy is completed. Once the remedy caps have been constructed, the model uses the projected PSCT and PCT extraction rates that the Groundwater Flow Model calculates.

vi. Construction Water

The model uses input construction water rates for years 2017 to 2019 that are based on the historical volumes of construction water previously needed to construct the P/S Landfill and EE/CA Area Landfills.

vii. RCRA Canyon Stormwater Discharge

The model assumes the remedy selected for the eastern slope of the RCRA Canyon is such that the stormwater runoff meets the requirements for the General Permit and is therefore discharged through the B-Drainage.

1.3 Model Results

The stormwater balance spreadsheet results are summarized by year in the two figures attached (Attachment H-1) which show the projected volume of stormwater in the RCF Pond and the A-Series Pond (or Evaporation Pond after it is constructed in the footprint of the A-Series Pond).

The model projects that the A-Series Pond should be emptied sufficiently enough to allow the recommended remedy construction for that pond to proceed in 2017. In the event that actual rainfall is higher than the projected rates and the pond is not empty, the remaining liquids will be transferred to the RCF Pond in order to keep construction on schedule.

The model projects that the RCF Pond will be sufficiently empty to allow remedy construction on it by 2017. As discussed in the FS, in the event higher rainfalls are experienced and the RCF

Pond cannot be sufficiently emptied, it may be necessary to utilize a NPDES Permit and treat and discharge some volume from the RCF Pond in order to keep construction on schedule.

