Appendix F
Golder Associates – Containment and Drainage Analysis Technical Memorandum to Suncor (dated August 16, 2014)

Golder Associates

TECHNICAL MEMORANDUM

Date:	August 16, 2014	**Made by:**	Rachel Williams
Project No.:	130-1742	**Checked by:**	Kati Petersburg
Subject:	Containment and Drainage Analysis	**Reviewed by:**	Paul Pigeon
Project Short Title:	Suncor Commerce City Refinery SPCC		

1.0 INTRODUCTION

Suncor Energy Commerce City Refinery (Refinery) requested a facility-wide drainage analysis of the Refinery, prompted by the update of their Spill Prevention, Control, and Countermeasure (SPCC) Plan. This technical memo summarizes Golder's drainage analysis effort, which includes:

- Definition of drainage basin boundaries and flow direction of surface drainage at the Refinery.
- Analysis of storage tank secondary containment areas and their capacity required to meet SPCC regulations.
- Analysis of tertiary containment areas for storage tanks and their capacity required to meet SPCC regulations.
- Summary of drainage in transfer areas including truck and rail loading and unloading areas.
- Recommendations for berm modifications to meet capacity requirements.

2.0 BACKGROUND

The Refinery is composed of three plants, each of which includes process areas for production, tank farms for storage, and loading/unloading zones for trucks and rail cars. Plant 1 is located to the northwest of Brighton Blvd., and south of Sand Creek and Highway 270. It occupies approximately 148 acres. Plant 2, approximately 30 acres, is located southeast of Brighton Blvd. and south of Sand Creek and Highway 270. Plant 3 occupies approximately 40 acres to the southeast of Plant 2 and west of Sand Creek.

The SPCC rule (40 Code of Federal Regulations 112) requires the Refinery to prepare a contingency plan for oil spill prevention, preparedness, and response to prevent oil discharges to navigable waters and adjoining shorelines. The Refinery utilizes earthen and concrete berms around tanks as secondary containment to contain spills. Under the SPCC regulations, each secondary containment area must be able to contain the volume of the largest tank in each containment area, as well as sufficient freeboard for a precipitation event. The recommended precipitation event is the 25-year frequency, 24-hour duration storm event.

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Previous studies were completed for the Refinery that overlap in scope with this study and were used as background for this analysis. All of these reports, with the exception of Jacobs Engineering (2003), were used as reference to understand the stormwater sewer (SWS) and oily water sewer (OWS) systems, and the existing berm structure. The Jacobs Engineering (2003) study was used to verify the results of the containment analysis in Plant 1. These studies include:

- Tetra Tech (2013). Final Report: Oily Wastewater Sewer and Stormwater Sewer Systems Study.

  The Tetra Tech study addressed the configuration of the OWS and SWS systems for the three plants. The systems were mapped and inventoried for physical dimensions and piping connectivity. The existing sewer systems were evaluated for compliance with New Source Performance Standard (NSPS) Subpart QQQ. Recommendations were made to achieve compliance with NSPS Subpart QQQ.

- Terracon (2011). Geotechnical Engineering Report for Suncor OMD Tank Berm Study.

  This study addressed groundwater conditions at the berms and geotechnical engineering criteria for the berms at all three plants. Samples of berm material and subgrade material were taken and evaluated for their potential to limit seepage of an oil spill to groundwater. Terracon made recommendations to improve the performance of existing berms and for construction of new berms in terms of recommended soil type, compaction, and erosion resistance.

- CH2M Hill (2011). Report of Survey: Suncor Energy OMD 2 & 3 Tank Dyke Study.

  CH2M Hill used high resolution scanning to create a model of OMD 2 and 3 including topographic information, pipe features, steel, tanks, and foundations. Modeling was performed in the Refinery local coordinate system.

- CH2M Hill (2007). Final Report: Suncor Energy Commerce City Facility Wastewater/Stormwater Collection System Enhancements.

  CH2M Hill studied drainage conveyance and the performance of OWS and SWS systems for all three plants. They determined that the OWS and SWS systems are not separate, they are treating substantial runoff generated offsite, and wet-weather flows are much higher than the design dry weather flow. They made recommendations to mitigate these problems and reduce the amount of water requiring treatment in the wastewater treatment plant.

- Jacobs Engineering (2003). Containment Study for ConocoPhilips Denver Refinery Revision B.

  This study was performed to analyze Plant 1 compliance with SPCC regulations, NFPA 30, and NFPA 11, and to estimate the cost of improvements to bring secondary containments into compliance. A 25-year frequency, 24-hour duration storm was considered. At the time of the study, Plant 1 was owned by ConocoPhilips. They found 9 of 20 existing containments in Plant 1 to be compliant and made recommendations for improving the inadequate berms. The 2003 compliance results were used to verify the results of this current analysis for Plant 1.

3.0 METHODOLOGY

This section includes a discussion of the methodology used in Golder's drainage analysis.

3.1 Drainage Basins

Golder used existing topographic mapping, provided by Suncor, to estimate high and low points within Plants 1, 2, and 3 of the Refinery and to define overall drainage basin boundaries within the Refinery. Drainage basin boundaries were confirmed by field visits to the site. Off-site topography was not available, and was therefore not considered in drawing the drainage basin boundaries. The analysis assumed that the existing topographic mapping is reliable for identifying general high and low boundaries in the plant areas. The Refinery is developing a facility-wide updated topographic map of the site based on high-resolution scanning; however, that topographic mapping was not complete for this study. Drainage basin boundaries used should be confirmed following the updated topographic mapping, and revisions to the drainage basins should be incorporated in future SPCC updates, if warranted.

3.2 Secondary Containment Areas

A two-part analysis was used to determine if secondary containment areas for the tanks are sufficient to meet current SPCC regulations. First, the required containment volume that must be stored was calculated and then the available capacity was calculated. SPCC regulations require that hydrocarbon storage containers have a secondary means of containment for the entire capacity of the largest single container, plus freeboard for precipitation, or sufficient drainage improvements that cause discharges to terminate and be confined in a basin or holding pond. To account for containment capacity displaced by existing tanks in the containment area, the capacity of the diked area enclosing more than one tank was calculated after deducting the displaced volume of the tanks, other than the largest single tank.

To calculate required containment volume, the volume of surface water runoff within each containment area was determined utilizing National Oceanic and Atmospheric Administration (NOAA) Atlas (2013) precipitation storm depths for the 25-year frequency, 24-hour duration storm in Commerce City, Colorado. The tank volume of the largest tank within each containment area was added to the 25-year frequency, 24-hour stormwater depth. Tank volumes were collected from the current Suncor database of storage tank data. Table 1 shows the precipitation depths for the 25-year, 24-hour storm and the 100-year, 24-hour storm. The 25-year storm must be contained in the event of an oil spill to meet current SPCC regulations, and the 100-year storm was analyzed for improved understanding of containment capacity.

Table 1: Precipitation Depths for Commerce City, CO (NOAA, 2013)

Storm	Precipitation Depth (inches)
25-Year, 24-Hour	3.60
100-Year, 24-Hour	4.75

Note: Secondary containment of storage tanks must meet the 25-year, 24-hour storm per SPCC regulations.

