RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

Iatan CCR Landfill

Prepared for:

Evergy Metro, Inc.

Iatan Generating Station

Weston, Missouri

Prepared by:

Evergy Environmental Services (Revision 1)

Revision 0 – October 2016

Revision 1 – October 2021

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Plan Review/Amendment Log §257.104(d)(3)

Date of Review	Reviewer Name	Amendment Required (YES/NO)	Sections Amended and Reason
October 2016 (original version)	Kansas City Power & Light Co., Inc.	N/A	Original
October 1, 2021 (Revision 1)	Jay Martin (Evergy Metro, Inc.)	Yes	Five-year periodic update; new company name; period review for compliance; added MDNR-approved stormwater calculations.

1.0 Background

The purpose of this CCR Run-on and Run Off Control System Plan (Plan) is to document, in accordance with the Coal Combustion Residuals Rule (CCR Rule),[1] how the run-on and run-off control systems for the Iatan Generating Station (Iatan) CCR landfill have been designed and constructed with recognized and generally accepted good engineering practices and to meet the applicable requirements of 40 CFR 257.81. The following sections provide background information on the facility and related regulatory requirements.

1.1 Facility Information

Name of Facility:	Iatan Generating Station
Name of CCR Unit:	CCR Landfill
Name of Operator	Evergy Metro (Evergy)
Facility Mailing Address:	20250 Hwy. 45, Weston, MO 64098
Location:	Approximately five miles northwest of Weston, Missouri.
Facility Description:	The Iatan Generating Station has two coal-fired units that produce fly ash, bottom ash, and gypsum. CCR not beneficially used is transported to the on-site landfill for disposal. Related landfill facilities include a groundwater monitoring system, storm water and leachate management systems, and haul/access roads. Phases I and II of the landfill have been constructed and are currently active. Phase III is under construction.

1.2 Regulatory Requirements

This Plan has been developed for the Iatan Generating Station CCR Landfill in accordance with 40 CFR 257.81 (c). The CCR Rule requires preparation of a Run-on and Run-off Control System Plan for all existing CCR landfills in operation as of October 19, 2015, the effective date of the CCR Rule. The plan must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of 40 CFR 257.81, and must be supported by appropriate engineering calculations (Appendix A[2]).

The owner or operator of a CCR unit must prepare a written Plan that includes the information specified in 40 CFR 257.81 (a) and (b). These items and the section of this plan responsive to each is as follows:

40 CFR 257.81 Run-on and Run-off Controls for CCR landfills

(a) The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate and maintain (Section 2):

(1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and

(2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm

(b) Run-off from the active portion of CCR unit must be handled in accordance with the surface water requirements under §257.3-3 (Section 3).

Selected definitions from the CCR Rule are provided below.

Active portion means that part of the CCR unit that has received or is receiving CCR or non-CCR waste and that has not completed closure in accordance with §257.102.

Closed means placement of CCR in a CCR unit has ceased, and the owner or operator has completed closure of the CCR unit in accordance with § 257.102 and has initiated post-closure care in accordance with § 257.104.

CCR (coal combustion residuals) means fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers.

CCR Landfill means an area of land or an excavation that receives CCR and which is not a surface impoundment, an underground injection well, a salt dome formation, a salt bed formation, an underground or surface coal mine, or a cave. For purposes of this subpart, a CCR landfill also includes sand and gravel pits and quarries that receive CCR, CCR piles, and any practice that does not meet the definition of a beneficial use of CCR.

CCR Unit means any CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit, or a combination of more than one of these units, based on the context of the paragraph(s) in which it is used. This term includes both new and existing units, unless otherwise specified.

Qualified Professional Engineer means an individual who is licensed by a state as a Professional Engineer to practice one or more disciplines of engineering and who is qualified by education, technical knowledge and experience to make the specific technical certifications required under this subpart. Professional engineers making these certifications must be currently licensed in the state where the CCR unit(s) is located.

Run-off means any rainwater, leachate, or other liquid that drains over land from any part of a CCR landfill or lateral expansion of a CCR landfill.

Run-on means any rainwater, leachate, or other liquid that drains over land onto any part of a CCR landfill or lateral expansion of a CCR landfill.

2.0 LANDFILL RUN-ON AND RUN-OFF CONTROLS

2.1 Design and Construction

The design for the Iatan CCR Landfill storm water run-on and run-off control system was completed in 2007 by Burns & McDonnell Engineering, Inc. (Burns & McDonnell).[5] The design was developed and sealed by a professional engineer licensed in the State of Missouri and in accordance with the Missouri Department of Natural Resources (MDNR) rules for Utility Waste Landfills[4]. These rules require the run-on and run-off control systems for utility waste landfills to be based on the 24-hour, 25-year storm event. The MDNR reviewed and approved the design of the landfill and storm water management system in 2007.

The storm water system design for the landfill consists of benches, berms, swales, channels, culverts, and letdown channels designed with typical slopes of between 0.5% and 25%; and a storm water run-off pond. The components of the storm water management system are constructed commensurate with landfill construction. A perimeter landfill berm completely surrounds the active landfill area, which includes Phases 1 and 2 of the three planned phases, which prevents run-on. Landfill runoff is routed to the landfill's stormwater pond before release through an NPDES-permitted outfall or reuse by the station.

2.2 Run-on Controls

The landfill, including the Phase I and II active areas, is designed and constructed within an elevated, engineered berm consisting of compacted cohesive soil material. The berm was by Burns & McDonnell and constructed in accordance with the plans approved by the MDNR. The berm is constructed to a minimum elevation of 787.0 feet National Geodetic Vertical Datum (NGVD), 1929. The 100-year flood elevation of the nearby Missouri River is approximately 784.5 feet NGVD. Review of record construction documents and related surveys[6, 7, 8] indicate the berm was constructed to planned elevations. Since the landfill perimeter berm system is approximately 2.4 feet above the 100-year flood, the run-on protection system exceeds the requirement to provide protection from run-on from the 24-hour, 25-year storm event. Evergy notes the perimeter is constructed to prevent inflow from the 500-year flood event.[3]

2.3 Run-off Controls

The run-off control system consists of benches, berms, swales, channels, culverts and letdown channels, as well as a storm water pond. The storm water management system runoff components for Phases I and II were constructed in accordance with the plans approved by the MDNR[5]. The design basis for the sizing of these components was the 24-hour, 25-year storm event. The runoff controls are constructed during phased landfill construction events. Storm water that remains on the landfill is managed through the leachate collection system to the landfill leachate pond discharge via a NPDES-permitted outfall. Contact runoff water is routed to the landfill perimeter ditches to the landfill storm water pond for reuse at the plant or discharge via a NPDES-permitted outfall.

Table 1 presents the excess capacities of the storm water run-off system components for the design storm event.

Table 2-1 Run-off Control Protection*

Storm Water Management System Component	Calculated Excess Capacity/ Parameter*	Units
Pond	34.3	acre-ft
Letdown Channels	0.7	feet freeboard
Culverts	0.0**	cubic feet per second
Berms-Landfill Top	1.7	feet freeboard
Berm/Ditch on 25% Sideslope	1.8	feet freeboard
Benches/Swales on 25% Sideslope	0.03	feet freeboard
Berm/Ditch at Landfill Base	1.7	feet freeboard

*For highest calculated flows for the final landfill design. Culverts have additional capacity when additional available headwater depths are considered.
** Additional flow capacity at the location with the highest flow is approximately 10 cubic feet per second, approximately 137% of design storm requirements.

The run-off protection system meets or exceeds the requirement to provide protection from run-off from the 24-hour, 25-year storm event.

3.0 RUN-OFF CONTROL FOR §257.3-3

The run-off from the Iatan CCR Landfill's active area is routed to the unit's storm water pond or reused by the station and discharged via an NPDES-permitted outfall or reused by the station. Per the current NPDES permit, discharged water is checked for pollutants and the discharge meets the minimum regulatory requirements of the permit. Therefore, the facility does not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the NPDES under Section 402 of the Clean Water Act, and therefore meets the requirements of 40 CFR 257.81 (b).

4.0 AMENDMENT OF RUN-ON AND RUN-OFF CONTROL PLAN

The owner or operator may amend the written run-off and run-on control system plan at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(g)(3).

The owner or operator must amend the written run-on and runoff control system plan whenever there is a change in conditions that would substantially affect the written plan in effect. Additionally, the owner or operator of the CCR unit must prepare periodic run-on and runoff control system plans every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first subsequent plan.

The owner or operator may complete any required plan prior to the required deadline provided the completed plan is placed into the facility's operating record within a reasonable amount of time.

A written certification from a qualified professional engineer that the initial and any amendment of the written run-on and run-off control system plan meets the requirements of § 257.81 must be obtained. Plan changes will be documented using the Revision History which prefaces this Plan. Changes to this plan will be certified by a Qualified Professional Engineer.

5.0 ENGINEERING CERTIFICATION

. Pursuant to 40 CFR 257.81(c)(5) and by means of this certification, I attest that:

(i) I am a Qualified Professional Engineer licensed in the State of Missouri;

(ii) I am familiar with the requirements of the CCR Rule (40 CFR 257);

(iii) I, or my agent, have visited and examined the Iatan Generating Station landfill;

(iv) I do hereby certify to the best of my knowledge, information, and belief that this Run-on and Run-off Control System Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards, and with the requirements of 40 CFR 257.81;

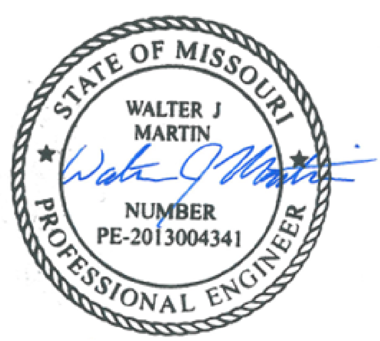
(v) this Run-on and Run-off Control System Plan meets the requirements of 40 CFR 257.81; and

(vi) the pages certified herein include Pages i, ii, 1 through 7, altogether a total of 9 pages in a protected Adobe™ document.

Walter J. Martin, P.E.
Printed Name of Qualified Professional Engineer
1200 Main St, Kansas City, MO 64105

Jays Sig Digitally signed by Jays Sig Date: 2021.10.01 16:52:39 -05'00'

P.E. SEAL, STATE OF MISSOURI



October 1, 2021

6.0 REFERENCES

1. U.S. Environmental Protection Agency, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, 40 CFR §257, Federal Register 80, Subpart D, April 17, 2015.
2. Kansas City Power & Light Company, Review of Iatan CCR Landfill Storm Water Plan Calculations, 2016.
3. Burns & McDonnell Engineering, Inc., Appendix J, Utility Waste Landfill Construction Permit Application for Kansas City Power & Light Company, Iatan Generating Station, Platte County, Missouri, January 2007.
4. Missouri Department of Natural Resources, Code of State Regulations, Rules of Department of Natural Resources, Division 80, Solid Waste Management, Chapter 11, Utility Waste Landfill, 1997.
5. Missouri Department of Natural Resources, Solid Waste Permit, Kansas City Power & Light Company, Iatan Generation Station Utility Waste Landfill, Solid Waste Disposal Area Construction Permit Number 0916501, Platte County, Missouri, Issue Date: July 16, 2007.
6. Burns & McDonnell Engineering Company, Inc., Iatan Utility Waste Landfill, Phase I Operating Permit Application, prepared for, Kansas City Power & Light Company, Kansas City, Missouri, October 2008.
7. Geotechnology, Inc., Construction Quality Assurance Report, Iatan Generating Station Utility Waste Landfill, Phase II-A Construction, January 20, 2016.
8. Geotechnology, Inc., Construction Quality Assurance Report, Iatan Generating Station Utility Waste Landfill, Phase II-B Construction, April 27, 2016.

APPENDIX A

Review of Iatan CCR Landfill Storm Water Plan Calculations
EVERGY, 2021

Review
Items

1. Permit Calculations (see the KCP&L review of Appendix J, Utility Waste Landfill Construction Permit Application)

Table 2-1 Run-off Control Protection

Storm Water System Component*	Calculated Excess Capacity/ Parameter*	Units	H, max capacity parameter	Planned, Design Storm Event	Sources (from Appendix J unless stated otherwise)
Pond (See Below)	34.3	acre-ft	59.7	25.4	Burns & Mac, Stormwater Table Spreadsheet, 2016. Appendix J & B&M Stormwater Calculation table
Letdown Channels	0.7	feet freeboard	1	0.26	Peak location: LC-4
Culverts	0.0	cubic feet per second**	27.5	27.5	Peak location: LC-4 (others are less). We have more than this if additional headwater is considered. At LC-4, there's 3' headwater depth available (787.0-784.0, per Dwg C-14) Approx capacity is about 37.7 CFS with 3' headwater depth (140% of design storm flow)
Berms-Landfill Top	1.7	feet freeboard	2	0.32	Sub-area 6
Berm/Ditch on 25% Sideslope	1.8	feet freeboard	2	0.19	Sub-area 4
Benches/Swales on 25% Sideslope	0.03	feet freeboard	0.4	0.37	Sub-area 4
Berm/Ditch at Landfill Base	1.7	feet freeboard	2	0.28	Sub-area 4

*Highest calculated flow for the final landfill design[1]. Culverts have additional capacity if additional available headwater depths are considered.
** Additional flow capacity at the location with the highest flow is approximately 10 cubic feet per second

Calculations, culvert, LC-4

Additional flow allowed in culverts at LC-4, per computer calcs	permit flow, 2.2' deep headwater	difference	
37.7	27.5	10.2 137%	Page 70 of the Adobe document: pg 2 of the "PERFORMANCE CURVE FOR CULVERT 1 - 2(2.00 (ft) BY 2.00 (ft)) CSP" calculations

Review of Iatan CCR Landfill Storm Water Plan Calculations
Kansas City Power & Light Company, 2016

Review
Items
2. Pond capacity Check:
From permit application:

The HEC-HMS output for each storm water runoff pond is as follows:

Open Landfill Phase(s)	Required Storm Water Storage Volume (acre-ft)
I	9.8
I/II	25.4
II	15.6
II/III	34.9
III	19.4
III/IV	***
IV	27.9

*** Phase III is to be closed before much of the Phase IV area is to be opened → required runoff storage volume should be no more than 27.9 acre-ft.

The peak required storm water storage volume needed for Phase I will be 9.8 acre-ft. The peak required storm water storage volume needed will occur when Phase III is newly opened and Phase II is being closed. That capacity will be 34.9 acre-ft. The actual storm water runoff pond layouts were designed using MicroStation CAD software.