ATTACHMENT H-1

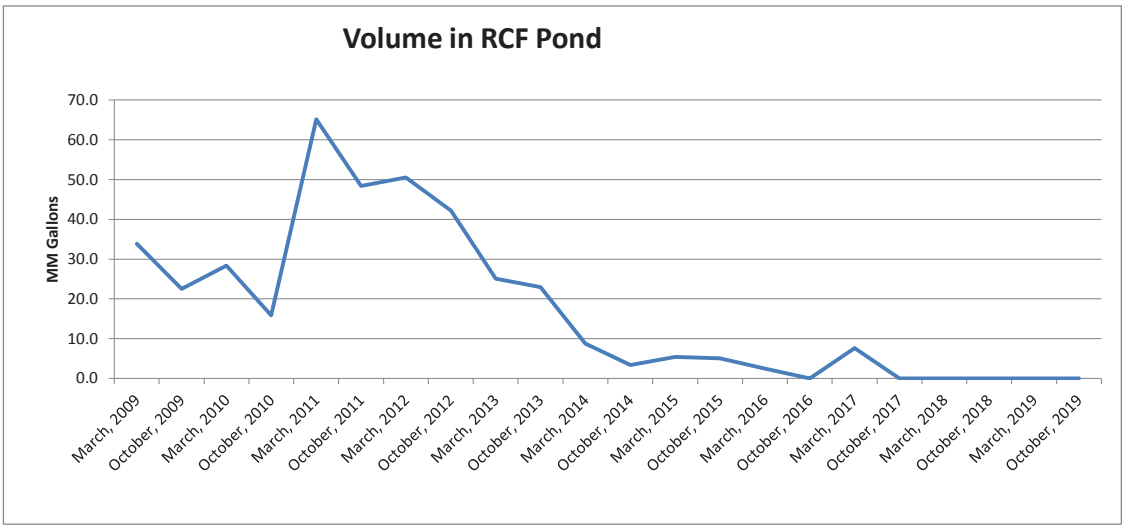
STORMWATER BALANCE CALCULATIONS AND CHARTS

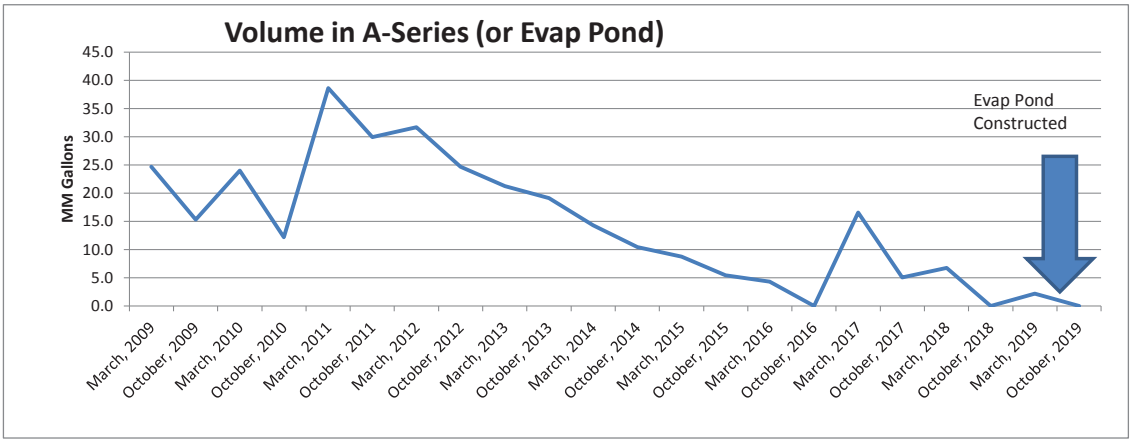
ATTACHMENT H-1

Stormwater Balance Calculations and Charts

revised 1.10.16

	minimum	maximum	model avg.
Rainfall (")	8	22	15.5
SW RO Factor	0.10	0.35	
Evaporation (")	44		
Capped SW to Wetlands	6	MM Gals	
Constrution Wtr	4	MM Gals	
Turbomister	4	MM Gals	
PSCT+PCT Vols	Based on GW Flow Model and vary as rainfall varies		
Use Random rain rates?	yes	Yes indicates model uses rainfall pattern randomly generated rain between min and max	
Discharge SW from east slope RCRA Canyon?	yes	Yes indicates model assumes SW runoff from the eastern slope of RCRA Canyon can be discharged	





RCF Pond

	Act or Est Volume in RCF Pond (MM Gals)	Evaporation (MM Gals)	SW Runoff (MM Gals)	Turbomister/Construction Water (MM Gals)	Treated PSCT and PCT Liqs to Pond (MM Gals)	RCF Pond Freeboard (Ft)	Monte Carlo Rain Rates ("/Yr)	SW RO Coeffic. (calcultd based on rain)
March, 2009	33.8	11.5				26.4		
October, 2009	22.6	3.8	13.5		2.0	34.5	16	0.24
March, 2010	28.4	11.5				34.5		
October, 2010	15.9	3.8	32.2		8.0	34.5	24	0.39
March, 2011	65.1	11.5				34.5		
October, 2011	48.4	3.8	5.9		5.1	34.5	11	0.15
March, 2012	50.5	11.5				34.5		
October, 2012	42.2	3.8	-2.3		4.7	24.4	9	0.12
March, 2013	25.1	11.5				28.5		
October, 2013	23.0	3.8	-3.2		4.5	29.0	8	0.10
March, 2014	8.8	11.5				32.4		
October, 2014	3.3	3.8	-2.3		4.7	33.7	9	0.12
March, 2015	5.4	11.5				33.2		
October, 2015	5.0	3.8	-3.2		4.5	33.3	8	0.10
March, 2016	2.5	11.5				33.9		
October, 2016	0.0	3.8	11.4			34.5	18	0.28
March, 2017	7.6	11.5				32.7		
October, 2017	0.0	3.8	-2.3	6.0		34.5	9	0.12
March, 2018	0.0	11.5				34.5		
October, 2018	0.0	3.8	5.7	4.0		34.5	15	0.23
March, 2019	0.0	11.5				34.5		
October, 2019	0.0	3.8	5.1	4.0		34.5	16	0.24

A-Series Pond

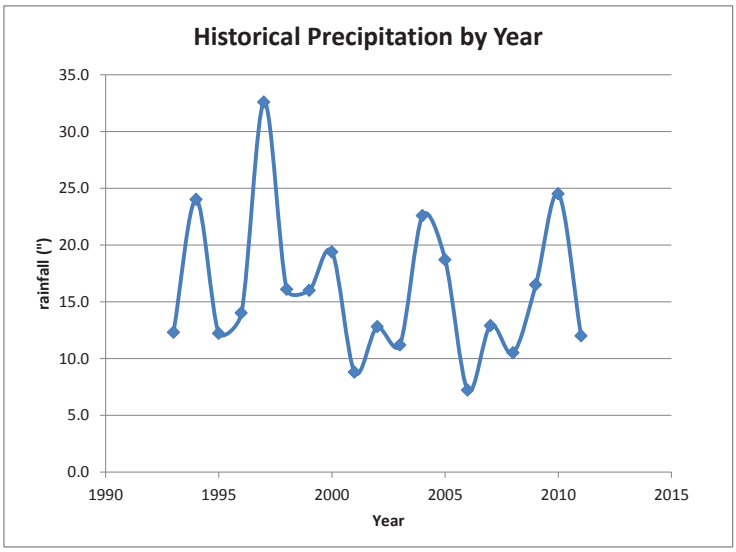
	Act or Est Volume in A-Series Pond or Evap Pond post 2016 (MM Gals)	Evaporation (MM Gals)	SW Runoff (MM Gals)	Turbomister (MM Gals)	Treated PSCT and PCT Liqs to Pond (MM Gals)	A-Series Pond Freeboard (Ft)	Rain (")	SW RO Coeffic. (calcultd based on rain)
March, 2009	24.7	9.6				27.6		
October, 2009	15.3	3.2	10.1		2.0	35.5	16	0.24
March, 2010	24.0	9.6				35.5		
October, 2010	12.2	3.2	24.2		1.0	35.5	24	0.39
March, 2011	38.6	9.6				35.5		
October, 2011	29.9	3.2	4.4			25.9	11	0.15
March, 2012	31.7	9.6				19.7		
October, 2012	24.7	3.2	2.8			27.6	9	0.12
March, 2013	21.2	9.6				28.7		
October, 2013	19.1	3.2	2.1			29.4	8	0.10
March, 2014	14.3	9.6				30.9		
October, 2014	10.4	3.2	2.8			32.2	9	0.12
March, 2015	8.7	9.6				32.7		
October, 2015	5.4	3.2	2.1			33.8	8	0.10
March, 2016	4.3	9.6				34.1		
October, 2016	0.0	3.2	13.1		6.6	35.5	18	0.28
March, 2017	16.5	11.5				30.2		
October, 2017	5.1	3.8	2.8	2.0	4.7	33.9	9	0.12
March, 2018	6.7	11.5				33.4		
October, 2018	0.0	3.8	2.0	2.0	6.0	35.5	15	0.23
March, 2019	2.1	11.5				34.8		
October, 2019	0.0	3.8	2.3	2.0		35.5	16	0.24