Second, the total storage capacity of each containment area was calculated. Golder modeled the containment capacity with Civil3D (2013) using a combination of existing and updated topographic information. Some of the berms within the site have eroded over time; consequently, the existing topographic information did not reflect real time conditions. In some areas, the topographic information was not of sufficient detail to describe the berm topography for calculating storage capacity. The berms with substantial erosion or topographical data gaps were identified for targeted surveying by Golder with a Global Positioning System (GPS) receiver. The GPS data was collected with Trimble R6 receivers with horizontal precision of 3-mm and vertical precision of 3.5-mm. Golder supplemented existing topographic mapping with the new GPS data to model existing containment area volumes.

To model the containment capacity, the lowest point along the berm was identified as the maximum height of containment. The difference between the artificial water surface elevation and the base topography is the total containment volume. Per regulations, the largest tank is considered active containment and is included in the total containment volume. The volume of the smaller tanks is displaced and therefore subtracted from the containment volume. When adjacent containments are hydraulically connected, the adjacent storage capacity is added to the total capacity. Adjacent containments are considered hydraulically connected when the lowest point in the containment berm causes overflow into an adjacent bermed area.

Available containment capacities greater than required storage volumes are sufficient to meet SPCC requirements. Assumptions for the secondary containment area analysis include:

- No evaporation or infiltration occurs in the secondary-containment areas.
- Existing topographic mapping, supplemented by recently obtained GPS data, is accurate.
- Low internal berms within containment areas do not act as containment.
- Pipe and equipment inside the bermed areas do not reduce or increase the overall containment capacity.
- Berms that have been removed for pipe or other maintenance will be re-constructed to the height of the surrounding berms.

3.3 Tertiary Containment Analysis

Six tertiary containment areas are located throughout the Suncor property, and also function as stormwater containment. Analysis of the tertiary containment areas was consistent with the procedure used for secondary containment. The required containment volume for the tertiary ponds was defined as the largest overflow from the secondary containment areas contributing to it plus the volume of stormwater generated by the 25-year, 24-hour storm in the contributing drainage basin. Within each tertiary containment area, only the stormwater that falls into the secondary containment area with the largest overflow was counted toward the required containment volume, since the other secondary containment areas are assumed to remain intact.

The tertiary containment capacity of each area was evaluated applying the same method as the secondary containment areas. The capacity was modeled in Civil3D using a variety of topographic and surveyed measurements. In the model, the lowest point along the berm or wall was identified as the maximum height of containment. An artificial water surface was created by adding a surface at this elevation in Civil3D that covered the extents of the tertiary containment area. The difference between the artificial water surface and the base topography of the tertiary containment area is the total containment volume.

Available containment capacities greater than required storage volumes are needed to sufficiently contain spilled oil on Suncor property. Assumptions for the tertiary containment area analysis include:

- Existing topographic mapping, supplemented by recently obtained GPS data, is accurate.
- In some cases, the pond depths represented in the base topography are less than the existing pond depth. In this situation, the actual depth could not be determined from design documents or field measurement, so the base topography was assumed to represent the actual available depth.
- The 25-year frequency, 24-hour duration storm in Commerce City, Colorado is 3.60 inches (NOAA, 2013).
- All stormwater goes to the tertiary containment areas.
- There is no pumping of the tertiary ponds.
- There is no initial abstraction of the stormwater volume.

3.4 Berm Height Recommendations

As part of this scope of work, Golder performed an evaluation of possible berm modifications needed to meet secondary containment capacity requirements for those areas that do not currently meet regulation. The evaluation is considered to be a preliminary analysis to guide decision making and not a full design. The methodology used for this analysis is the same as the technique used to calculate the volume of existing secondary and tertiary containment areas. An iterative approach was used to determine how high a berm must be raised to contain the largest tank volume and 25-yr, 24-hr storm volume. The evaluation also considered the option of hydraulically connecting adjacent containment areas.

Some additional assumptions were made in the analysis to simplify the calculations:

- Additional berm height is assumed to be a straight wall with zero width. Figure 1 below demonstrates this assumption, where the alternative is to do a detailed design of the additional berm height so that the new profile matches with the existing berm.
- A proposed hydraulic connection between secondary containment areas does not take up any volume in the respective areas.