Constructed volume check by Burns & McDonnell, Nov. 2015

Storm water pond						
Overflow elevation = 779.0 Top of liner = 780.0						
	STAGE - ELEV.	Area Sq. Ft.	Avg. Area Sq. Ft.	Vol./stage-increment Cu. Ft.	Acre-Ft.	Total Vol Acre-Ft.
	772	143,627				
	772.5	203,016	173,322	86,661	2.0	2.0
	773	262,404	232,710	116,355	2.7	4.7
	773.5	323,090	292,747	146,374	3.4	8.0
	774	383,777	353,433	176,717	4.1	12.1
	774.5	390,027	386,902	193,451	4.4	16.5
	775	396,277	393,152	196,576	4.5	21.0
	775.5	402,563	399,420	199,710	4.6	25.6
	776	408,850	405,706	202,853	4.7	30.3
	776.5	415,172	412,011	206,005	4.7	35.0
	777	421,495	418,334	209,167	4.8	39.8
	777.5	427,851	424,673	212,337	4.9	44.7
	778	434,208	431,030	215,515	4.9	49.6
	778.5	440,594	437,401	218,700	5.0	54.6
Overflow	**779**	**446,980**	**443,787**	**221,893**	**5.1**	**59.7**
	779.5	453,378	450,179	225,089	5.2	64.9

Review of Iatan CCR Landfill Storm Water Plan Calculations
Kansas City Power & Light Company, 2016

Review Items

3. Base Flood (100-year) Levels

Berm elevation (additional road surfacing is above this)	787.0
Flood Level (approximately, flood elevation line passes through Phase 1)	784.6
Feet above the 100-year flood:	2.4

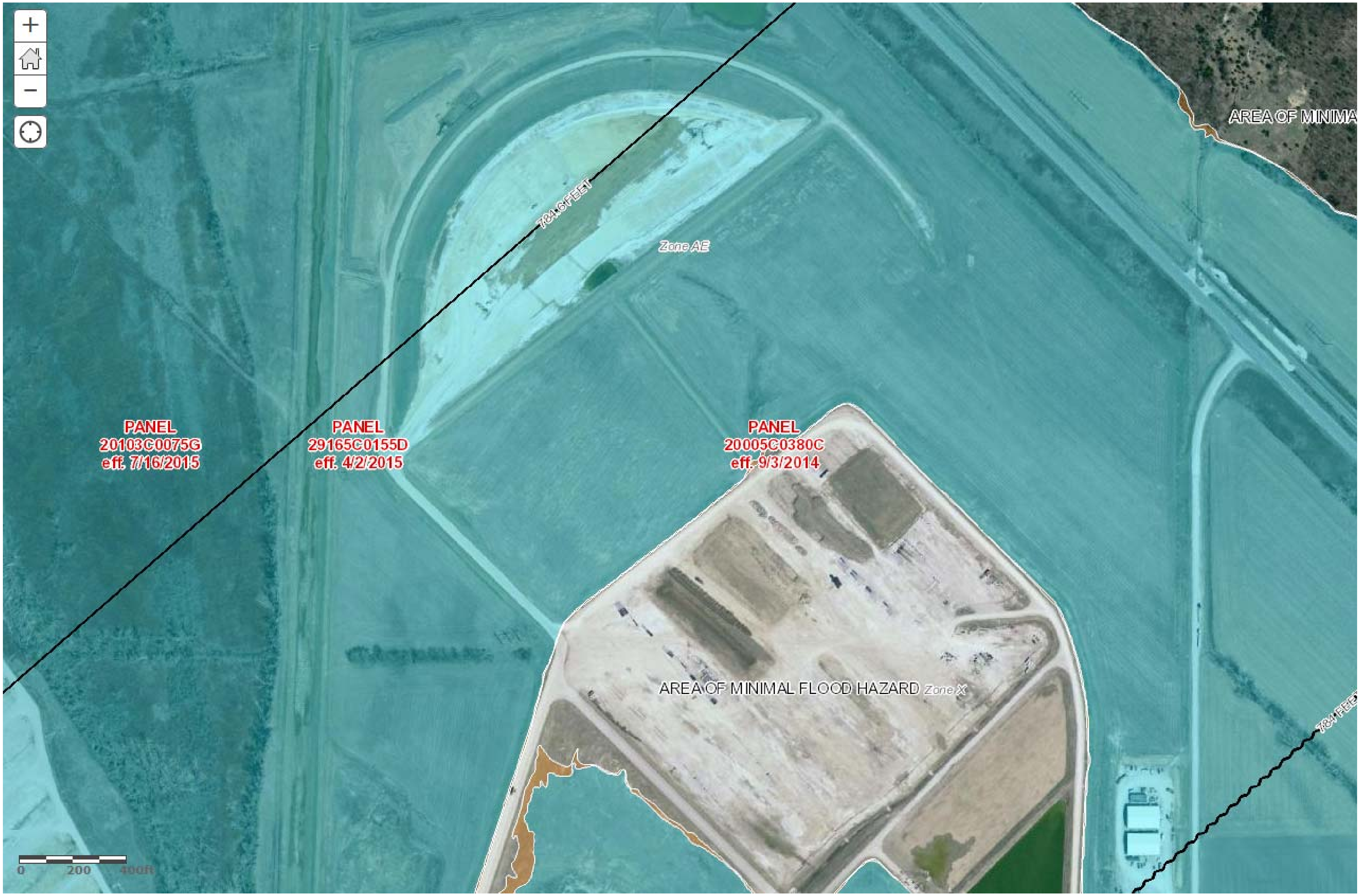
FLOOD PLAIN AND ELEVATIONS REVIEW

FEMA Map, Iatan Plant Area along the Missouri River
http://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=cbe088e7c8704464aa0fc34eb99e7f30&extent=-94.9772129440297,39.44645320460343,-94.9564419174178,39.45192109512081

Map shows the 100-Year flood elevation in the landfill vicinity to be approximately 784.5 ft. The top of berm around the landfill is constructed to at least 787.0 ft. There are no areas within the landfill area (Phase I and II) designated as being within the zone of the 500-year flood (0.2% Annual Chance Flood Hazard).

FEMA Map, Iatan Plant Area along the Missouri River

http://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=cbe088e7c8704464aa0fc34eb99e7f30&extent=-94.9772129440297,39.44645320460343,-94.9564419174178,39.45192109512081



KCPL Iatan Utility Waste Landfill
Storm Water Design Calculations
B&McD Project No. 39343
January 12, 2007

Storm Water Runoff Pond Sizing

The storm water runoff pond intended for Phase I will receive runoff from one cell. The expanded storm water runoff pond intended to receive storm water runoff from two landfill phases (e.g., one pond serving the cells of Phases II and III) is sized for the landfill phase cells that are recently developed or just starting operation but relatively empty and the previous landfill phase cells that are nearly full but not yet closed with final cover material. This scenario should only occur for relatively brief amounts of time until the previous landfill cell is closed, and during all other times the storm water runoff pond would only be receiving runoff from the active cells of the one open landfill phase.

The storm water runoff ponds were designed using the US Army Corps of Engineers Hydrologic Modeling System, HEC-HMS, which is a hydrologic modeling software designed to be applicable in a wide range of geographic areas for solving the widest possible range of problems. The program is a generalized modeling system capable of representing many different watersheds. A model of a watershed is constructed by separating the hydrologic cycle into manageable pieces and constructing boundaries around the watershed of interest. The program allows for a variety of calculation methods to be utilized for a given model; in this case, the SCS method was used for this landfill modeling situation.

All storm water drainage features of the landfill facility are designed based on a 25-year, 24-hour design storm. "Technical Paper No. 40, Rainfall Frequency Atlas of the United States" (TP-40) published by the US Department of Commerce indicates the 25-year, 24-hour design rainfall is 6.1 inches for the project site.

For both the open landfill cell full of waste but not yet closed and newly constructed landfill cell, the SCS runoff curve numbers were estimated assuming that both the in-place ash surface of the full landfill cell and the bare soil surface of the new constructed landfill cell both behave as a Hydrologic Soil Group C/D bare soil surface. Using this assumption, the estimated runoff curve number for both landfill cells was 89.

Overland flow was assumed for the first 100 feet of runoff, followed by shallow concentrated flow through the rest of the landfill cell area.

The HEC-HMS output for each storm water runoff pond is as follows:

Open Landfill Phase(s)	Required Storm Water Storage Volume (acre-ft)
I	9.8
I/II	25.4
II	15.6
II/III	34.9
III	19.4
III/IV	***
IV	27.9

Phase I & II buildout volume

*** Phase III is to be closed before much of the Phase IV area is to be opened → required runoff storage volume should be no more than 27.9 acre-ft.

The peak required storm water storage volume needed for Phase I will be 9.8 acre-ft. The peak required storm water storage volume needed will occur when Phase III is newly opened and Phase II is being closed. That capacity will be 34.9 acre-ft. The actual storm water runoff pond layouts were designed using MicroStation CAD software.

Landfill Cell Storm Water Drainage Culverts to Storm Water Runoff Ponds

Based on the Tabular Hydrograph from the HEC-HMS analyses from above, the peak flow coming from each of the full landfill cells to the storm water runoff ponds resulting from the 25-year, 24-hour design storm is given in the following table, and the overall peak flow is 48.0 cfs coming from Phase II-B. Using the Federal Highway Administration SCS Tabular Method for culvert flow (see attached), a single 24-inch diameter HDPE drainage pipe will be capable of transferring the storm water runoff from this full landfill cell to the storm water runoff pond without overtopping the haul road, and as such this pipe configuration should work for all other landfill cells.

Landfill Cell	Peak Discharge Culvert Flow to Storm Water Runoff Pond (cfs)
I	42.2
II-A	46.8
II-B	48.0
III-A	41.6
III-B	39.9
III-C	25.5
III-D	20.7

Letdown Channel and Interior Drainage Ditch Sizing

For the closed landfill with final cover applied, the SCS runoff curve number was estimated assuming that the final cover surface behaves as a Hydrologic Soil Group B/C grass-covered surface. Using this assumption, the estimated runoff curve number used in the final landfill drainage was 77.

Ditch Sizing Calculations

The minimum ditch sizing required can be calculated using Manning's equation:

$$Q = \frac{1.49}{n} \times A \times R_h^{2/3} \times S^{1/2}$$

where Q = flowrate, cfs
A = flow area, ft^2
R_h = hydraulic radius, ft
S = pipe slope, ft/ft

Assuming a trapezoidal shape to the ditch (or a V-ditch with width = 0), the flow area and hydraulic radius can be defined as

$$A = \tfrac{1}{2}\left(\text{width} + \left(\text{width} + \text{leftslope}\times h + \text{rightslope}\times h\right)\right)h \quad \text{and}$$

$$R_h = \frac{\tfrac{1}{2}\left(\text{width} + \left(\text{width} + \text{leftslope}\times h + \text{rightslope}\times h\right)\right)h}{\text{width} + \sqrt{h^2 + (\text{leftslope}\times h)^2} + \sqrt{h^2 + (\text{rightslope}\times h)^2}}$$

Substituting these expressions into Manning's equation and using a Manning's n value of 0.030, the flow equation becomes

$$Q = \frac{1.49}{0.030} \times \left(\tfrac{1}{2}\left(\text{width} + \left(\text{width} + \text{leftslope}\times h + \text{rightslope}\times h\right)\right)h\right)$$

$$\times \left(\frac{\tfrac{1}{2}\left(\text{width} + \left(\text{width} + \text{leftslope}\times h + \text{rightslope}\times h\right)\right)h}{\text{width} + \sqrt{h^2 + (\text{leftslope}\times h)^2} + \sqrt{h^2 + (\text{rightslope}\times h)^2}}\right)^{2/3} \times S^{1/2}$$

Top of Landfill berms, top of landfill

The contributing drainage area from the landfill top for each letdown channel subbasin is given in the table below (designated "Top of Landfill"). Flow was assumed to be overland flow at a 1% slope from the crest of each area to the berm. The flow along the berm to the beginning of the letdown channel was assumed to be shallow concentrated flow at 0.5%. Based on the HEC-HMS analysis for each of these areas, the peak flow entering any of the letdown channels is 11.1 cfs. Using the open channel flow equation above for V-ditches having a 0.5% slope, a Manning's n value of 0.030, and side slopes of 3:1 and 100:1 (1%), the minimum depth in the drainage ditch along the top berm is 0.32 feet. ← H=2'

Upper 4:1 Slope — Bench/swale ← H=0.4'

The contributing drainage area of the landfill side slopes between the top of the landfill and the upper intermediate bench for each letdown channel is given in the table below (designated "Upper 4:1 Slope"). Flow was assumed to be shallow concentrated flow for the length of 4:1 side slope to the intermediate bench and open channel flow from the edge of the drainage area along the bench to the letdown channel. Based on the HEC-HMS analysis for each of these areas, the peak flow entering any of the letdown channels is 3.2 cfs. This flow is for this entire drainage area, and since the drainage area is equivalent on each side of the letdown channel, the peak flow in either of the two drainage swales along the intermediate bench draining to the let-down channel was assumed to be 1.6 cfs. Using the open channel equation above for V-ditches above with a 0.5% slope, one 4:1 side slope, one 50:1 (2%) side slope, and a Manning's n value of 0.030, the minimum peak depth in the drainage ditch along the intermediate bench is 0.26 feet.

Upper Middle 4:1 Slope — berm/ditch ← 2' berm

The contributing drainage area of the landfill side slopes between the upper intermediate bench and the bench formed from the top of Phases I, II, and III perimeter berm for each letdown channel is given in the table below (designated "Upper Middle 4:1 Slope"). Flow was assumed to be shallow concentrated flow for the length of 4:1 side slope to the intermediate bench and open channel flow from the edge of the drainage area along the interior drainage ditch to the letdown channel. Based on the HEC-HMS analysis for each of these areas, the peak flow entering any of the letdown channels is 4.3 cfs. This flow is for this entire drainage area, and since the drainage area is equivalent on each side of the let-down channel, the peak flow in either of the two drainage ditches inside the perimeter road draining to the letdown channel is assumed to be 2.15 cfs. Using the open channel equation above for 10-foot flat bottom ditches above with a 0.5% slope, one 4:1 side slope, one 3:1 side slope, and a Manning's n value of 0.030, the minimum peak depth in the drainage ditch along the inside perimeter drainage ditches is 0.19 feet.

Lower Middle 4:1 Slope — bench/swale ← 0.4'

The contributing drainage area of the landfill side slopes between the bench formed from the top of Phases I, II, and III perimeter berm and the lower intermediate bench for each letdown channel is given in the table below (designated "Lower Middle 4:1 Slope"). Flow was assumed to be shallow concentrated flow for the length of 4:1 side slope to the intermediate bench and open channel flow from the edge of the drainage area along the bench to the letdown channel. Based on the HEC-HMS analysis for each of these areas, the peak flow entering any of the letdown channels is 8.4 cfs. This flow is for this entire drainage area, and since the drainage area is equivalent on each side of the letdown channel, the peak flow in either of the two drainage swales along the intermediate bench draining to the letdown channel was assumed to be 4.2 cfs. Using the open channel equation above for V-ditches above with a 0.5% slope, one 4:1 side slope, one 50:1 (2%) side slope, and a Manning's n value of 0.030, the minimum peak depth in the drainage ditch along the intermediate bench is 0.37 feet.

bench-greatest depth is 0.37'

Lower 4:1 Slope bench

The contributing drainage area of the landfill side slopes below the lower intermediate bench for each letdown channel is given in the table below (designated "Lower 4:1 Slope"). Flow was assumed to be shallow concentrated flow for the length of 4:1 side slope to the intermediate bench and open channel flow from the edge of the drainage area along the interior drainage ditch to the letdown channel. Based on the HEC-HMS analysis for each of these areas, the peak flow entering any of the letdown channels is 8.5 cfs. This flow is for this entire drainage area, and since the drainage area is equivalent on each side of the letdown channel, the peak flow in either of the two drainage ditches inside the perimeter road draining to the letdown channel is assumed to be 4.25 cfs. Using the open channel equation above for 10-foot flat bottom ditches above with a 0.5% slope one 4:1 side slope, one 3:1 side slope, and a Manning's n value of 0.030, the minimum peak depth in the drainage ditch along the inside perimeter drainage ditches is 0.28 feet.