Proposed Stormwater Pond Plan/Construction Sequencing

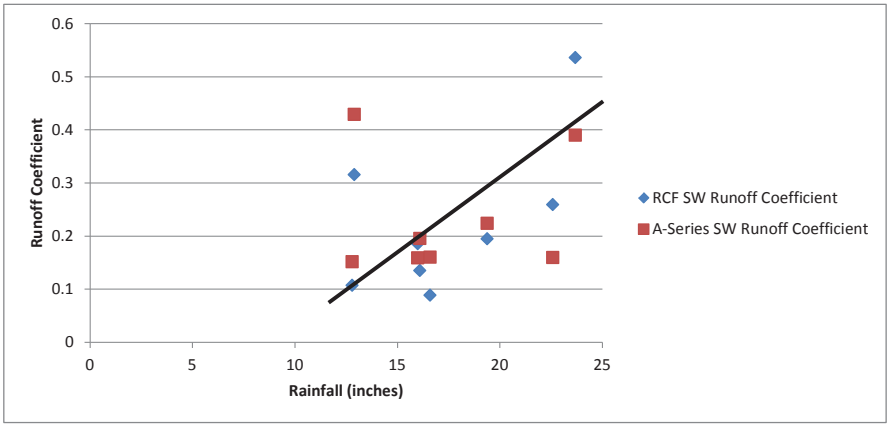
0. Install "Enhanced Evaporation Mister" in RCF Pond in 2013. Use as necessary through 2019
1. Complete RCRA Canyon remedy in 2019. Discharge capped acres of RCRA Canyon SW runoffthru wetlands starting in 2019.
2. Construct cap in CDA and complete grading/BMPs south of PSCT in 2017. Discharge eastern 180 acres of site to wetlands/B Drainage in 2018
3. Use RCF Pond for source of FS Cap construction water in 2018

Background Information

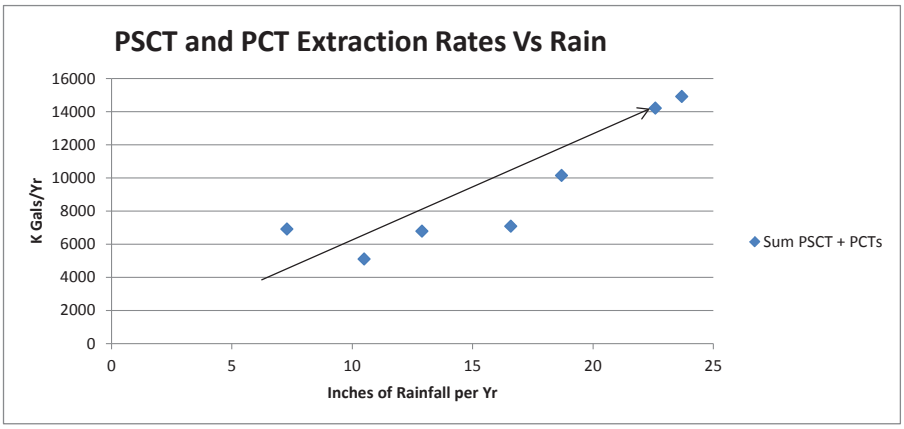
Precipitation



SW Runoff Coefficient Versus Rainfall



PCT Extraction rates Versus Rainfall

K Galllons/Year

Year	*PSCTs*	*RAPA*	*RAPC*	*Rainfall*	*Sum PSCT + PCTs*	*Sum PCTs*
2004-2005	4,360	2,150	5,880	22.6	12,390	8,030
2005-2006	3,600	1,873	3,760	18.7	9,233	5,633
2006-2007	1,600	1,180	3,015	7.3	5,795	4,195
2007-2008	2,712	1,650	2,000	12.9	6,362	3,650
2008-2009	1,320	1,112	2,025	10.5	4,457	3,137
2009-2010	2,240	1,085	2,050	16.6	5,375	3,135
2010-2011	7,200	2,100	3,200	23.7	12,500	5,300