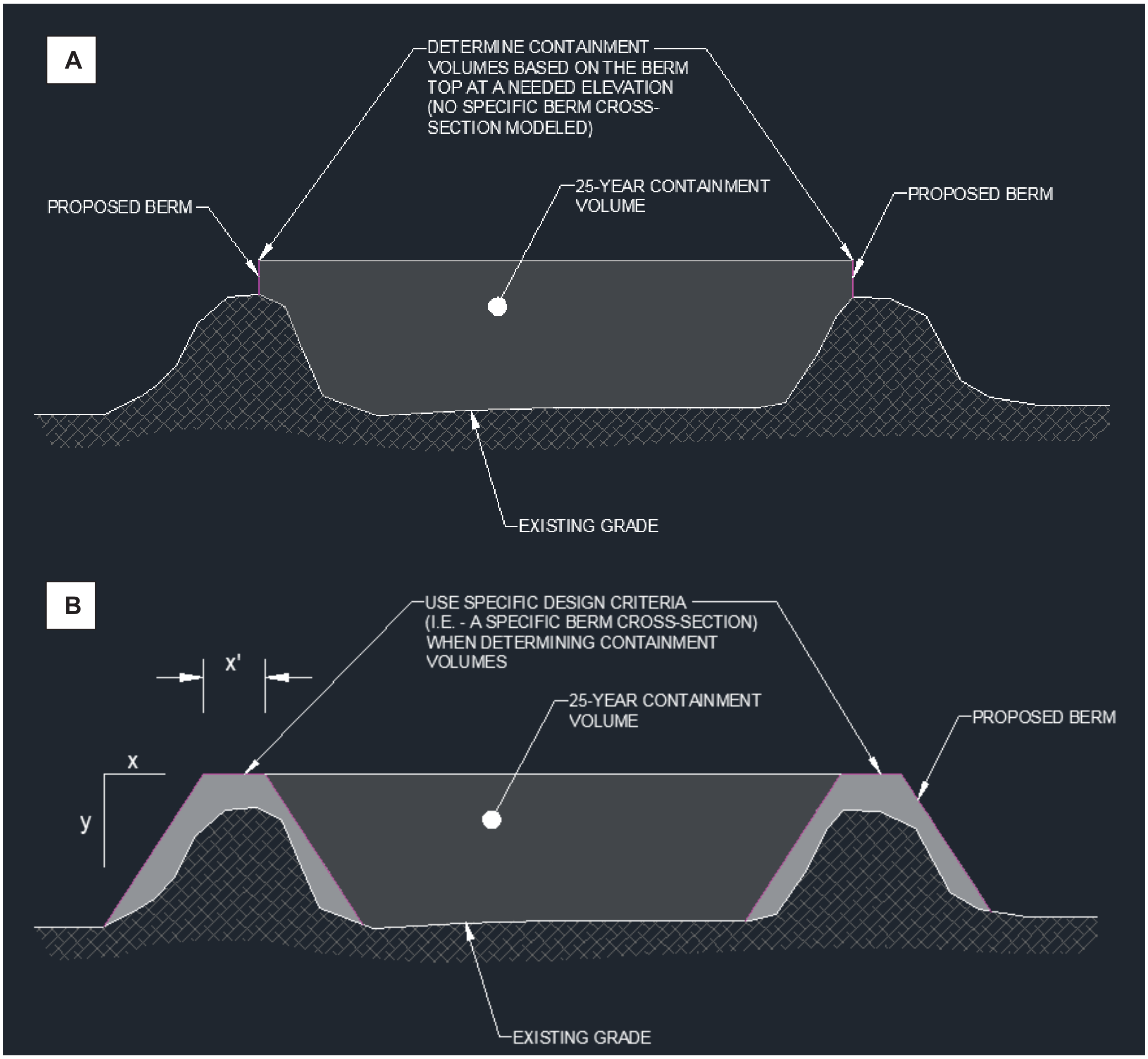

Figure 1: Assumption for structure of additional berm elevation; A: Simplified method used for this analysis, B: Alternative method for detailed design analysis.

3.5 Transfer Areas Drainage Analysis

Transfer areas include truck and rail loading and unloading areas. The drainage of spills and stormwater runoff in the transfer areas was summarized for Plants 1, 2, and 3. A GPS Trimble R6 receiver was used to collect topography data of these areas and associated stormwater inlets. The GPS data and field visits were used to identify primary drainage routes including the ultimate destination through storm drains and routes of overflow from storm drains.

4.0 RESULTS & RECOMMENDATIONS

Results for the analysis are presented in the appendices. The drainage basin boundaries at the Refinery are shown on the map included in Drawing 005-CV-D-002. Drawing 005-CV-D-001 displays the secondary containment areas and Drawing 005-CV-D-006 summarizes the tertiary containment ponds. The loading and unloading zone drainage analysis is summarized in text and figures in Attachment 1.

4.1 Drainage Basins

The drainage basins map shows the boundaries of the general drainage basins at the Refinery. If a spill were to breach an outside berm, this map shows what direction the spill would migrate. Since the topography of the site is generally flat, a spill that breaches an outside berm near the boundary of a drainage basin could move to multiple basins depending on the location of the spill within the containment and local variation of the berm heights in proximity to the spill. Since topographic data are only available for Suncor property, the drainage basin boundaries do not include off-site locations.

4.2 Secondary Containment Areas

Of the 31 secondary containment areas analyzed for this study, 12 were found to have sufficient containment to be in compliance with the SPCC secondary containment regulations (Table 2). This count does not include those tanks that do not have any containment, such as those in the wastewater treatment plant. These results were compared with the 2003 Jacobs Engineering study that evaluated Plant 1 when it was under the ownership of ConocoPhilips. In Plant 1, Golder found 11 of the 21 secondary containments to be in compliance. The Jacobs Engineering study identified an additional two containments that were in compliance. These are the secondary containments labeled A-4 (T-77) and E-3 (T-58, T-88, T-135). For areas A-4 and E-3, the difference between the results is likely due to erosion of the berms over the past 10 years. Golder found that three additional containment areas, C-1, C-2, and D-4 were in compliance compared to Jacobs Engineering study. Their compliance is due to being hydraulically connected to adjacent containment areas which increases the total containment volume available.

Table 2: Summary of Secondary Containment Compliance

Plant	Containment	Area (ft^2)	Required 25-year Volume (gallons)	Required 100-year Volume (gallons)	Containment Capacity (gallons)	Adequate for 25-year	Adequate for 100-year
Plant 1	A-1	53,011	3,478,974	3,516,977	2,454,395	No	No
	A-2~	65,764	5,215,487	5,262,632	3,561,418	No	No
	A-3**,~	69,262	5,195,449	5,245,102	4,028,989	No	No
	A-4**,~	74,104	5,206,315	5,259,439	4,010,811	No	No
	A-5	137,108	3,563,835	3,662,126	4,472,929	Yes	Yes
	A-6	150,763	4,118,347	4,226,426	6,236,975	Yes	Yes
	A-7	57,622	549,314	590,623	612,185	Yes	Yes
	A-8*	90,544	1,253,199	1,318,109	0	No	No
	B~	141,620	3,545,485	3,647,010	6,903,289	Yes	Yes
	C-1~	80,597	3,540,882	3,598,660	4,300,241	Yes	Yes
	C-2~	63,192	3,501,822	3,547,123	4,299,029	Yes	Yes
	C-3**,~	82,616	3,410,550	3,469,776	3,808,635	Yes	Yes
	C-4**,~	52,715	1,173,344	1,211,134	3,296,629	Yes	Yes
	D-1	86,552	5,234,250	5,296,298	2,216,469	No	No
	D-2~	85,493	5,119,532	5,180,821	4,109,375	No	No
	D-3~	84,517	5,229,683	5,290,272	4,106,547	No	No
	D-4~	66,781	5,189,881	5,237,755	5,249,723	Yes	Yes
	D-5~	81,536	5,222,993	5,281,445	5,280,221	Yes	No
	E-1	76,365	2,403,177	2,457,922	2,555,382	Yes	Yes
	E-2	63,006	4,866,114	4,911,282	1,761,218	No	No
	E-3	39,768	1,139,249	1,167,758	418,895	No	No
	E-4~	62,232	4,864,377	4,908,991	2,542,860	No	No
Plant 2	F	206,556	8,989,568	9,137,645	7,151,718	No	No
	G	249,592	2,907,931	3,086,860	2,661,801	No	No
	H~	157,472	5,393,056	5,505,945	6,049,341	Yes	Yes
	I	116,490	1,583,426	1,666,936	1,455,429	No	No
	J-1	9,220	461,692	468,302	406,777	No	No
	J-2**	27,029	1,110,660	1,130,037	1,170,645	Yes	Yes
Plant 3	K-1	329,928	5,780,075	6,016,596	3,197,258	No	No
	K-2~	38,242	1,765,709	1,793,124	4,222,279	Yes	Yes
	K-3*	44,143	728,066	759,711	0	No	No
	K-4*	34,880	498,248	523,253	0	No	No

Notes:

*As of December 2013 no containment is provided for these tanks. The containment area is based on an estimate of future berm locations.

**As of December 2013 the containment wall or berm was partially removed. ~Adjacent hydraulically connected containment included in total containment capacity.

In Plant 1, several secondary containment areas that contain one tank are not in compliance, but they could be combined with adjacent single containment berms to improve containment capacity. Examples include secondary containment areas A-3 (T-78) and A-4 (T-77), and Area D containments.

In Plant 2, Golder found one of the six containment areas to be in compliance; Area H. J-2 will be compliant if the walls are re-built where they have been removed. Areas F, G, and I are non-compliant due to erosion of the berms, and containment for area F is a particular challenge due to the relatively large volume of the tanks.