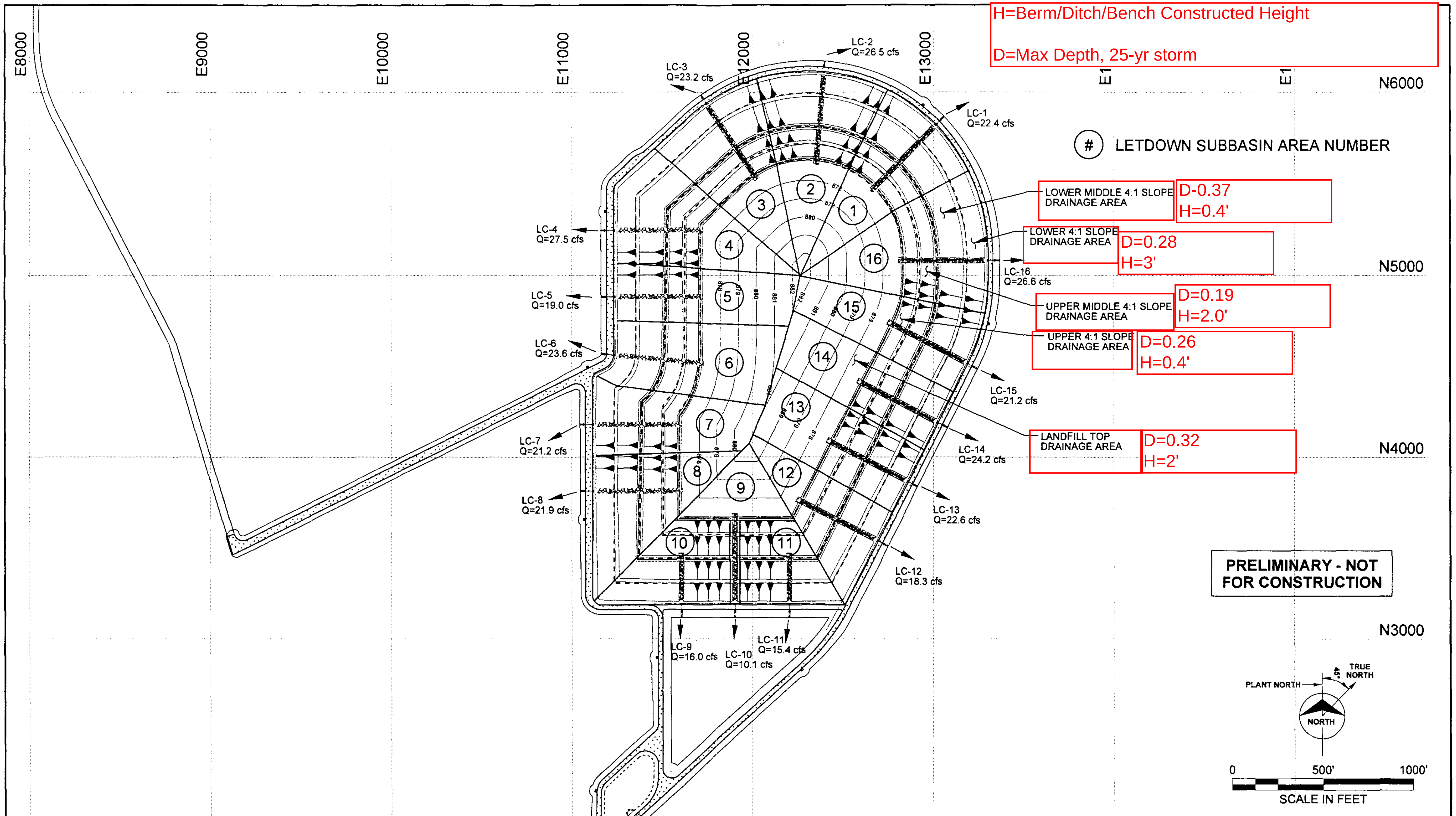
H=2' typical (detail in permit plans)

Overall Letdown Channel

Based on the summation of the drainage from the areas described above, the peak flows for each letdown channel is summarized in the table below. The overall peak flow in any letdown channel is 27.5 cfs (Letdown Channel 4). Using the peak flow of 27.5 cfs and a channel with slope of 25%, 3:1 side slopes on each side of the letdown channel, and a Manning's n value of 0.030, the letdown channel requires a minimum peak depth of 0.26 feet. Based on the above analysis, the letdown channels and interior drainage swales were sized to provide 1 foot of drainage depth to accommodate the 25-year, 24-hour storm water flow.

H=design height →	2' berm/ swale	0.4' Bench/ swale	2' berm/ ditch	0.4' Bench/ swale	2' Berm/ ditch	1' Letdown
Let-Down Channel Drainage Subbasin	**Top of Landfill Outflow (cfs)**	**Upper 4:1 Slope Outflow (cfs)**	**Upper Middle 4:1 Slope Outflow (cfs)**	**Lower Middle 4:1 Slope Outflow (cfs)**	**Lower 4:1 Slope Outflow (cfs)**	**Overall Letdown Channel Outflow (cfs) (Culvert Name)**
1	6.1	2.7	3.5	6.1	5.7	22.4 (LC-1)
2	7.4	3.1	3.9	7.5	6.9	26.5 (LC-2)
3	6.5	2.7	3.2	6.5	5.8	23.2 (LC-3)
4	6.7	3.2	4.3	8.4	8.5	27.5 (LC-4)
5	9.4	2.5	2.8	4.0	3.9	19.0 (LC-5)
6	11.1	2.9	3.5	4.7	5.5	23.6 (LC-6)
7	7.6	2.7	4.0	4.8	5.5	21.2 (LC-7)
8	4.0	2.7	4.2	5.2	6.4	21.9 (LC-8)
9	6.4	4.3	-	-	-	10.1 (LC-9)
10	-	-	4.7	5.0	6.3	16.0 (LC-10)
11	-	-	4.6	5.0	6.0	15.4 (LC-11)
12	4.6	2.3	4.3	4.3	4.0	18.3 (LC-12)
13	10.2	2.8	3.9	4.2	4.4	22.6 (LC-13)
14	9.8	2.4	3.5	4.2	4.3	24.2 (LC-14)
15	8.9	2.7	3.6	4.0	4.6	21.2 (LC-15)
16	7.6	3.1	4.2	6.9	6.5	26.6 (LC-16)
D=Channel design Depth →	D=0.32'	see flow for Lower Middle outflow	D=0.19	D=0.37'	D=0.28'	D=0.26'

discussions above said these was the max for those sections. Not an issue since 4.2 (8.4 total) is the max flow and design basis (0.37' depth).



Burns & McDonnell SINCE 1898	KCPL	project 39343
date JANUARY 4, 2007	IATAN LANDFILL	contract
designed C. SPEEGLE	LANDFILL RUNOFF	SK - 021

Pipe Sizing for Culverts Under Haul Road for Letdown Channels

Once a landfill cell has been closed with final cover installed, all storm water runoff will be routed to outside drainage instead of to the storm water runoff pond. This storm water runoff will be collected and conveyed down the side slopes using letdown channels and will then be discharged off-site via culverts underneath the haul road.

Based on the HEC-HMS analysis from earlier, the peak flow within each letdown channel resulting from the 25-year, 24-hour design storm is 27.5 cfs. The flow transported down the landfill side slope will be conveyed underneath the haul road to off-site drainage via two culvert pipes, meaning the design flow for the culvert pipes is also 27.5 cfs based on the HEC-HMS analysis from above. Assuming the culverts will be corrugated HDPE pipe sloped at 2% minimum and will gravity drain the runoff underneath the haul road, the required pipe diameter for full pipe flow calculated using the HY-8 culvert design software is 24 inches. HY-8 software is an automation of the Federal Highway Administration's Hydraulic Design Series No. 5 "Hydraulic Design of Highway Culverts" and is a culvert design manual which allows for consideration of inlet and outlet control analysis.

Storm water runoff discharged from the culverts under the haul road will be conveyed via a riprap let-down channel down the landfill perimeter berm, spread to more sheet flow via a splash pad at the bottom of the berm, and allowed to flow into adjacent wetland areas.

POND SIZING AND LANDFILL CELL
STORM WATER DRAINAGE CULVERT CALCULATIONS


Phase 1

HMS * Summary of Results

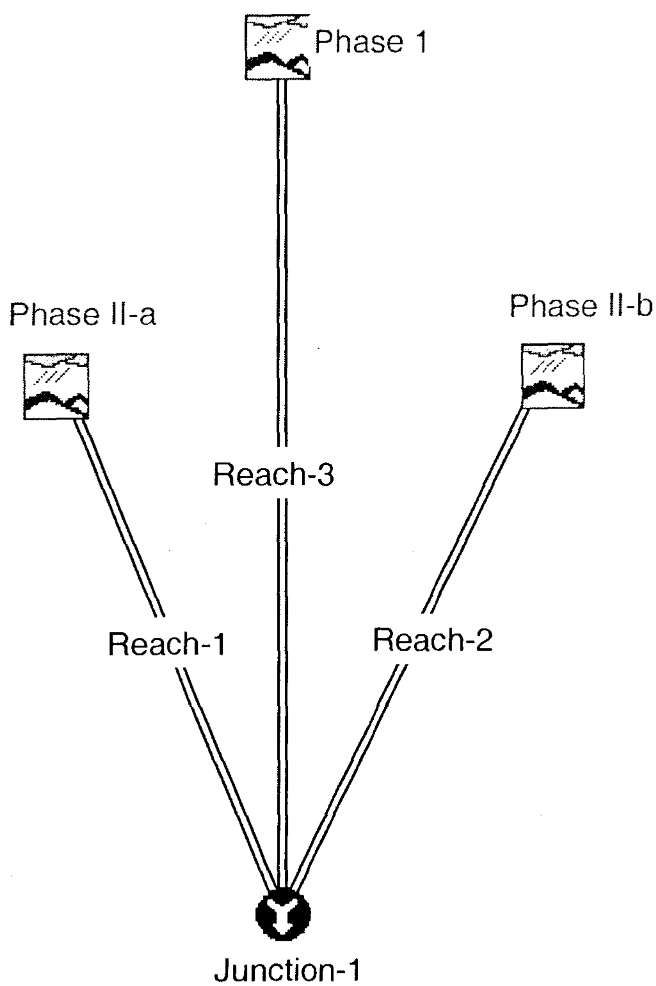
Project : KCPL Iatan   Run Name : Run 14

Start of Run : 01Jun06 1200   Basin Model : Phase 1 (Lag)

End of Run : 02Jun06 1200   Met. Model : 25-Yr

Execution Time : 14Jul06 1509   Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
Phase 1	42.237	02 Jun 06 0115	9.8633	0.039


Phase 1
Phase II-a
Phase II-b
Reach-3
Reach-1
Reach-2
Junction-1

HMS * Summary of Results

Project : KCPL Iatan   Run Name : Run 34

Start of Run : 01Jun06 1200   Basin Model : Phase II

End of Run : 02Jun06 1200   Met. Model : 25-Yr

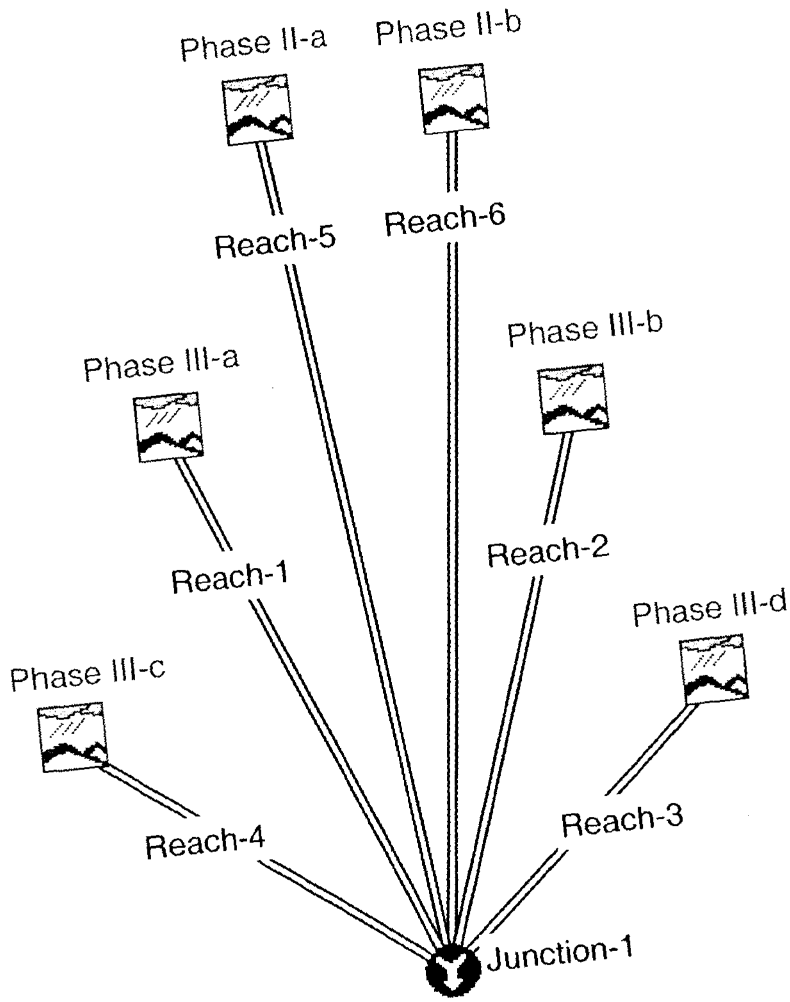
Execution Time : 25Jul06 0823   Control Specs : Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
Phase II-a	46.763	02 Jun 06 0045	7.6542	0.030
Reach-1	46.528	02 Jun 06 0045	7.6455	0.030
Phase 1	42.738	02 Jun 06 0115	9.8727	0.039
Reach-3	42.644	02 Jun 06 0115	9.8576	0.039
Phase II-b	48.040	02 Jun 06 0045	7.9085	0.031
Reach-2	47.755	02 Jun 06 0045	7.8995	0.031
Junction-1	127.54	02 Jun 06 0050	25.403	0.100