In Plant 3, Golder found one of the four containment areas to be in compliance, Area K-2. The berms for other containment areas, especially K-3, K-4 and the north side of K-1, are highly eroded and provide little containment.

Many berms require intensive re-building and maintenance to reach compliance. In general, a regular berm maintenance schedule should be employed to keep the secondary containments in compliance with current SPCC regulations.

4.3 Tertiary Containment Analysis

The objective of the tertiary containment analysis is to determine if tertiary ponds are sufficient to contain the potential overflow volume from the secondary containments that can contribute to it. All of the results for the tertiary analysis are summarized by drainage basins, since ponds in one drainage basin are often connected. The tertiary ponds and drainage basin areas contributing to the ponds are identified in Drawing 005-CV-D-006 and summarized in Table 3. Two of the six tertiary drainage basins, located in the southern most section of Plant 2, do not have contributing secondary containment overflow and were not analyzed for spill containment.

Table 3: Summary of Tertiary Drainage Basins

Tertiary Drainage Basins	Ponds	Tertiary Containment Volume (gallons)	25-Year Stormwater Volume (gallons)	Adequate for 25-year Stormwater
Plant 1-DB-1	Sand Creek Swale	1,663,201	2,962,934	No
Plant 1-DB-3 & Plant 1-DB-4	Webers Pond, and Finger Lake	1,573,340	5,632,252	No
Plant 2-DB-1	Plant 2 Northern Retention Basin	8,907	2,594,194	No
Plant 2-DB-2	Plant 2 South 1 Pond	170,687	1,509,075	No
Plant 2-DB-3	Plant 2 South 2, Plant 2 South 3	75,319	837,037	No
Plant 3-DB-1	Mary's Pond, Perimeter Canal	619,181	2,658,431	No

The adequacy of tertiary ponds for containment are summarized in Table 4 for all secondary containment areas for two scenarios: a 25-year storm, and dry conditions with no storm. Of the four tertiary drainage basins analyzed for spill containment, none provided adequate storage for the potential spill volumes contributing to it from the secondary containment areas during the 25-year storm. In dry conditions, overflow from nine secondary containments can be contained by the tertiary ponds (Table 4).

Table 4: Summary of Tertiary Containment Compliance

Plant	Tertiary Drainage Basin	Containment	Potential No Storm Spill Volume (gal)	Potential 25-year Spill Volume (gal)	Adequate for No Storm	Adequate for 25-year
Plant 1	Plant 1-DB-3	A-1	905,614	1,024,579	Yes	No
		A-2~	1,506,484	1,654,069	Yes	No
		A-3**,~	1,011,025	1,166,460	Yes	No
		A-4**,~	1,029,202	1,195,504	Yes	No
		A-5				
		A-6				
		A-7				
		A-8*	1,050,003	1,253,199	Yes	No
	Plant 1-DB-4	B~				
		C-1~				
		C-2~				
		C-3**,~				
		C-4**,~				
	Plant 1-DB-1	D-1	2,823,544	3,017,781	No	No
		D-2~	818,297	1,010,158	Yes	No
		D-3~	933,466	1,123,136	Yes	No
		D-4~				
		D-5~				
	Plant 1-DB-3	E-1				
		E-2	2,963,500	3,104,896	No	No
		E-3	631,108	720,353	Yes	No
		E-4~	2,181,859	2,321,517	No	No
Plant 2	Plant 2-DB-1	F	1,374,305	1,837,850	No	No
		G		246,130		No
	Plant 3-DB-1	H~				
		I		127,997		No
	Plant 2-DB-1	J-1	34,224	54,916	No	No
		J-2**				
Plant 3	Plant 3-DB-1	K-1	1,842,406	2,582,818	No	No
		K-2~				
		K-3*	629,002	728,066	No	No
		K-4*	419,972	498,248	Yes	No

Notes:

*As of December 2013 no containment is provided for these tanks. The containment area is based on an estimate of future berm locations.

**As of December 2013 the containment wall or berm was partially removed. ~Adjacent hydraulically connected containment included in total containment capacity.

Of the six tertiary drainage basins, only Plant 1-DB-1 in the northern most section of Plant 1 (Drawing 005-CV-D-006), has tertiary containment sufficient to store the 25-year stormwater volume (neglecting spill volumes). Plant 1-DB-3, Plant 1-DB-4, and Plant 3-DB-1 drainage basins can store smaller storm volumes between 0.5 to 0.75-inches in depth (neglecting spill volumes). Plant 2-DB-1 drainage basin has negligible storage capacity. The northern part of Plant 2 is relatively flat and constrained by railroad tracks on both sides. As a result, if Plant 2 northern tertiary containment capacity were increased, it would be difficult to direct spills toward the containment. These results neglect pumping that occurs from tertiary containment to other containments or the waste water treatment plant (WWTP). However the capacity of the WWTP is not designed to treat overflow from a combined design storm and spill of this magnitude.

4.4 Recommendations

Golder provided general recommendations (Table 5) to meet compliance for the individual secondary containment areas. The recommendations provide a preliminary estimate of proposed berm elevations or combined containment areas that could be used to meet compliance standards. For secondary containment areas that currently have berms, the recommendations suggest heightening berms between 0.2 and 2.7 feet. Three containment areas currently lack berms, and the recommend heights for these are 5.1 and 6.4 feet.

Table 5: Recommendations for Compliance of Storage Tank Containment

Plant	Containment	Secondary Adequate	Tertiary Adequate	Recommendation	Height Raised (ft)	Alternative
Plant 1	A-1	No	No	A-1 and A-2 are hydraulically linked. Raise both berms.	2.4	Hydraulically link A-1, A-2, A-3, and A-4. No berm elevation required
	A-2	No	No		2.4	
	A-3	No	No	A-3 and A-4 are hydraulically linked. Raise both berms.	1.4	
	A-4	No	No		1.4	
	A-5	Yes				
	A-6	Yes				
	A-7	Yes				
	A-8	No	No	Not evaluated.		
	B	Yes				
	C-1	Yes				
	C-2	Yes				
	C-3	Yes				
	C-4	Yes				
	D-1	No	No	Hydraulically Link D-1, D-2, and D-3, and maintain the berms. There currently is a link between D-2 and D-3.	0	Double the capacity of the tertiary containment.
	D-2	No	No		0	
	D-3	No	No		0	
	D-4	Yes				
	D-5	Yes				
	E-1	Yes				
	E-2	No	No	Raise the existing secondary berm of E-2 and E-4, and hydraulically link E-2, E-3, and E-4. Currently E-3 is linked to E-4.	0.3	
	E-3	No	Yes		0	
	E-4	No	No		1.2	
Plant 2	F	No	No	Raise the existing secondary berm.	1.6	
	G	No	No	Raise the existing secondary berm.	0.3	
	H	Yes				
	I	No	No	Raise the existing secondary berm.	0.2	
	J-1	No	No	Add a secondary berm.	4.5	
	J-2	Yes				
Plant 3	K-1	No	No	Raise the existing secondary berm.	1.3	
	K-2	Yes				
	K-3	No	No	Add a secondary berm.	5.1	
	K-4	No	No	Add a secondary berm.	6.3	

5.0 REFERENCES

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ATTACHMENT 1
DRAINAGE ANALYSIS OF TRANSFER AREAS

Transfer areas include rail and truck loading and unloading zones in Plants 1, 2, and 3. The transfer locations are shown on Drawing 005-CV-M-002. The following sections describe the drainage patterns in these zones.