HEC-HMS

Project: KCPL Iatan

Basin Model: Phase

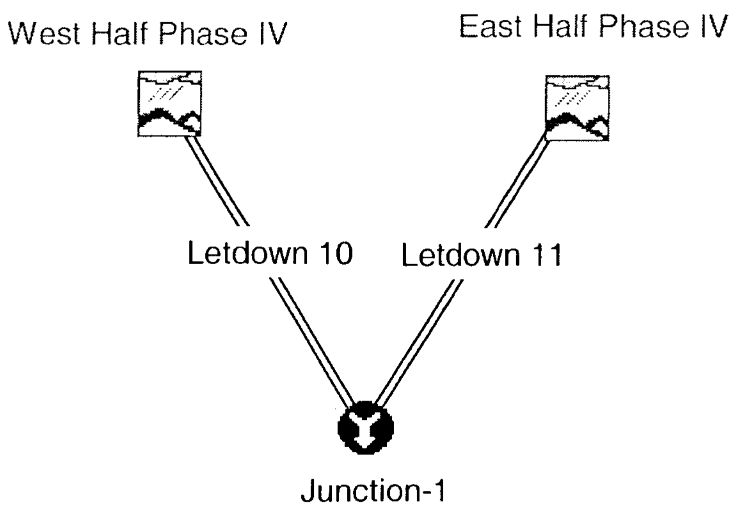


HMS * Summary of Results

Project : KCPL Iatan   Run Name : Run 33

Start of Run	: 01Jun06 1200	Basin Model	:	Phase III
End of Run	: 02Jun06 1200	Met. Model	:	25-Yr
Execution Time	: 25Jul06 1446	Control Specs	:	Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
Phase III-c	25.491	02 Jun 06 0045	4.0840	0.016
Reach-4	25.489	02 Jun 06 0045	4.0840	0.016
Phase III-a	41.608	02 Jun 06 0035	6.1345	0.024
Reach-1	41.501	02 Jun 06 0035	6.1341	0.024
Phase II-a	37.081	02 Jun 06 0100	7.6181	0.030
Reach-5	37.073	02 Jun 06 0105	7.6089	0.030
Phase II-b	38.316	02 Jun 06 0100	7.8720	0.031
Reach-6	38.308	02 Jun 06 0105	7.8623	0.031
Phase III-b	39.874	02 Jun 06 0035	5.8789	0.023
each-2	39.711	02 Jun 06 0040	5.8774	0.023
ase III-d	20.712	02 Jun 06 0045	3.3183	0.013
Reach-3	20.711	02 Jun 06 0045	3.3182	0.013
Junction-1	187.81	02 Jun 06 0045	34.885	0.137


West Half Phase IV
East Half Phase IV
Letdown 10
Letdown 11
Junction-1

HMS * Summary of Results

Project : KCPL Iatan   Run Name : Run 35

Start of Run	: 01Jun06 1200	Basin Model	: Phase IV
End of Run	: 02Jun06 1200	Met. Model	: 25-Yr
Execution Time	: 26Jul06 1430	Control Specs	: Control 1

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
West Half of Phase	104.44	02 Jun 06 0025	13.066	0.051
Letdown 10	104.28	02 Jun 06 0025	13.066	0.051
East Half of Phase	118.18	02 Jun 06 0025	14.859	0.058
Letdown 11	118.00	02 Jun 06 0025	14.858	0.058
Junction-1	222.27	02 Jun 06 0025	27.924	0.109

STORAGE ROUTING FORM

1. INFLOW HYDROGRAPH GENERATION:
   a. Hydrograph method used:
   b. Time interval selected for routing:
   (inflow hydrograph attached)

2. APPROXIMATE FLOW REDUCTION DUE TO ROUTING
   a. Peak inflow: Q_p=________ft³/s
   b. Upstream storage: S=________ft³
   c. Time to peak: t_p=______min

$$Q_r = Q_p \frac{S}{80\, t_p} =$$

3. ELEVATION - DISCHARGE RELATIONSHIP FOR TRIAL CULVERT

ELEVATION ft	779.0	779.5	780.0	780.5	781.0	781.5	782.0	782.5
DISCHARGE ft³/s	2	6	11	14	15	16	17	18

4. ELEVATION - STORAGE RELATIONSHIP FOR UPSTREAM PONDING

ELEVATION ft	AREA ft²	INCREMENTAL VOLUME ft³	ACCUMULATED VOLUME ft³
778.5	0		0
		844	
779.0	3375		844
		2531	
779.5	6750		3375
		4547	
780.0	11438		7922
		7110	
780.5	17000		15032
		10110	
781.0	23438		25142
		13547	
781.5	30750		38689
		16031	
782.0	33750		54720
		17343	
782.5	36000		72064
		18656	
783.0	37313		90720
		19640	
783.5	41250		110361
		21281	
794.0	43875		121002
		22594	
784.5	46500		143596
		23906	
785.0	49125		167502
		25219	
785.5	51750		192721
		26531	
786.0	54375		219252

5. STORAGE - OUTFLOW RELATIONSHIP

Elevation ft	Discharge (O) ft³/s	Storage (S) ft³	2s/Δt ft³/s	2s/Δt + O ft³/s
778.5	0	0	0	0
779.0	2	844	0	2
779.5	6	3375	2	8
780.0	11	7722	4	15
780.5	14	15032	7	21
781.0	15	25142	11	26
781.5	16	38689	17	33
782.0	17	54720	24	41
782.5	18	72064	32	50
783.0	18	90720	40	58
783.5	19	110361	48	67
784.0	20	121042	53	73
784.5	21	143592	63	84
785.0	22	167502	74	96
785.5	23	192721	[illegible]	108
786.0	24	219252	96	120

6. STORAGE - INDICATION ROUTING TABLE

(1) TIME min	(2) INFLOW (I) ft³/s	(3) 2s/Δt − O ft³/s	(4) 2s/Δt + O ft³/s	(5) OUTFLOW (O) ft³/s	
0	0				
527	1	0	1	0	
653	2	0	3	3	
679	4	0	6	5	
725	14	9	18	13	
765	48	26	62	18	
785	38	66	112	23	
815	19	75	123	24	← PEAK
845	10	58	104	23	
875	6	34	74	20	
905	5	11	45	17	
935	4	0	20	14	
965	3	0	7	5	

(Rows 765–905 bracketed:) WATER LEVEL OVER TOP OF OUTLET PIPE.

* PEAK FLOW OF 24 CFS OCCURS @ EL 786.0 WHICH IS BELOW BERM EL 787.0

HMS * Summary of Results for Phase II-b

Project : KCPL Iatan Run Name : Run 34

Start of Run : 01Jun06 1200 Basin Model : Phase II

End of Run : 02Jun06 1200 Met. Model : 25-Yr

Execution Time : 25Jul06 0909 Control Specs : Control 1

Date	Time	Precip. (in)	Loss (in)	Excess (in)	Direct Q (cfs)	Base-flow (cfs)	Total Q (cfs)
01 Jun 06	1200				0.000	0.000	0.000
01 Jun 06	1205	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1210	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1215	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1220	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1225	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1230	0.00	0.00	0.00	0.000	0.000	0.000
1 Jun 06	1235	0.00	0.00	0.00	0.000	0.000	0.000
1 Jun 06	1240	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1245	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1250	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1255	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1300	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1305	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1310	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1315	0.00	0.00	0.00	0.000	0.000	0.000
01 Jun 06	1320	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1325	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1330	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1335	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1340	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1345	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1350	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1355	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1400	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1405	0.01	0.01	0.00	0.000	0.000	0.000
Jun 06	1410	0.01	0.01	0.00	0.000	0.000	0.000
Jun 06	1415	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1420	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1425	0.01	0.01	0.00	0.000	0.000	0.000

Date	Time	Precip. (in)	Loss (in)	Excess (in)	Direct Q (cfs)	Base-flow (cfs)	Total Q (cfs)
01 Jun 06	1430	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1435	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1440	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1445	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1450	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1455	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1500	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1505	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1510	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1515	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1520	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1525	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1530	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1535	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1540	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1545	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1550	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1555	0.01	0.01	0.00	0.000	0.000	0.000
. Jun 06	1600	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1605	0.01	0.01	0.00	0.000	0.000	0.000
01 Jun 06	1610	0.01	0.01	0.00	0.001	0.000	0.001
01 Jun 06	1615	0.01	0.01	0.00	0.002	0.000	0.002
01 Jun 06	1620	0.01	0.01	0.00	0.004	0.000	0.004
01 Jun 06	1625	0.01	0.01	0.00	0.007	0.000	0.007
01 Jun 06	1630	0.01	0.01	0.00	0.011	0.000	0.011
01 Jun 06	1635	0.01	0.01	0.00	0.017	0.000	0.017
01 Jun 06	1640	0.01	0.01	0.00	0.024	0.000	0.024
01 Jun 06	1645	0.01	0.01	0.00	0.032	0.000	0.032
01 Jun 06	1650	0.01	0.01	0.00	0.041	0.000	0.041
01 Jun 06	1655	0.01	0.01	0.00	0.052	0.000	0.052
01 Jun 06	1700	0.01	0.01	0.00	0.064	0.000	0.064
01 Jun 06	1705	0.01	0.01	0.00	0.076	0.000	0.076
01 Jun 06	1710	0.01	0.01	0.00	0.089	0.000	0.089
01 Jun 06	1715	0.01	0.01	0.00	0.103	0.000	0.103
01 Jun 06	1720	0.01	0.01	0.00	0.117	0.000	0.117
01 Jun 06	1725	0.01	0.01	0.00	0.132	0.000	0.132
01 Jun 06	1730	0.01	0.01	0.00	0.147	0.000	0.147
Jun 06	1735	0.01	0.01	0.00	0.163	0.000	0.163
01 Jun 06	1740	0.01	0.01	0.00	0.179	0.000	0.179
01 Jun 06	1745	0.01	0.01	0.00	0.195	0.000	0.195
01 Jun 06	1750	0.01	0.01	0.00	0.212	0.000	0.212

Date	Time	Precip. (in)	Loss (in)	Excess (in)	Direct Q (cfs)	Base-flow (cfs)	Total Q (cfs)
01 Jun 06	1755	0.01	0.01	0.00	0.229	0.000	0.229
01 Jun 06	1800	0.01	0.01	0.00	0.246	0.000	0.246
01 Jun 06	1805	0.01	0.01	0.00	0.264	0.000	0.264
01 Jun 06	1810	0.01	0.01	0.00	0.283	0.000	0.283
01 Jun 06	1815	0.01	0.01	0.00	0.302	0.000	0.302
01 Jun 06	1820	0.01	0.01	0.00	0.323	0.000	0.323
01 Jun 06	1825	0.01	0.01	0.00	0.345	0.000	0.345
01 Jun 06	1830	0.01	0.01	0.00	0.368	0.000	0.368
01 Jun 06	1835	0.01	0.01	0.00	0.392	0.000	0.392
01 Jun 06	1840	0.01	0.01	0.00	0.417	0.000	0.417
01 Jun 06	1845	0.01	0.01	0.00	0.443	0.000	0.443
01 Jun 06	1850	0.01	0.01	0.00	0.469	0.000	0.469
01 Jun 06	1855	0.01	0.01	0.00	0.496	0.000	0.496
01 Jun 06	1900	0.01	0.01	0.00	0.523	0.000	0.523
01 Jun 06	1905	0.01	0.01	0.00	0.551	0.000	0.551
01 Jun 06	1910	0.01	0.01	0.00	0.578	0.000	0.578
01 Jun 06	1915	0.01	0.01	0.00	0.606	0.000	0.606
01 Jun 06	1920	0.01	0.01	0.00	0.634	0.000	0.634
1 Jun 06	1925	0.01	0.01	0.00	0.662	0.000	0.662
01 Jun 06	1930	0.01	0.01	0.00	0.691	0.000	0.691
01 Jun 06	1935	0.01	0.01	0.00	0.720	0.000	0.720
01 Jun 06	1940	0.01	0.01	0.00	0.750	0.000	0.750
01 Jun 06	1945	0.01	0.01	0.00	0.780	0.000	0.780
01 Jun 06	1950	0.01	0.01	0.00	0.811	0.000	0.811
01 Jun 06	1955	0.01	0.01	0.00	0.842	0.000	0.842
01 Jun 06	2000	0.01	0.01	0.01	0.875	0.000	0.875
01 Jun 06	2005	0.01	0.01	0.01	0.908	0.000	0.908
01 Jun 06	2010	0.01	0.01	0.01	0.941	0.000	0.941
01 Jun 06	2015	0.01	0.01	0.01	0.976	0.000	0.976
01 Jun 06	2020	0.01	0.01	0.01	1.012	0.000	1.012
01 Jun 06	2025	0.01	0.01	0.01	1.048	0.000	1.048
01 Jun 06	2030	0.01	0.01	0.01	1.085	0.000	1.085
01 Jun 06	2035	0.01	0.01	0.01	1.124	0.000	1.124
01 Jun 06	2040	0.01	0.01	0.01	1.163	0.000	1.163
01 Jun 06	2045	0.01	0.01	0.01	1.204	0.000	1.204
01 Jun 06	2050	0.01	0.01	0.01	1.246	0.000	1.246
01 Jun 06	2055	0.01	0.01	0.01	1.289	0.000	1.289
Jun 06	2100	0.01	0.01	0.01	1.334	0.000	1.334
01 Jun 06	2105	0.01	0.01	0.01	1.380	0.000	1.380
01 Jun 06	2110	0.01	0.01	0.01	1.426	0.000	1.426
01 Jun 06	2115	0.01	0.01	0.01	1.473	0.000	1.473

Date	Time	Precip. (in)	Loss (in)	Excess (in)	Direct Q (cfs)	Base-flow (cfs)	Total Q (cfs)
01 Jun 06	2120	0.01	0.01	0.01	1.519	0.000	1.519
01 Jun 06	2125	0.02	0.01	0.01	1.564	0.000	1.564
01 Jun 06	2130	0.02	0.01	0.01	1.608	0.000	1.608
01 Jun 06	2135	0.02	0.01	0.01	1.652	0.000	1.652
01 Jun 06	2140	0.02	0.01	0.01	1.698	0.000	1.698
01 Jun 06	2145	0.02	0.01	0.01	1.746	0.000	1.746
01 Jun 06	2150	0.02	0.01	0.01	1.797	0.000	1.797
01 Jun 06	2155	0.02	0.01	0.01	1.851	0.000	1.851
01 Jun 06	2200	0.02	0.01	0.01	1.909	0.000	1.909 *
01 Jun 06	2205	0.02	0.01	0.01	1.972	0.000	1.972
01 Jun 06	2210	0.02	0.01	0.01	2.040	0.000	2.040
01 Jun 06	2215	0.02	0.01	0.01	2.114	0.000	2.114
01 Jun 06	2220	0.02	0.01	0.01	2.193	0.000	2.193
01 Jun 06	2225	0.02	0.01	0.01	2.277	0.000	2.277
01 Jun 06	2230	0.02	0.01	0.01	2.368	0.000	2.368
01 Jun 06	2235	0.03	0.01	0.02	2.468	0.000	2.468
01 Jun 06	2240	0.03	0.01	0.02	2.579	0.000	2.579
01 Jun 06	2245	0.03	0.01	0.02	2.704	0.000	2.704
1 Jun 06	2250	0.03	0.01	0.02	2.847	0.000	2.847
01 Jun 06	2255	0.03	0.01	0.02	3.012	0.000	3.012
01 Jun 06	2300	0.03	0.01	0.02	3.199	0.000	3.199
01 Jun 06	2305	0.04	0.01	0.03	3.406	0.000	3.406
01 Jun 06	2310	0.04	0.01	0.03	3.633	0.000	3.633
01 Jun 06	2315	0.04	0.01	0.03	3.879	0.000	3.879
01 Jun 06	2320	0.04	0.01	0.03	4.145	0.000	4.145
01 Jun 06	2325	0.05	0.01	0.04	4.431	0.000	4.431 *
01 Jun 06	2330	0.05	0.01	0.04	4.745	0.000	4.745
01 Jun 06	2335	0.12	0.03	0.09	5.133	0.000	5.133
01 Jun 06	2340	0.13	0.03	0.10	5.655	0.000	5.655
01 Jun 06	2345	0.15	0.03	0.12	6.369	0.000	6.369
01 Jun 06	2350	0.24	0.04	0.20	7.414	0.000	7.414
01 Jun 06	2355	0.28	0.04	0.24	8.960	0.000	8.960
01 Jun 06	2400	0.28	0.03	0.24	11.092	0.000	11.092
02 Jun 06	0005	0.86	0.08	0.78	14.315	0.000	14.315 *
02 Jun 06	0010	0.19	0.01	0.18	18.642	0.000	18.642
02 Jun 06	0015	0.26	0.02	0.24	23.795	0.000	23.795
02 Jun 06	0020	0.16	0.01	0.15	29.654	0.000	29.654
Jun 06	0025	0.14	0.01	0.13	35.828	0.000	35.828
02 Jun 06	0030	0.12	0.01	0.12	41.290	0.000	41.290
02 Jun 06	0035	0.06	0.00	0.05	45.215	0.000	45.215
02 Jun 06	0040	0.05	0.00	0.05	47.431	0.000	47.431

Date	Time	Precip. (in)	Loss (in)	Excess (in)	Direct Q (cfs)	Base-flow (cfs)	Total Q (cfs)	
02 Jun 06	0045	0.05	0.00	0.04	48.040	0.000	48.040	→ PEAK
02 Jun 06	0050	0.04	0.00	0.04	47.109	0.000	47.109	
02 Jun 06	0055	0.04	0.00	0.04	44.879	0.000	44.879	
02 Jun 06	0100	0.04	0.00	0.03	41.780	0.000	41.780	
02 Jun 06	0105	0.04	0.00	0.03	37.927	0.000	37.927	*
02 Jun 06	0110	0.03	0.00	0.03	33.763	0.000	33.763	
02 Jun 06	0115	0.03	0.00	0.03	29.954	0.000	29.954	
02 Jun 06	0120	0.03	0.00	0.03	26.548	0.000	26.548	
02 Jun 06	0125	0.03	0.00	0.03	23.527	0.000	23.527	
02 Jun 06	0130	0.03	0.00	0.03	20.950	0.000	20.950	
02 Jun 06	0135	0.02	0.00	0.02	18.665	0.000	18.665	*
02 Jun 06	0140	0.02	0.00	0.02	16.720	0.000	16.720	
02 Jun 06	0145	0.02	0.00	0.02	15.034	0.000	15.034	
02 Jun 06	0150	0.02	0.00	0.02	13.583	0.000	13.583	
02 Jun 06	0155	0.02	0.00	0.02	12.316	0.000	12.316	
02 Jun 06	0200	0.02	0.00	0.02	11.180	0.000	11.180	
02 Jun 06	0205	0.02	0.00	0.02	10.201	0.000	10.201	*
02 Jun 06	0210	0.02	0.00	0.02	9.325	0.000	9.325	
2 Jun 06	0215	0.02	0.00	0.02	8.568	0.000	8.568	
02 Jun 06	0220	0.02	0.00	0.02	7.900	0.000	7.900	
02 Jun 06	0225	0.02	0.00	0.02	7.310	0.000	7.310	
02 Jun 06	0230	0.02	0.00	0.02	6.800	0.000	6.800	
02 Jun 06	0235	0.02	0.00	0.01	6.347	0.000	6.347	*
02 Jun 06	0240	0.02	0.00	0.01	5.956	0.000	5.956	
02 Jun 06	0245	0.01	0.00	0.01	5.611	0.000	5.611	
02 Jun 06	0250	0.01	0.00	0.01	5.307	0.000	5.307	
02 Jun 06	0255	0.01	0.00	0.01	5.041	0.000	5.041	
02 Jun 06	0300	0.01	0.00	0.01	4.800	0.000	4.800	
02 Jun 06	0305	0.01	0.00	0.01	4.580	0.000	4.580	*
02 Jun 06	0310	0.01	0.00	0.01	4.381	0.000	4.381	
02 Jun 06	0315	0.01	0.00	0.01	4.201	0.000	4.201	
02 Jun 06	0320	0.01	0.00	0.01	4.040	0.000	4.040	
02 Jun 06	0325	0.01	0.00	0.01	3.897	0.000	3.897	
02 Jun 06	0330	0.01	0.00	0.01	3.771	0.000	3.771	
02 Jun 06	0335	0.01	0.00	0.01	3.663	0.000	3.663	*
02 Jun 06	0340	0.01	0.00	0.01	3.577	0.000	3.577	
02 Jun 06	0345	0.01	0.00	0.01	3.500	0.000	3.500	
Jun 06	0350	0.01	0.00	0.01	3.432	0.000	3.432	
2 Jun 06	0355	0.01	0.00	0.01	3.368	0.000	3.368	
02 Jun 06	0400	0.01	0.00	0.01	3.308	0.000	3.308	
02 Jun 06	0405	0.01	0.00	0.01	3.251	0.000	3.251	

Date	Time	Precip. (in)	Loss (in)	Excess (in)	Direct Q (cfs)	Base-flow (cfs)	Total Q (cfs)
02 Jun 06	0410	0.01	0.00	0.01	3.195	0.000	3.195
02 Jun 06	0415	0.01	0.00	0.01	3.140	0.000	3.140
02 Jun 06	0420	0.01	0.00	0.01	3.086	0.000	3.086
02 Jun 06	0425	0.01	0.00	0.01	3.033	0.000	3.033
02 Jun 06	0430	0.01	0.00	0.01	2.982	0.000	2.982
02 Jun 06	0435	0.01	0.00	0.01	2.933	0.000	2.933
02 Jun 06	0440	0.01	0.00	0.01	2.885	0.000	2.885
02 Jun 06	0445	0.01	0.00	0.01	2.839	0.000	2.839
02 Jun 06	0450	0.01	0.00	0.01	2.794	0.000	2.794
02 Jun 06	0455	0.01	0.00	0.01	2.750	0.000	2.750
02 Jun 06	0500	0.01	0.00	0.01	2.708	0.000	2.708
02 Jun 06	0505	0.01	0.00	0.01	2.668	0.000	2.668
02 Jun 06	0510	0.01	0.00	0.01	2.628	0.000	2.628
02 Jun 06	0515	0.01	0.00	0.01	2.590	0.000	2.590
02 Jun 06	0520	0.01	0.00	0.01	2.553	0.000	2.553
02 Jun 06	0525	0.01	0.00	0.01	2.517	0.000	2.517
02 Jun 06	0530	0.01	0.00	0.01	2.482	0.000	2.482
02 Jun 06	0535	0.01	0.00	0.01	2.448	0.000	2.448
! Jun 06	0540	0.01	0.00	0.01	2.416	0.000	2.416
02 Jun 06	0545	0.01	0.00	0.01	2.384	0.000	2.384
02 Jun 06	0550	0.01	0.00	0.01	2.353	0.000	2.353
02 Jun 06	0555	0.01	0.00	0.01	2.323	0.000	2.323
02 Jun 06	0600	0.01	0.00	0.01	2.294	0.000	2.294
02 Jun 06	0605	0.01	0.00	0.01	2.265	0.000	2.265
02 Jun 06	0610	0.01	0.00	0.01	2.235	0.000	2.235
02 Jun 06	0615	0.01	0.00	0.01	2.205	0.000	2.205
02 Jun 06	0620	0.01	0.00	0.01	2.172	0.000	2.172
02 Jun 06	0625	0.01	0.00	0.01	2.136	0.000	2.136
02 Jun 06	0630	0.01	0.00	0.01	2.099	0.000	2.099
02 Jun 06	0635	0.01	0.00	0.01	2.060	0.000	2.060
02 Jun 06	0640	0.01	0.00	0.01	2.020	0.000	2.020
02 Jun 06	0645	0.01	0.00	0.01	1.982	0.000	1.982
02 Jun 06	0650	0.01	0.00	0.01	1.945	0.000	1.945
02 Jun 06	0655	0.01	0.00	0.01	1.910	0.000	1.910
02 Jun 06	0700	0.01	0.00	0.01	1.877	0.000	1.877
02 Jun 06	0705	0.01	0.00	0.01	1.846	0.000	1.846
02 Jun 06	0710	0.01	0.00	0.01	1.819	0.000	1.819
Jun 06	0715	0.01	0.00	0.01	1.793	0.000	1.793
02 Jun 06	0720	0.01	0.00	0.01	1.769	0.000	1.769
02 Jun 06	0725	0.01	0.00	0.01	1.747	0.000	1.747
02 Jun 06	0730	0.01	0.00	0.01	1.725	0.000	1.725

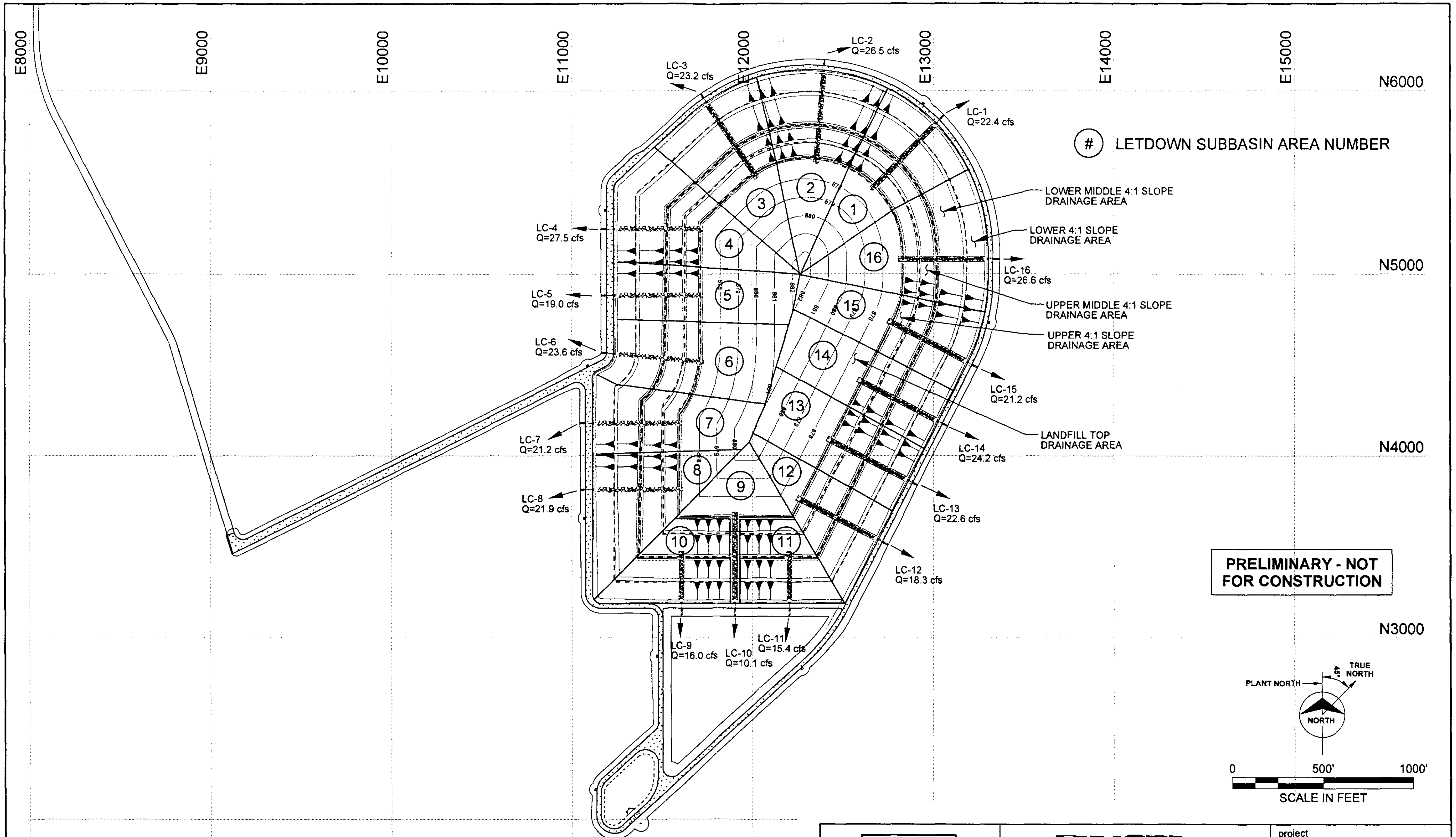
Date	Time	Precip. (in)	Loss (in)	Excess (in)	Direct Q (cfs)	Base-flow (cfs)	Total Q (cfs)
02 Jun 06	0735	0.01	0.00	0.01	1.705	0.000	1.705
02 Jun 06	0740	0.01	0.00	0.01	1.686	0.000	1.686
02 Jun 06	0745	0.01	0.00	0.01	1.668	0.000	1.668
02 Jun 06	0750	0.01	0.00	0.01	1.650	0.000	1.650
02 Jun 06	0755	0.01	0.00	0.01	1.633	0.000	1.633
02 Jun 06	0800	0.01	0.00	0.01	1.617	0.000	1.617
02 Jun 06	0805	0.01	0.00	0.01	1.601	0.000	1.601
02 Jun 06	0810	0.01	0.00	0.01	1.586	0.000	1.586
02 Jun 06	0815	0.01	0.00	0.01	1.571	0.000	1.571
02 Jun 06	0820	0.01	0.00	0.01	1.557	0.000	1.557
02 Jun 06	0825	0.01	0.00	0.01	1.543	0.000	1.543
02 Jun 06	0830	0.01	0.00	0.01	1.529	0.000	1.529
02 Jun 06	0835	0.01	0.00	0.01	1.516	0.000	1.516
02 Jun 06	0840	0.01	0.00	0.01	1.503	0.000	1.503
02 Jun 06	0845	0.01	0.00	0.01	1.490	0.000	1.490
02 Jun 06	0850	0.01	0.00	0.01	1.477	0.000	1.477
02 Jun 06	0855	0.01	0.00	0.01	1.465	0.000	1.465
02 Jun 06	0900	0.01	0.00	0.01	1.453	0.000	1.453
02 Jun 06	0905	0.01	0.00	0.01	1.442	0.000	1.442
02 Jun 06	0910	0.01	0.00	0.01	1.430	0.000	1.430
02 Jun 06	0915	0.01	0.00	0.01	1.419	0.000	1.419
02 Jun 06	0920	0.01	0.00	0.01	1.408	0.000	1.408
02 Jun 06	0925	0.01	0.00	0.01	1.397	0.000	1.397
02 Jun 06	0930	0.01	0.00	0.01	1.386	0.000	1.386
02 Jun 06	0935	0.01	0.00	0.01	1.376	0.000	1.376
02 Jun 06	0940	0.01	0.00	0.01	1.366	0.000	1.366
02 Jun 06	0945	0.01	0.00	0.01	1.356	0.000	1.356
02 Jun 06	0950	0.01	0.00	0.01	1.346	0.000	1.346
02 Jun 06	0955	0.01	0.00	0.01	1.336	0.000	1.336
02 Jun 06	1000	0.01	0.00	0.01	1.326	0.000	1.326
02 Jun 06	1005	0.01	0.00	0.01	1.317	0.000	1.317
02 Jun 06	1010	0.01	0.00	0.01	1.308	0.000	1.308
02 Jun 06	1015	0.01	0.00	0.01	1.299	0.000	1.299
02 Jun 06	1020	0.01	0.00	0.01	1.290	0.000	1.290
02 Jun 06	1025	0.01	0.00	0.00	1.281	0.000	1.281
02 Jun 06	1030	0.01	0.00	0.00	1.272	0.000	1.272
02 Jun 06	1035	0.01	0.00	0.00	1.263	0.000	1.263
Jun 06	1040	0.01	0.00	0.00	1.255	0.000	1.255
02 Jun 06	1045	0.01	0.00	0.00	1.247	0.000	1.247
02 Jun 06	1050	0.00	0.00	0.00	1.239	0.000	1.239
02 Jun 06	1055	0.00	0.00	0.00	1.231	0.000	1.231