1.0 PLANT 1

1.1 Rail Loading Area

The Plant 1 rail yard has French drains lining the entire length of the rail yard and three storm inlets set away from the rail yard: one to the northeast near the OMD 1 control building, one to the northwest, and a third to the southwest. The French drains are directly connected to the Tank 70 secondary containment area, which drains to the Tank 94 lagoon for further drainage to Finger Lake by a manually operated pump. Storm inlets in Plant 1, including the three around the rail yard, drain into the Plant 1 WWTP. A spill in this rail yard that is not contained by the French drains would not necessarily drain to one of the three storm inlets, because not all of the surrounding area is sloped towards the inlets. A spill on the far west end of the rail yard would drain west into the containment areas of Tank 7 or 39, or alternatively into the stormwater pond directly west called Finger Lake. A spill along the property boundary of the southeast side of the rail yard would be directed south off of Suncor property, where there are no apparent storm inlets or containments. A spill on the northeast side of the rail yard could potentially drain towards Plant 1 process area or off-site rather than to the northeast storm inlet. The drainage summary is shown in Figure C1.

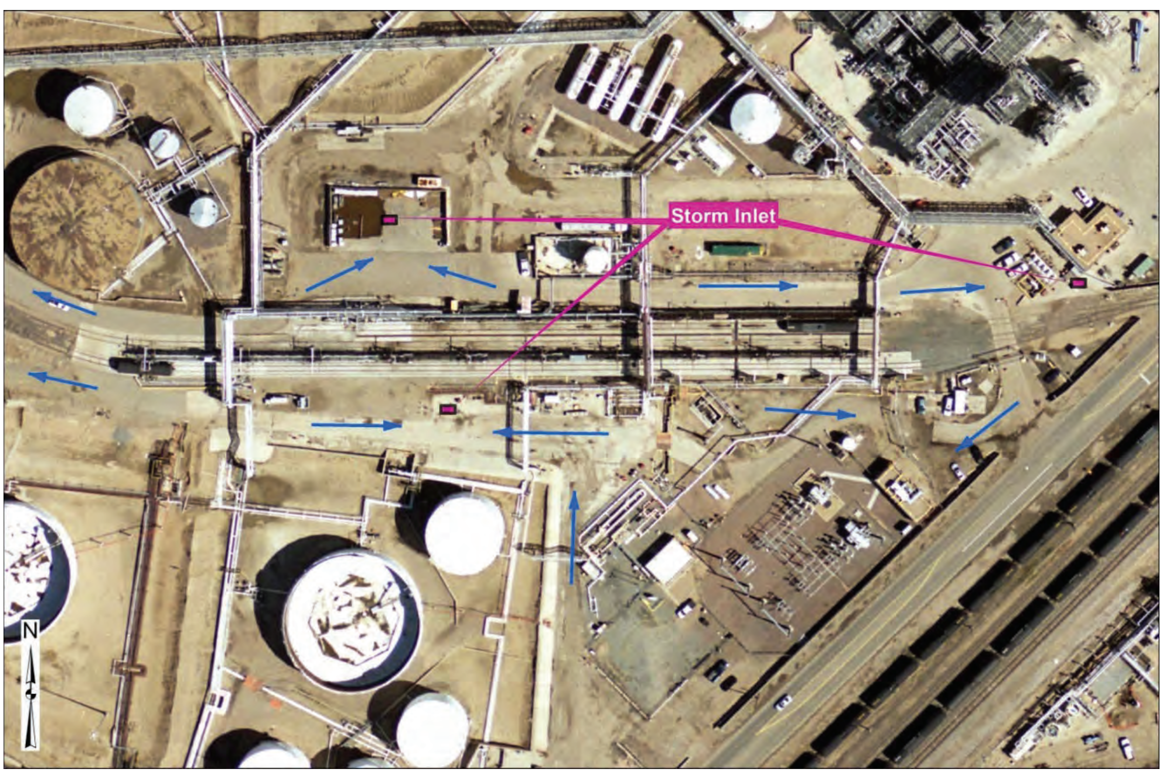

Figure C1: Plant 1 Rail Loading Area Drainage Summary

1.2 West Truck Rack

The West Truck Rack is located at the southern end of Plant 1 as shown in Figure C2. The loading terminal includes 5 truck loading bays in a covered structure. Each loading bay has a center drain to collect overflow, which is directed to a bermed collection area directly south of the covered structure. The low collection area is equipped with a pump to move water to tank T-6000 (Slop Tank). Stormwater at the West Truck Rack is also directed to the low collection area. On the northwest corner of the West Truck Rack, stormwater and overflow is directed north to a collection ditch. The collection ditch directs water north along the west edge of the tank farm and terminates at a road directing flow the Webers Pond. Overflow at the West Truck Rack is expected to stay on site.