Date	Time	Precip. (in)	Loss (in)	Excess (in)	Direct Q (cfs)	Base-flow (cfs)	Total Q (cfs)
02 Jun 06	1100	0.00	0.00	0.00	1.223	0.000	1.223
02 Jun 06	1105	0.00	0.00	0.00	1.215	0.000	1.215
02 Jun 06	1110	0.00	0.00	0.00	1.207	0.000	1.207
02 Jun 06	1115	0.00	0.00	0.00	1.199	0.000	1.199
02 Jun 06	1120	0.00	0.00	0.00	1.192	0.000	1.192
02 Jun 06	1125	0.00	0.00	0.00	1.185	0.000	1.185
02 Jun 06	1130	0.00	0.00	0.00	1.177	0.000	1.177
02 Jun 06	1135	0.00	0.00	0.00	1.170	0.000	1.170
02 Jun 06	1140	0.00	0.00	0.00	1.163	0.000	1.163
02 Jun 06	1145	0.00	0.00	0.00	1.156	0.000	1.156
02 Jun 06	1150	0.00	0.00	0.00	1.149	0.000	1.149
02 Jun 06	1155	0.00	0.00	0.00	1.142	0.000	1.142
02 Jun 06	1200	0.00	0.00	0.00	1.136	0.000	1.136

LETDOWN CHANNEL SUBBASIN DRAINAGE CALCULATIONS

	HEC-HMS Inputs						HEC-HMS Output	Letdown Culvert Name
	Area (sq mi)	Initial Loss (in)	% Impervious	CN	Time of Lag (min)	Base Flow	Peak Outflow (cfs)	
Letdown Channel 1								
Landfill Top	0.00387	0.597	0.0	77	22.6	None	6.1	
4:1 Slope 1	0.00119	0.597	0.0	77	9.5	None	2.7	
4:1 Slope 2	0.00164	0.597	0.0	77	11.1	None	3.5	
4:1 Slope 3	0.00305	0.597	0.0	77	12.4	None	6.1	
4:1 Slope 4	0.00283	0.597	0.0	77	12.3	None	5.7	
Overall	0.0126						22.4	LC-1
Letdown Channel 2								
Landfill Top	0.00474	0.597	0.0	77	23.6	None	7.4	
4:1 Slope 1	0.00141	0.597	0.0	77	10.4	None	3.1	
4:1 Slope 2	0.00184	0.597	0.0	77	11.4	None	3.9	
4:1 Slope 3	0.00360	0.597	0.0	77	12.2	None	7.5	
4:1 Slope 4	0.00332	0.597	0.0	77	12.2	None	6.9	
Overall	0.0149						26.5	LC-2
Letdown Channel 3								
Landfill Top	0.00432	0.597	0.0	77	25.9	None	6.5	
4:1 Slope 1	0.00135	0.597	0.0	77	13.4	None	2.7	
4:1 Slope 2	0.00157	0.597	0.0	77	13.1	None	3.2	
4:1 Slope 3	0.00333	0.597	0.0	77	13.9	None	6.5	
4:1 Slope 4	0.00301	0.597	0.0	77	14.1	None	5.8	
Overall	0.0136						23.2	LC-3
Letdown Channel 4								
Landfill Top	0.00425	0.597	0.0	77	23.3	None	6.7	
4:1 Slope 1	0.00140	0.597	0.0	77	9.2	None	3.2	
4:1 Slope 2	0.00180	0.597	0.0	77	8.5	None	4.3	
4:1 Slope 3	0.00336	0.597	0.0	77	7.9	None	8.4	
4:1 Slope 4	0.00342	0.597	0.0	77	7.9	None	8.5	
Overall	0.0142						27.5	LC-4
Letdown Channel 5								
Landfill Top	0.00569	0.597	0.0	77	21.1	None	9.4	
4:1 Slope 1	0.00104	0.597	0.0	77	8.7	None	2.5	
4:1 Slope 2	0.00116	0.597	0.0	77	8.6	None	2.8	
4:1 Slope 3	0.00164	0.597	0.0	77	8.5	None	4.0	
4:1 Slope 4	0.00154	0.597	0.0	77	7.8	None	3.9	
Overall	0.0111						19.0	LC-5
Letdown Channel 6								
Landfill Top	0.00691	0.597	0.0	77	22.3	None	11.1	
4:1 Slope 1	0.00132	0.597	0.0	77	10.3	None	2.9	
4:1 Slope 2	0.00155	0.597	0.0	77	9.6	None	3.5	
4:1 Slope 3	0.00204	0.597	0.0	77	9.1	None	4.7	
4:1 Slope 4	0.00215	0.597	0.0	77	7.6	None	5.5	
Overall	0.0140						23.6	LC-6
Letdown Channel 7								
Landfill Top	0.00448	0.597	0.0	77	19.5	None	7.6	
4:1 Slope 1	0.00112	0.597	0.0	77	8.8	None	2.7	
4:1 Slope 2	0.00163	0.597	0.0	77	8.2	None	4.0	
4:1 Slope 3	0.00193	0.597	0.0	77	7.9	None	4.8	
4:1 Slope 4	0.00215	0.597	0.0	77	7.3	None	5.5	
Overall	0.0113						21.2	LC-7
Letdown Channel 8								
Landfill Top	0.00231	0.597	0.0	77	18.7	None	4.0	
4:1 Slope 1	0.00125	0.597	0.0	77	10.7	None	2.7	
4:1 Slope 2	0.00229	0.597	0.0	77	16.6	None	4.2	
4:1 Slope 3	0.00290	0.597	0.0	77	17.3	None	5.2	
4:1 Slope 4	0.00378	0.597	0.0	77	19.7	None	6.4	
Overall	0.0125						21.9	LC-8

	HEC-HMS Inputs						HEC-HMS Output	Letdown Culvert Name
	Area (sq mi)	Initial Loss (in)	% Impervious	CN	Time of Lag (min)	Base Flow	Peak Outflow (cfs)	
Letdown Channel 9								
Landfill Top	0.00429	0.597	0.0	77	25.9	None	6.4	
4:1 Slope 1	0.00234	0.597	0.0	77	16.6	None	4.3	
Overall	0.0066						10.1	LC-9
Letdown Channel 10								
4:1 Slope 2	0.00232	0.597	0.0	77	12.9	None	4.7	
4:1 Slope 3	0.00259	0.597	0.0	77	14.9	None	5.0	
4:1 Slope 4	0.00348	0.597	0.0	77	16.9	None	6.3	
Overall	0.0084						16.0	LC-10
Letdown Channel 11								
4:1 Slope 2	0.00225	0.597	0.0	77	12.9	None	4.6	
4:1 Slope 3	0.00239	0.597	0.0	77	12.2	None	5.0	
4:1 Slope 4	0.00279	0.597	0.0	77	11.5	None	6.0	
Overall	0.0074						15.4	LC-11
Letdown Channel 12								
Landfill Top	0.00266	0.597	0.0	77	19.4	None	4.6	
4:1 Slope 1	0.00102	0.597	0.0	77	9.8	None	2.3	
4:1 Slope 2	0.00186	0.597	0.0	77	9.2	None	4.3	
4:1 Slope 3	0.00209	0.597	0.0	77	12.6	None	4.3	
4:1 Slope 4	0.00250	0.597	0.0	77	14.1	None	4.0	
Overall	0.0101						18.3	LC-12
Letdown Channel 13								
Landfill Top	0.00612	0.597	0.0	77	20.9	None	10.2	
4:1 Slope 1	0.00129	0.597	0.0	77	10.3	None	2.8	
4:1 Slope 2	0.00176	0.597	0.0	77	9.9	None	3.9	
4:1 Slope 3	0.00187	0.597	0.0	77	9.4	None	4.2	
4:1 Slope 4	0.00181	0.597	0.0	77	8.5	None	4.4	
Overall	0.0128						22.6	LC-13
Letdown Channel 14								
Landfill Top	0.00596	0.597	0.0	77	21.4	None	9.8	
4:1 Slope 1	0.00108	0.597	0.0	77	9.6	None	2.4	
4:1 Slope 2	0.00151	0.597	0.0	77	9.1	None	3.5	
4:1 Slope 3	0.00177	0.597	0.0	77	8.7	None	4.2	
4:1 Slope 4	0.00171	0.597	0.0	77	7.8	None	4.3	
Overall	0.0120						24.2	LC-14
Letdown Channel 15								
Landfill Top	0.00544	0.597	0.0	77	21.6	None	8.9	
4:1 Slope 1	0.00115	0.597	0.0	77	8.9	None	2.7	
4:1 Slope 2	0.00161	0.597	0.0	77	10.0	None	3.6	
4:1 Slope 3	0.00185	0.597	0.0	77	11.2	None	4.0	
4:1 Slope 4	0.00210	0.597	0.0	77	10.9	None	4.6	
Overall	0.0121						21.2	LC-15
Letdown Channel 16								
Landfill Top	0.00515	0.597	0.0	77	26.3	None	7.6	
4:1 Slope 1	0.00161	0.597	0.0	77	14.1	None	3.1	
4:1 Slope 2	0.00217	0.597	0.0	77	14.8	None	4.2	
4:1 Slope 3	0.00374	0.597	0.0	77	16.6	None	6.9	
4:1 Slope 4	0.00360	0.597	0.0	77	17.4	None	6.5	
Overall	0.0163						26.6	LC-16
Intermediate Top Drainage								
West Basin	0.05100	0.247	0.0	89	23.5	None	104.4	
Overall							104.3	
East Basin	0.05800	0.247	0.0	89	23.7	None	118.2	
Overall							118.0	



Burns & McDonnell SINCE 1898

date JANUARY 4, 2007

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IATAN LANDFILL

LANDFILL RUNOFF

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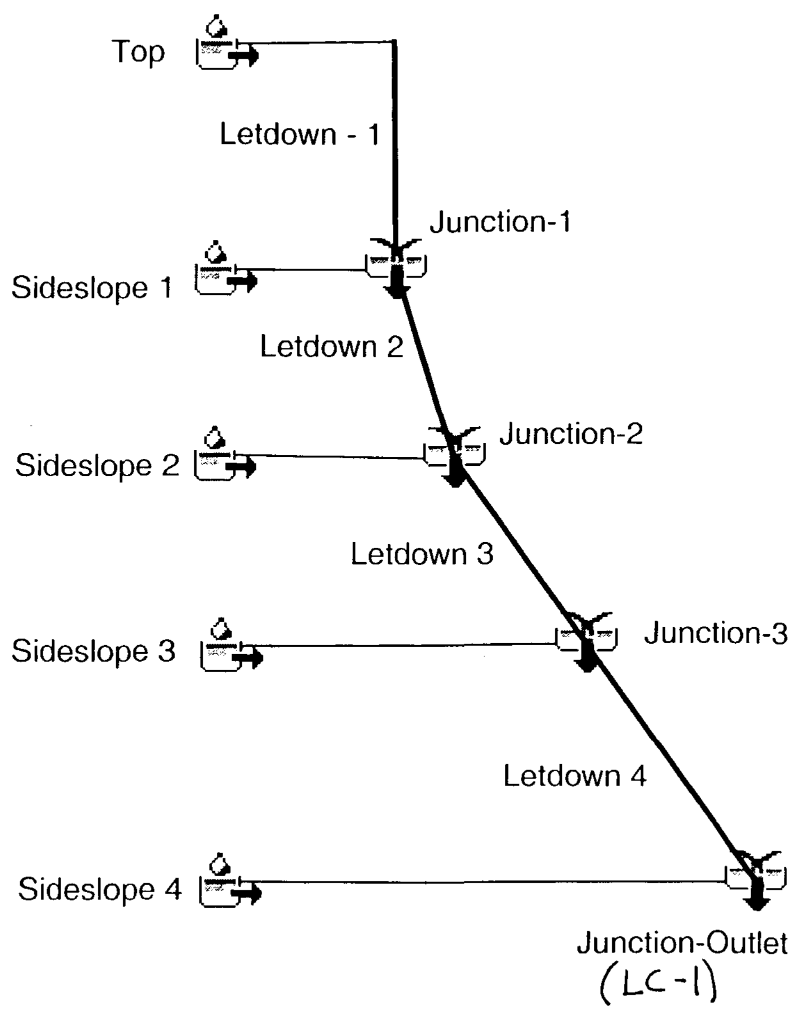
Project : Iatan landfill

Basin Model : SB-1

Jul 25 08:21:36 CDT 2006



Project: Iatan landfill	Simulation Run: subbasin 1

Start of Run: 01Jun2006, 12:00 Basin Model: SB-1
End of Run: 02Jun2006, 12:00 Meteorologic Model: 25-Yr
Execution Time: 13Jul2006, 16:01:20 Control Specifications: Control 1

Volume Units: AC-FT

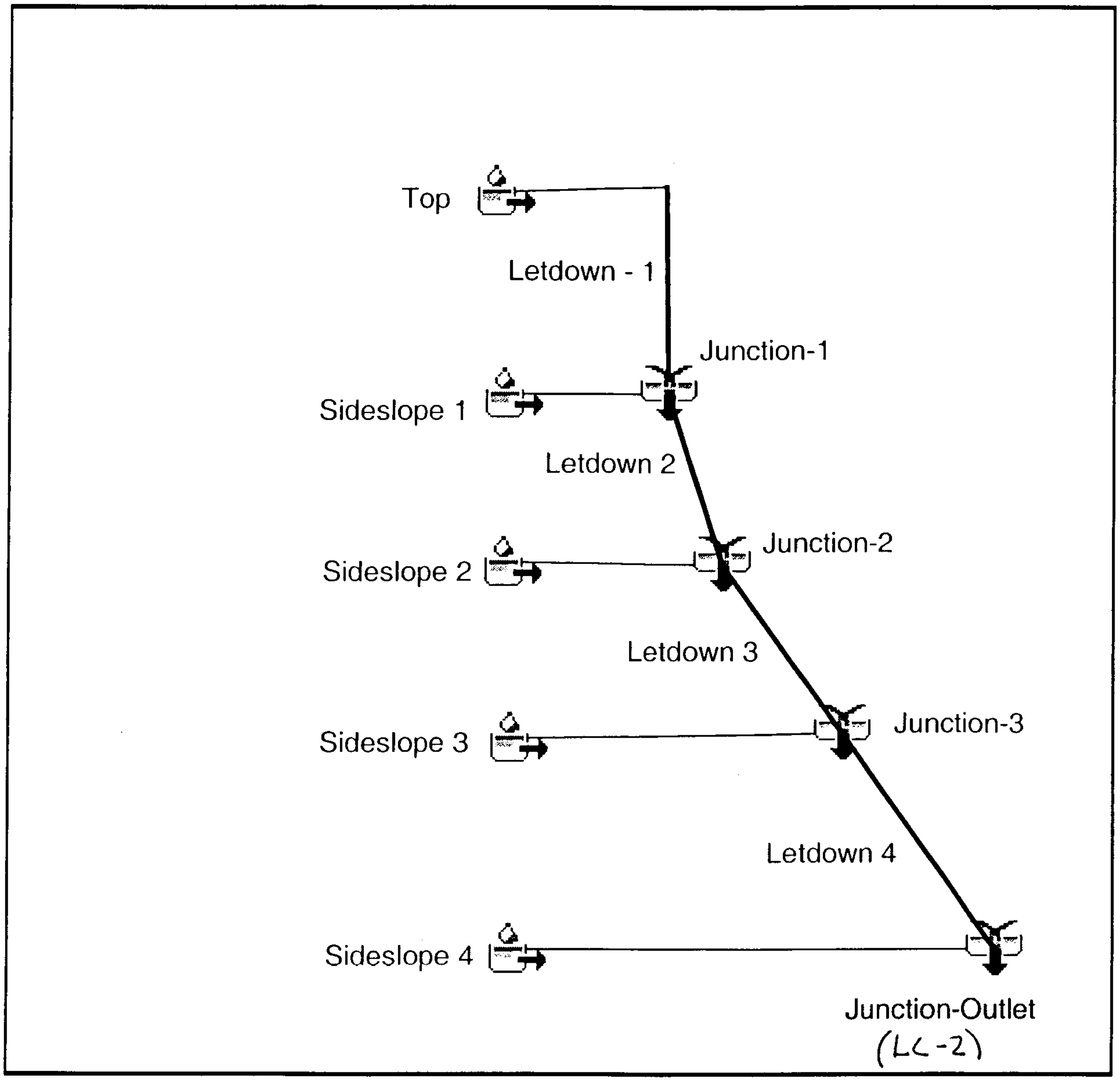
	Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
	Junction-1	0.0051	7.84	02Jun2006, 00:25	0.96
	Junction-2	0.0067	10.90	02Jun2006, 00:20	1.27
	Junction-3	0.0098	16.84	02Jun2006, 00:20	1.85
(LC-1)	Junction-Outlet	0.0126	22.36 *	02Jun2006, 00:20	2.38
	Letdown - 1	0.0039	6.12	02Jun2006, 00:30	0.73
	Letdown 2	0.0051	7.83	02Jun2006, 00:25	0.96
	Letdown 3	0.0067	10.88	02Jun2006, 00:20	1.27
	Letdown 4	0.0098	16.83	02Jun2006, 00:20	1.85
	Sideslope 1	0.0012	2.66	02Jun2006, 00:10	0.23
	Sideslope 2	0.0016	3.52	02Jun2006, 00:15	0.31
	Sideslope 3	0.0030	6.12	02Jun2006, 00:15	0.58
	Sideslope 4	0.0028	5.70	02Jun2006, 00:15	0.54
	Top	0.0039	6.14	02Jun2006, 00:25	0.73

HEC-HMS

Project : Iatan landfill

Basin Model : SB-2

Jul 25 08:22:37 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 2

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-2
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 16:51:25	Control Specifications:	Control 1

Volume Units:	AC-FT

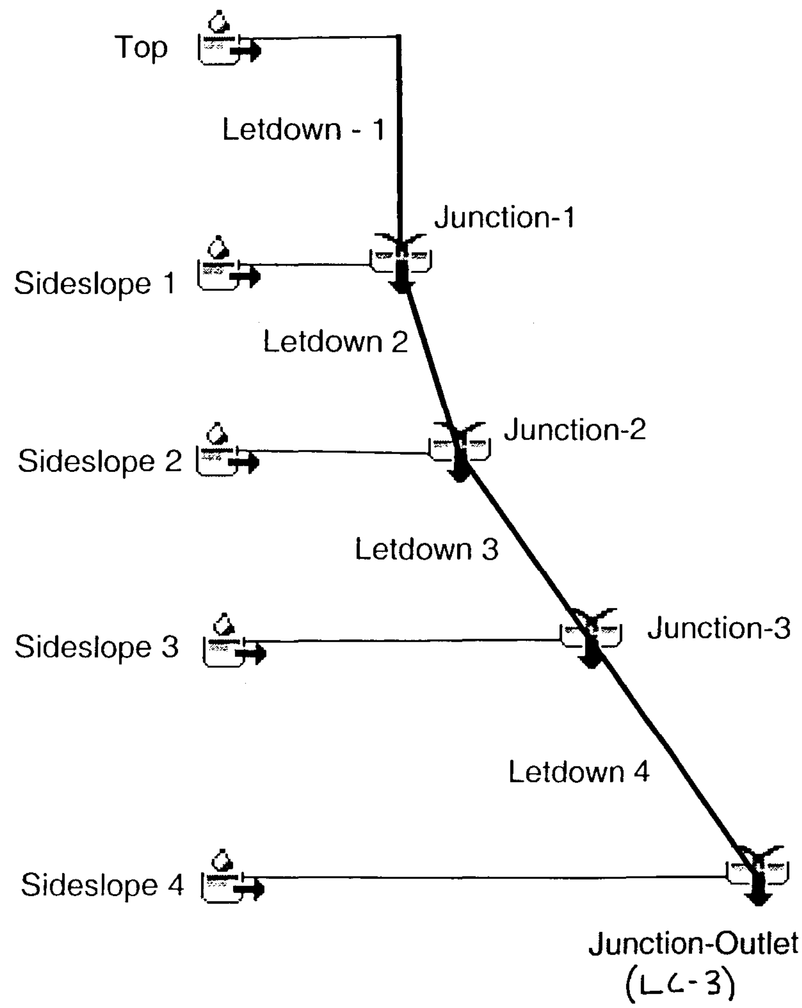
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0062	9.37	02Jun2006, 00:25	1.16
Junction-2	0.0080	12.72	02Jun2006, 00:20	1.51
Junction-3	0.0116	19.75	02Jun2006, 00:20	2.19
(LC-2) Junction-Outlet	0.0149	26.47 *	02Jun2006, 00:15	2.82
Letdown - 1	0.0047	7.39	02Jun2006, 00:30	0.90
Letdown 2	0.0062	9.36	02Jun2006, 00:25	1.16
Letdown 3	0.0080	12.69	02Jun2006, 00:20	1.51
Letdown 4	0.0116	19.74	02Jun2006, 00:20	2.19
Sideslope 1	0.0014	3.09	02Jun2006, 00:15	0.27
Sideslope 2	0.0018	3.94	02Jun2006, 00:15	0.35
Sideslope 3	0.0036	7.50	02Jun2006, 00:15	0.68
Sideslope 4	0.0033	6.92	02Jun2006, 00:15	0.63
Top	0.0047	7.40	02Jun2006, 00:30	0.90

HEC-HMS

Project : Iatan landfill

Basin Model : SB-3

Jul 25 08:22:50 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 3

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-3
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:01:30	Control Specifications:	Control 1

Volume Units:	AC-FT

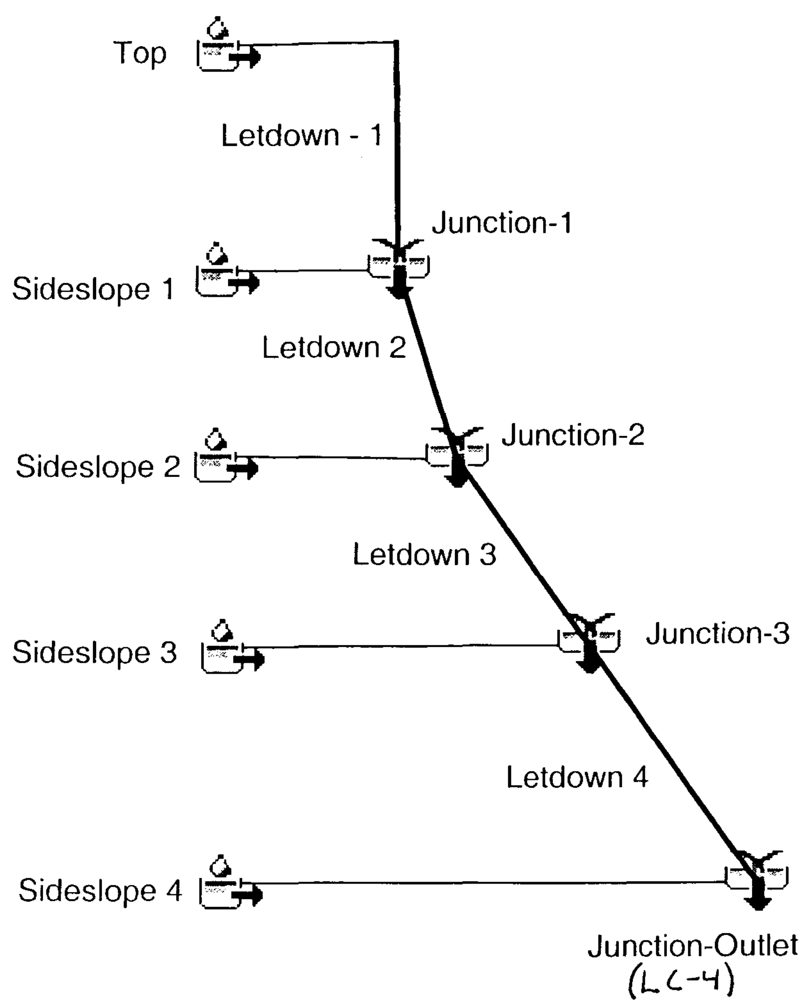
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0057	8.39	02Jun2006, 00:25	1.07
Junction-2	0.0072	10.99	02Jun2006, 00:25	1.37
Junction-3	0.0106	17.37	02Jun2006, 00:20	2.00
(LC-3) Junction-Outlet	0.0136	23.17 *	02Jun2006, 00:20	2.57
Letdown - 1	0.0043	6.43	02Jun2006, 00:30	0.82
Letdown 2	0.0057	8.36	02Jun2006, 00:25	1.07
Letdown 3	0.0072	10.99	02Jun2006, 00:25	1.37
Letdown 4	0.0106	17.35	02Jun2006, 00:20	2.00
Sideslope 1	0.0014	2.68	02Jun2006, 00:15	0.26
Sideslope 2	0.0016	3.16	02Jun2006, 00:15	0.30
Sideslope 3	0.0033	6.49	02Jun2006, 00:15	0.63
Sideslope 4	0.0030	5.82	02Jun2006, 00:20	0.57
Top	0.0043	6.46	02Jun2006, 00:30	0.82

HEC-HMS

Project : Iatan landfill

Basin Model : SB-4

Jul 25 08:23:07 CDT 2006



Project: Iatan landfill	Simulation Run: subbasin 4

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-4
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:06:20	Control Specifications:	Control 1

Volume Units:	AC-FT

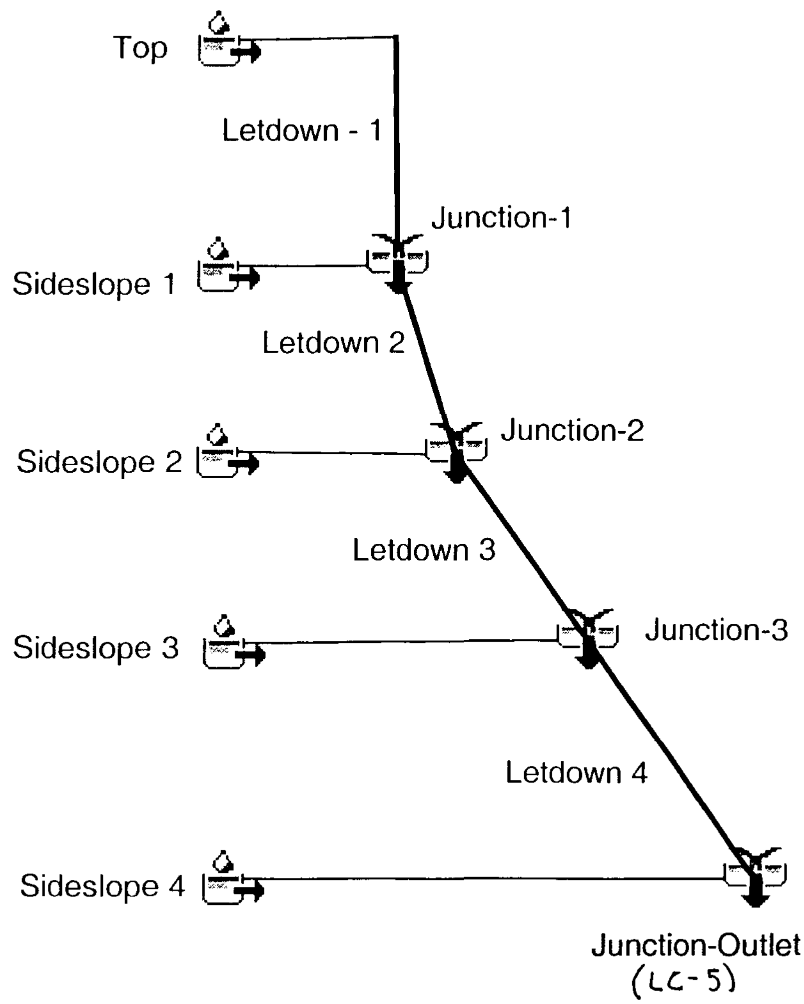
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0057	8.56	02Jun2006, 00:25	1.07
Junction-2	0.0074	11.85	02Jun2006, 00:15	1.41
Junction-3	0.0108	19.16	02Jun2006, 00:15	2.05
(LC-4) Junction-Outlet	0.0142	27.52 *	02Jun2006, 00:10	2.70
Letdown - 1	0.0042	6.65	02Jun2006, 00:30	0.80
Letdown 2	0.0057	8.55	02Jun2006, 00:25	1.07
Letdown 3	0.0074	11.79	02Jun2006, 00:15	1.41
Letdown 4	0.0108	19.15	02Jun2006, 00:15	2.05
Sideslope 1	0.0014	3.22	02Jun2006, 00:10	0.27
Sideslope 2	0.0018	4.34	02Jun2006, 00:10	0.34
Sideslope 3	0.0034	8.38	02Jun2006, 00:10	0.64
Sideslope 4	0.0034	8.53	02Jun2006, 00:10	0.65
Top	0.0042	6.66	02Jun2006, 00:30	0.80

HEC-HMS

Project : Iatan landfill

Basin Model : SB-5

Jul 25 08:23:20 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 5

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-5
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:10:40	Control Specifications:	Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0067	10.81	02Jun2006, 00:25	1.27
Junction-2	0.0079	12.56	02Jun2006, 00:20	1.49
Junction-3	0.0095	15.65	02Jun2006, 00:15	1.80
(LC-5) Junction-Outle	0.0111	18.98 *	02Jun2006, 00:15	2.10
Letdown - 1	0.0057	9.34	02Jun2006, 00:25	1.08
Letdown 2	0.0067	10.79	02Jun2006, 00:25	1.27
Letdown 3	0.0079	12.53	02Jun2006, 00:20	1.49
Letdown 4	0.0095	15.62	02Jun2006, 00:15	1.80
Sideslope 1	0.0010	2.47	02Jun2006, 00:10	0.20
Sideslope 2	0.0012	2.76	02Jun2006, 00:10	0.22
Sideslope 3	0.0016	3.95	02Jun2006, 00:10	0.31
Sideslope 4	0.0015	3.86	02Jun2006, 00:10	0.29
Top	0.0057	9.39	02Jun2006, 00:25	1.08