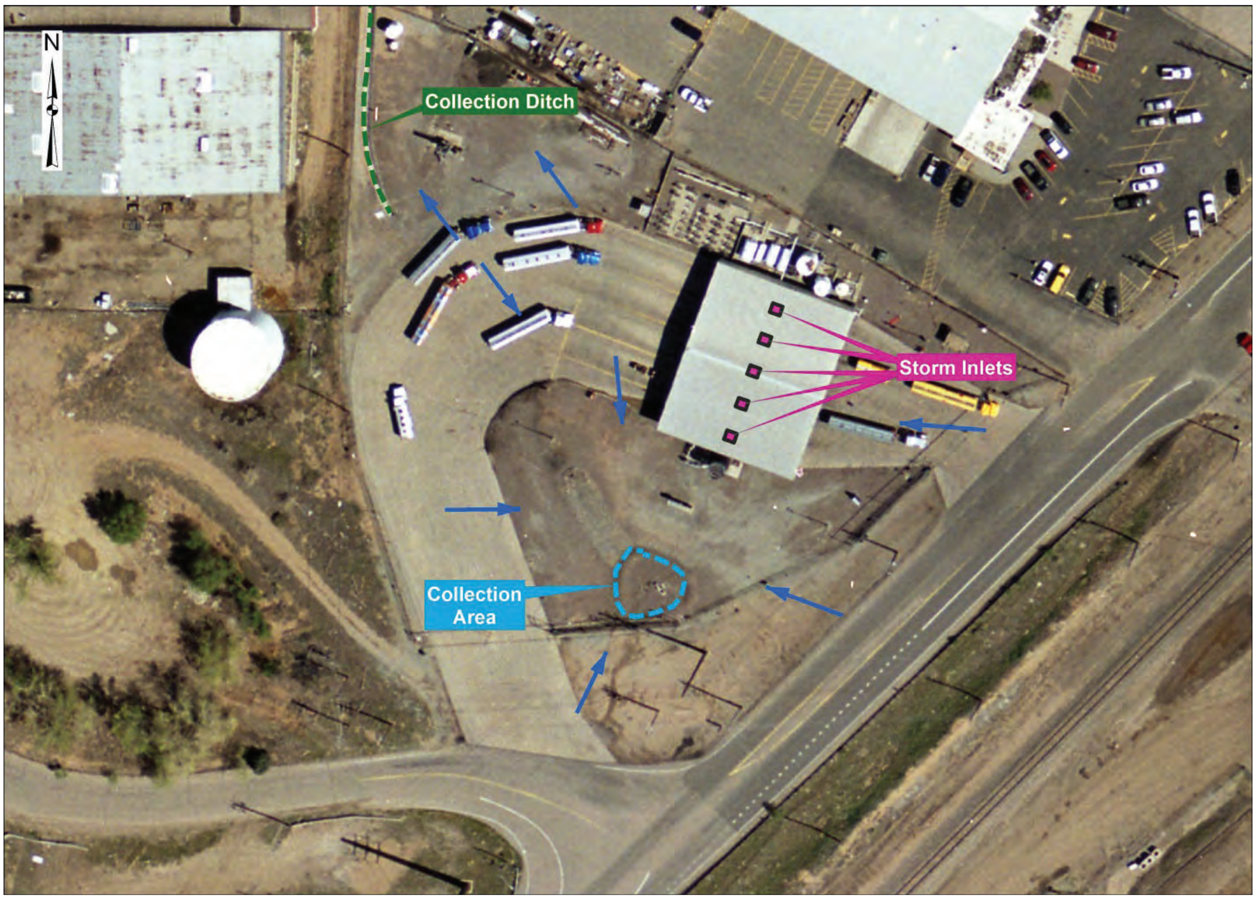

Figure C2: Plant 1 West Truck Rack Drainage Summary

2.0 PLANT 2

2.1 North Truck and Rail Loading Area

Plant 2 includes a combined truck and rail loading area. The drainage summary is shown in Figure C3. French drains run along each of seven truck loading locations. There are no storm inlets to drain low spots in the area. A concrete swale along the road centerline diverts overflow northeast towards the service warehouse and does not include a storm inlet at the low point. Overflow at the south side of the rail yard would also be directed south east towards the service warehouse. The far north side of the rail yard would drain north towards Tanks 19 and 29 or towards Plant 2 process area. Stormwater that is captured by the storm inlets in Plant 2 is directed through lift station to Tank 29 for settling, and is eventually processed through the Plant 1 WWTP. If a spill were to occur at this site, it is expected to stay onsite.

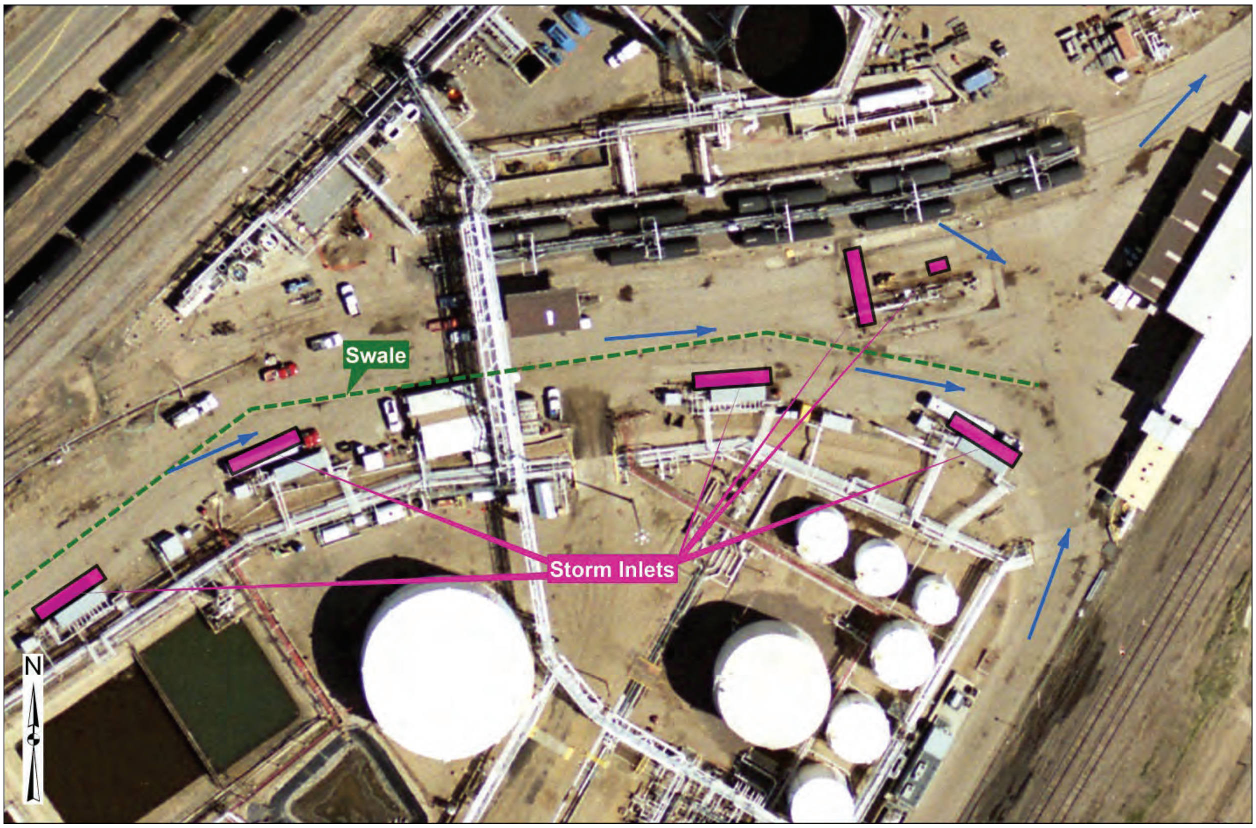

Figure C3: Plant 2 North Truck and Rail Loading Area Drainage Summary

2.2 South Truck Unloading and Rail Loading Area

Crude truck unloading and product rail loading are located in Parcels II and IV south of Plant 2. The drainage summary is shown in Figure C4. French drains are located at each truck loading station. Additional storm inlets are located south and east of the main truck unloading area. Overflow from the truck unloading area would primarily drain south. The rail yard does not have any storm inlets. The rail yard drains south along swales paralleling the rail road tracks to the east and west sides. Overflow from the rail yard is contained by earthen berms to the east and south sides of the rail yard.

Figure C4: Plant 2 South Truck Unloading and Rail Loading Area Drainage Summary

3.0 PLANT 3

3.1 Rail and Truck Loading Area

The Plant 3 rail and truck loading area is located west of the primary tank farm and process unit. The drainage summary is shown in Figure C5. Three storm inlets are present at the north end of rail yard. Overflow from the north portion of the rail yard is drained to these inlets and secondarily to the stormwater detention basin at the north end of Plant 3 referred to as Mary's Pond. Overflow from the central and southern portions of the rail yard is directed primarily east towards the tank farm, which eventually drains north to Mary's Pond. The highly eroded earth berms on the west side of the tank farm are evidence of this drainage. Overflow from the west side of the central rail yard could also drain west towards Tanks 161-176.

Figure C5: Plant 3 Rail and Truck Loading Area Drainage Summary

CALCULATIONS

Secondary Containment Analysis Calculations: Plant 1

Plant 1 Containment Areas

Date:	2/18/14
By:	REW
Chkd:	AJR
Apprvd:	

25-yr Storm Depth (in)	100-yr Storm Depth (in)
3.6	4.75

													Recommended Berm Heights								
Containment Area	Tanks	Largest Tank	Largest Volume (gallons)	Largest Volume (ft^3)	Containment Area (ft^2)	25-Year Storm Volume (ft^3)	100-Year Storm Volume (ft^3)	Total Required 25-Year Volume (ft^3)	Total Required 100-Year Volume (ft^3)	Current Containment Capacity (ft^3)	Notes	Jacobs Eng (2003) Compliance Results	Iteration 1	Height Raised (ft)	New Capacity (ft^3)	Iteration 2	Required Containment Capacity	New Capacity (ft^3)	Iteration 3	Required Containment Capacity	New Capacity (ft^3)
A-1	T-94	T-94	3360000	449167	53011	15903	20984	465070	470150	328104		no	The individual containment area berms are raised	3	487,107	Try A-1 and A-2 connected	484799	(as is - no raise) 500,958	A-1+A-2+A-3+A-4	527,809	954,261 (as is - no raise)
A-2	T-80	T-80	5067888	677478	65764	19729	26032	697207	703510	476091	Hydraulically connected to A-1	no		6.8	698,106	Try A-2 + A-1 area	713111	476,064 short <237047> raise each 2.4 ft 721,656	A-1+A-2+A-3+A-4	756,120	929,421 (as is - no raise)
A-3	T-78	T-78	5040000	673750	69262	20779	27416	694529	701166	538596	Hydraulically connected to A-4	no		5.6	695,586	Try A-3 + A-4	716760	538,569 short <178,191> raise both 1.4 ft 719,188	A-1+A-2+A-3+A-4	752,392	936,603 (as is - no raise)
A-4	T-77	T-77	5040000	673750	74104	22231	29333	695981	703083	536166	Hydraulically connected to A-3	yes		5.2	699,026	Try A-4 + A-3	716760	536,183 short <179967> raise both 1.4 ft 716,660	A-1+A-2+A-3+A-4	752,392	934200 (as is - no raise)
A-5	T-2010, T-55	T-55	3256134	435282	137108	41132	54272	476414	489554	597942		yes		ok							
A-6	T-1, T-67, T-34	T-34	3780000	505312	150763	45229	59677	550541	564989	833760		yes		ok							
A-7	T-39, T-76, T-68, T-69	T-76	420000	56146	57622	17287	22809	73432	78955	81837	T-39 reported to be out of service	no		ok							
A-8	T-4512, T-4511, T-4504, T-60, T-29, T-28, T-26	T-60	1050000	140365	90544	27163	35840	167528	176205	0	WWTP, has no containment	NA									
B	T-72, T-116, T-96, T-97, T-74, T-62	T-72	3227658	431475	141620	42486	56058	473961	487533	922833	Hydraulically connected to C-3	yes		ok							
C-1	T-71	T-71	3360000	449167	80597	24179	31903	473346	481070	574857	Hydraulically connected to C-2	no		ok							
C-2	T-75	T-75	3360000	449167	63192	18958	25014	468124	474180	574695	Hydraulically connected to C-1	no		ok							
C-3	T-70	T-70	3225138	431138	82616	24785	32702	455923	463840	509139	Hydraulically connected to C-4	yes		ok							
C-4	T-64, T-65, T-66	T-64, T-65, T-66	1055040	141038	52715	15815	20866	156853	161905	440694	Hydraulically connected to C-3	yes		ok							
D-1	T-774	T-774	5040000	673750	86552	25966	34260	699716	708010	296298		NA		4.7	703092	Try D-1 + D-2 +D-3	750719	778,161 (as is - no raise)			
D-2	T-775	T-775	4927659	658732	85493	25648	33841	684380	692573	549342	Hydraulically connected to D-3	no		4.6	690,105	Try D-1 + D-2 +D-3	735701	783,405 (as is - no raise)			
D-3	T-776	T-776	5040000	673750	84517	25355	33455	699105	707205	548964	Hydraulically connected to D-2	no		4.5	699898	Try D-1 + D-2 +D-3	750719	783,027 (as is - no raise)			
D-4	T-777	T-777	5040000	673750	66781	20034	26434	693784	700184	701784	Hydraulically connected to D-5	no		ok							
D-5	T-778	T-778	5040000	673750	81536	24461	32275	698211	706025	705861	Hydraulically connected to D-4	yes		ok							
E-1	T-3801, T-52	T-3801	2231796	298348	76365	22910	30228	321257	328576	341604		yes		ok							
E-2	T-3	T-3	4724706	631601	63006	18902	24940	650503	656541	235440		no		6.6	651,279	Try E-2 + E-3 + E-4	681103	500,904 short <180,199> Raise each 0.3 ft 713,230			
E-3	T-58, T-88, T-135	T-58	1050000	140365	39768	11930	15742	152295	156106	55998		yes		2.5	155418	Try E-2 + E-3 + E-4	189866	436,401 (ok as is)			
E-4	T-2	T-2	4724706	631601	62232	18670	24634	650271	656235	339930	Hydraulically connected to E-3	no		5.8	652626	Try E-2 + E-3 + E-4	681103	502,983 short <178120> Raise each 1.2 ft 680284			

Secondary Containment Analysis Calculations: Plant 2

Plant 2 Containment Areas

Date:	2/18/14
By:	REW
Chkd:	AJR
Apprvd:	

25-yr Storm Depth (in)	100-yr Storm Depth (in)
3.6	4.75

Containment Area	Tanks	Largest Tank	Largest Volume (gallons)	Largest Volume (ft^3)	Area (ft^2)	25-Year Storm Volume (ft^3)	100-Year Storm Volume (ft^3)	Total Required 25-Year Volume (ft^3)	Total Required 100-Year Volume (ft^3)	Current Containment Capacity (ft^3)	Notes	Recommended Berm Raise: Iteration 1	Height Raised (ft)	New Capacity (ft^3)
F	TK-6, TK-39, TK-30, TK-28, TK-38, TK-46	TK-6	8526000	1139760	206556	61967	81762	1201727	1221522	956043			1.6	1229230
G	TK-27, TK-11, TK-26, TK-10, TK-9, TK-20, TK-8, TK-5, TK-4, TK-23, TK-24, TK-25, TK-40, TK-41, TK-42, TK-43	TK-27, TK-11, TK-26, TK-10	2347800	313855	249592	74878	98797	388733	412652	355830		The individual containment area berms are raised	0.3	403965
H	TK-79, TK-62, TK-57, TK-35, TK-36	TK-79	5039650	673703	157472	47242	62333	720945	736036	808677	Hydraulically connected to I			
I	TK-44, TK-45, TK-52, TK-53, TK-54, TK-37, TK-47, TK-58, TK-12	TK-47	1322000	176726	116490	34947	46111	211673	222836	194562			0.2	213644
J-1	TK-32, TK-48, TK-49	TK-48, TK-49	441000	58953	9220	2766	3650	61719	62603	54378		Add wall from existing ground	4.5	61774
J-2	TK-19, TK-29	TK-19, TK-29	1050000	140365	27029	8109	10699	148473	151064	156492				

Secondary Containment Analysis Calculations: Plant 3

Plant 3 Containment Areas

Date:	2/18/14
By:	REW
Chkd:	AJR
Apprvd:	

25-yr Storm Depth (in)	100-yr Storm Depth (in)
3.6	4.75

Containment Area	Tanks	Largest Tank	Largest Volume (gallons)	Largest Volume (ft^3)	Area (ft^2)	25-Year Storm Volume (ft^3)	100-Year Storm Volume (ft^3)	Total Required 25-Year Volume (ft^3)	Total Required 100-Year Volume (ft^3)	Current Containment Capacity (ft^3)	Notes	Recommended Berm Heights: Iteration 1	Height Raised (ft)	New Capacity (ft^3)
K-1	T-3201, T-142, T-147, T-140, T-2006, T-145, T-146, T-194	T-3201	5039650	673703	329928	98978	130597	772682	804300	427410		Raise individual berm	1.3	784942
K-2	T-144	T-144	1679883	224568	38242	11473	15137	236040	239705	564435				
K-3*	T-112		629000	84085	44143	13243	17473	97328	101558	0	No existing containment	Add wall from existing ground	2.3	101528
K-4*	T-141, T-193, T-191, T-192	T-193, T-191, T-192	419971	56142	34880	10464	13807	66606	69949	0	No existing containment		2.4	66890

*As of December 2013 no containment is provided for these tanks. The containment area is based on an estimate of future berm locations.

Tertiary Containment Analysis Calculations

Summary of Tertiary Containment Ponds

Tertiary Containment	Containment Volume (yd^3)
Plant 1 North	8234.89
Plant 1 Webers Pond	1341.13
Plant 1 Finger Lake	2238.72
Plant 1 Flooded Weber and Finger	7789.97
Plant 2 North	44.1
Plant 2 OWS Ponds	544.89
Plant 2 South 1 (N)	845.11
Plant 2 South 2 (Mid)	320.66
Plant 2 South 3 (S)	52.26
Plant 3 Mary's Ponc	2988.61
Plant 3 Canal	77.1

Date:	8/6/14
By:	REW
Chkd:	AJR
Apprvd:	

Analysis for the Largest Tank in each Tertiary Drainage Basin

Tertiary Drainage Basins	Ponds	Tertiary Containment Volume (yd^3)	Drainage Basin Area (ft^2)	Secondary Containment in Drainage Basin Area (ft^2)	Total Contributing Area (ft^2)	25-Year Stormwater Volume (yd^3)	25-Year Stormwater Volume minus Initial Abstractions (yd^3)	25-Year Spill Volume (yd^3)	Spill Containment	Adequate for 25-Year Stormwater	Adequate for 25-Year Spill
Plant 1-DB-1	Sand Creek Swale	8235	1638642	318327	1320315	14670	14670	14941	D-1	No	No
Plant 1-DB-3 & Plant 1-DB-4	Webers Pond, and Finger Lake	7790	3807076	1297283	2509792	27887	27887	15373	E-2	No	No
Plant 2-DB-1	Plant 2 Northern Retention Basir	44	1441842	285841	1156001	12844	12844	9099	F	No	No
Plant 2-DB-2	Plant 2 South 1 Ponc	845	672460		672460	7472	7472		none	No	NA
Plant 2-DB-3	Plant 2 South 2, Plant 2 South :	373	372992		372992	4144	4144		none	No	NA
Plant 3-DB-1	Mary's Pond, Perimeter Cana	3066	1575853	391227	1184626	13163	13163	12788	K-1	No	No

Analysis for every Secondary Containment area in each Tertiary Drainage Basin

Plant	Tertiary Drainage Basin	Containment	Area (ft^2)	Required Volume No Storm (ft^3)	Required 25-Year Volume (ft^3)	Containment Capacity (ft^3)	Adequate for 25-year	Potential No Storm Spill Volume (ft^3)	Potential 25-Year Spill Volume (ft^3)	Adequate for No Storm	Adequate for 25-year
Plant 1	Plant 1-DB-3	A-1	53011	449167	465070	328104	No	121,063	136,966	Yes	No
		A-2~	65764	677478	697207	476091	No	201,387	221,116	Yes	No
		A-3**,~	69262	673750	694529	538596	No	135,154	155,933	Yes	No
		A-4**,~	74104	673750	695981	536166	No	137,584	159,815	Yes	No
		A-5	137108	435282	476414	597942	Yes				
		A-6	150763	505312	550541	833760	Yes				
		A-7	57622	56146	73432	81837	Yes				
		A-8*	90544	140365	167528	0	No	140,365	167,528	Yes	No
	Plant 1-DB-4	B~	141620	431475	473961	922833	Yes				
		C-1~	80597	449167	473346	574857	Yes				
		C-2~	63192	449167	468124	574695	Yes				
		C-3**,~	82616	431138	455923	509139	Yes				
		C-4**,~	52715	141038	156853	440694	Yes				
	Plant 1-DB-1	D-1	86552	673750	699716	296298	No	377,452	403,418	No	No
		D-2~	85493	658732	684380	549342	No	109,390	135,038	Yes	No
		D-3~	84517	673750	699105	548964	No	124,786	150,141	Yes	No
		D-4~	66781	673750	693784	701784	Yes				
		D-5~	81536	673750	698211	705861	Yes				
	Plant 1-DB-3	E-1	76365	298348	321257	341604	Yes				
		E-2	63006	631601	650503	235440	No	396,161	415,063	No	No
		E-3	39768	140365	152295	55998	No	84,367	96,297	Yes	No
		E-4~	62232	631601	650271	339930	No	291,671	310,341	No	No
Plant 2	Plant 2-DB-1	F	206556	1139760	1201727	956043	No	183,717	245,684	No	No
		G	249592	313855	388733	355830	No		32,903		No
	Plant 3-DB-1	H~	157472	673703	720945	808677	Yes				
		I	116490	176726	211673	194562	No	-17836.32	17,111	Yes	No
	Plant 2-DB-1	J-1	9220	58953	61719	54378	No	4,575	7,341	No	No
		J-2**	27029	140365	148473	156492	Yes				
Plant 3	Plant 3-DB-1	K-1	329928	673703	772682	427410	No	246,293	345,272	No	No
		K-2~	38242	224568	236040	564435	Yes				
		K-3*	44143	84085	97328	0	No	84,085	97,328	No	No
		K-4*	34880	56142	66606	0	No	56,142	66,606	Yes	No