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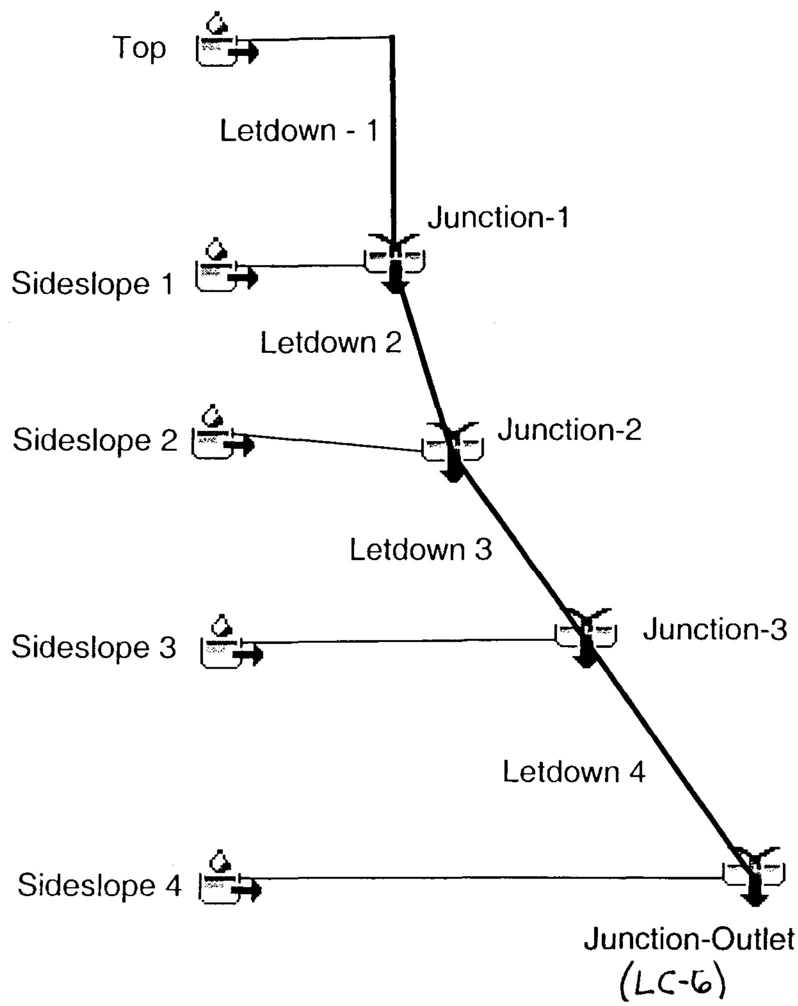
Project : Iatan landfill

Basin Model : SB-6

Jul 25 08:23:30 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 6

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-6
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:28:26	Control Specifications:	Control 1

Volume Units: AC-FT

	Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
	Junction-1	0.0082	12.98	02Jun2006, 00:25	1.56
	Junction-2	0.0098	15.36	02Jun2006, 00:20	1.85
	Junction-3	0.0118	18.95	02Jun2006, 00:15	2.24
(LC-6)	Junction-Outle	0.0140	23.56 *	02Jun2006, 00:15	2.64
	Letdown - 1	0.0069	10.98	02Jun2006, 00:25	1.31
	Letdown 2	0.0082	12.95	02Jun2006, 00:25	1.56
	Letdown 3	0.0098	15.32	02Jun2006, 00:20	1.85
	Letdown 4	0.0118	18.95	02Jun2006, 00:20	2.24
	Sideslope 1	0.0013	2.90	02Jun2006, 00:15	0.25
	Sideslope 2	0.0016	3.47	02Jun2006, 00:10	0.29
	Sideslope 3	0.0020	4.72	02Jun2006, 00:10	0.39
	Sideslope 4	0.0022	5.45	02Jun2006, 00:10	0.41
	Top	0.0069	11.06	02Jun2006, 00:25	1.31

Project : Iatan landfill

Basin Model : SB-7

Jul 25 08:23:41 CDT 2006

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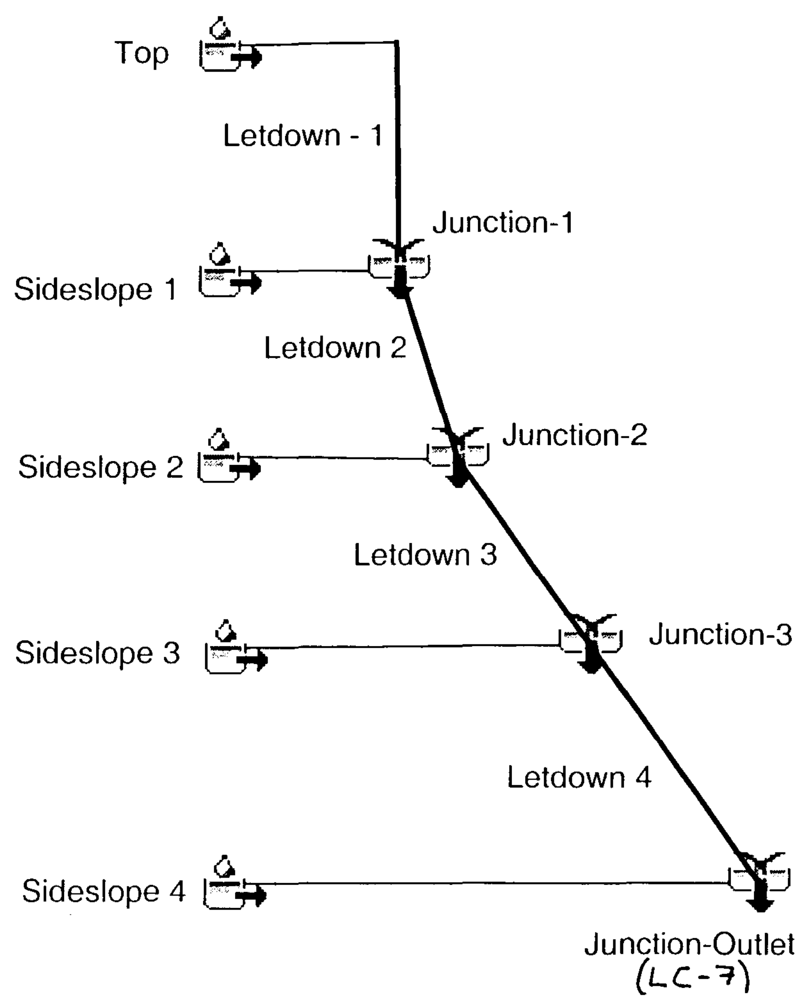


Project: Iatan landfill	Simulation Run: subbasin 7

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-7
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:27:51	Control Specifications:	Control 1

Volume Units: AC-FT

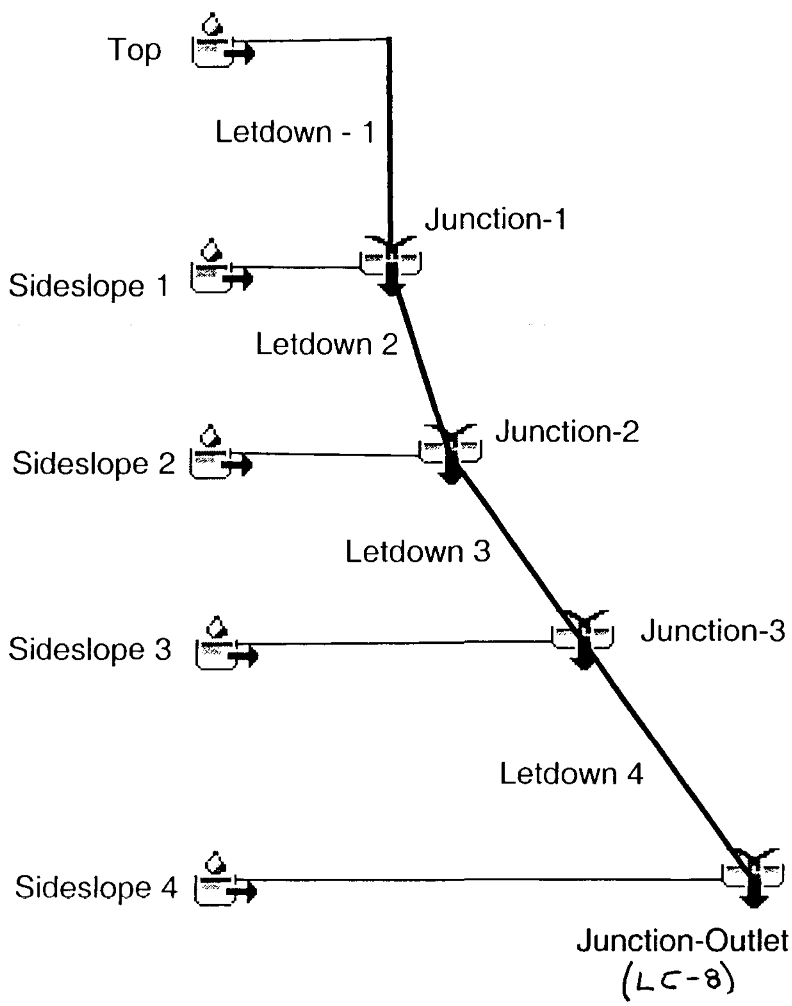
	Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
	Junction-1	0.0056	9.34	02Jun2006, 00:20	1.06
	Junction-2	0.0072	12.33	02Jun2006, 00:15	1.37
	Junction-3	0.0092	16.50	02Jun2006, 00:15	1.73
(LC-7)	Junction-Outlet	0.0113	21.24 *	02Jun2006, 00:10	2.14
	Letdown - 1	0.0045	7.62	02Jun2006, 00:25	0.85
	Letdown 2	0.0056	9.30	02Jun2006, 00:20	1.06
	Letdown 3	0.0072	12.27	02Jun2006, 00:15	1.37
	Letdown 4	0.0092	16.48	02Jun2006, 00:15	1.73
	Sideslope 1	0.0011	2.65	02Jun2006, 00:10	0.21
	Sideslope 2	0.0016	3.99	02Jun2006, 00:10	0.31
	Sideslope 3	0.0019	4.81	02Jun2006, 00:10	0.37
	Sideslope 4	0.0022	5.54	02Jun2006, 00:10	0.41
	Top	0.0045	7.64	02Jun2006, 00:25	0.85

HEC-HMS

Project : Iatan landfill

Basin Model : SB-8

Jul 25 08:23:49 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 8

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-8
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:32:45	Control Specifications:	Control 1

Volume Units: AC-FT

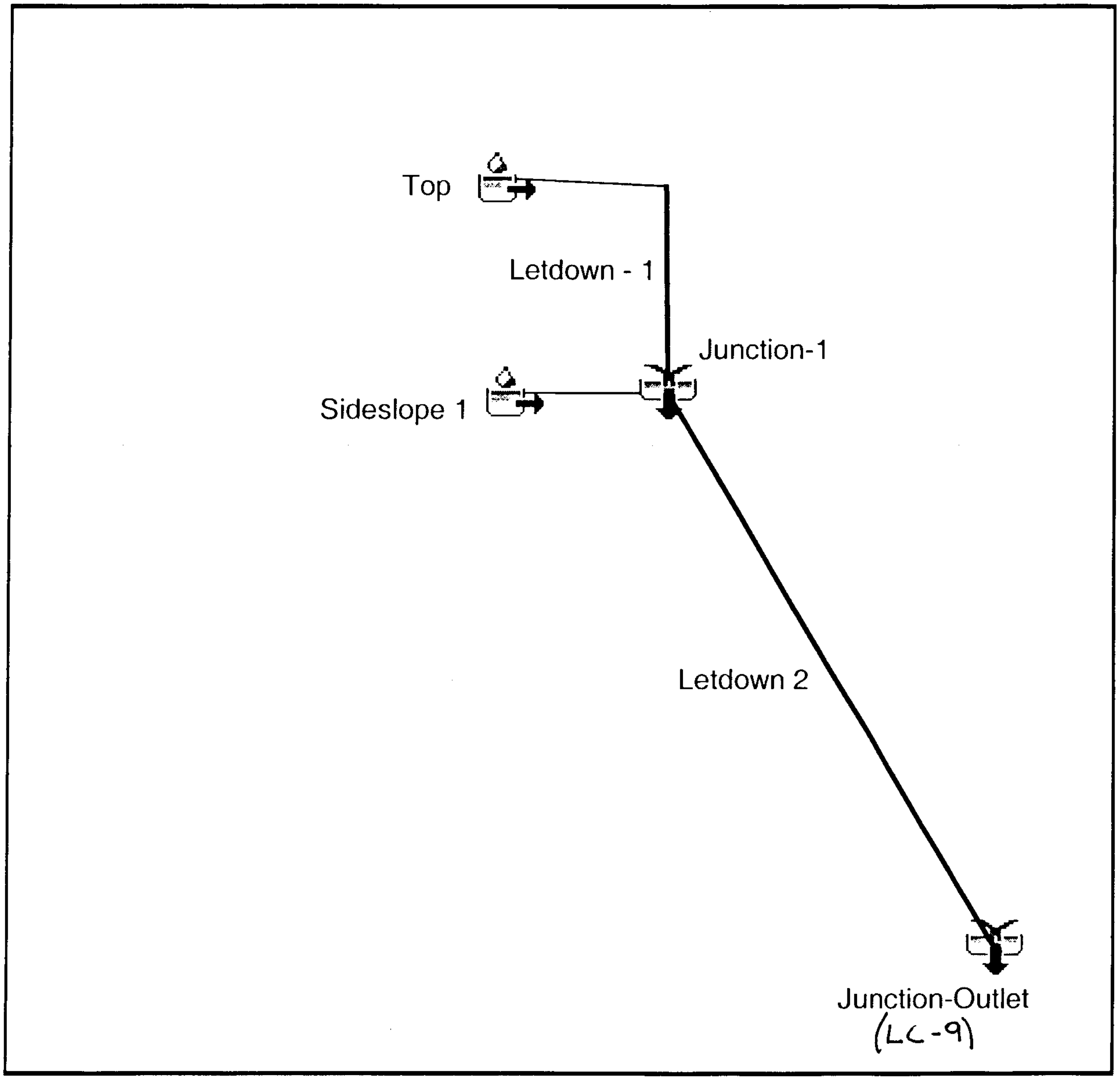
	Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
	Junction-1	0.0036	6.30	02Jun2006, 00:20	0.67
	Junction-2	0.0058	10.48	02Jun2006, 00:20	1.11
	Junction-3	0.0087	15.66	02Jun2006, 00:20	1.66
(LC-8)	Junction-Outlet	0.0125	21.90 *	02Jun2006, 00:20	2.37
	Letdown - 1	0.0023	3.99	02Jun2006, 00:25	0.44
	Letdown 2	0.0036	6.28	02Jun2006, 00:20	0.67
	Letdown 3	0.0058	10.45	02Jun2006, 00:20	1.11
	Letdown 4	0.0087	15.64	02Jun2006, 00:20	1.66
	Sideslope 1	0.0012	2.72	02Jun2006, 00:15	0.24
	Sideslope 2	0.0023	4.20	02Jun2006, 00:20	0.43
	Sideslope 3	0.0029	5.21	02Jun2006, 00:20	0.55
	Sideslope 4	0.0038	6.43	02Jun2006, 00:25	0.71
	Top	0.0023	3.99	02Jun2006, 00:25	0.44

HEC-HMS

Project : Iatan landfill

Basin Model : SB-9

Jul 25 08:24:01 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 9

Start of Run: 01Jun2006, 12:00 Basin Model: SB-9
End of Run: 02Jun2006, 12:00 Meteorologic Model: 25-Yr
Execution Time: 13Jul2006, 17:45:40 Control Specifications: Control 1

Volume Units: AC-FT

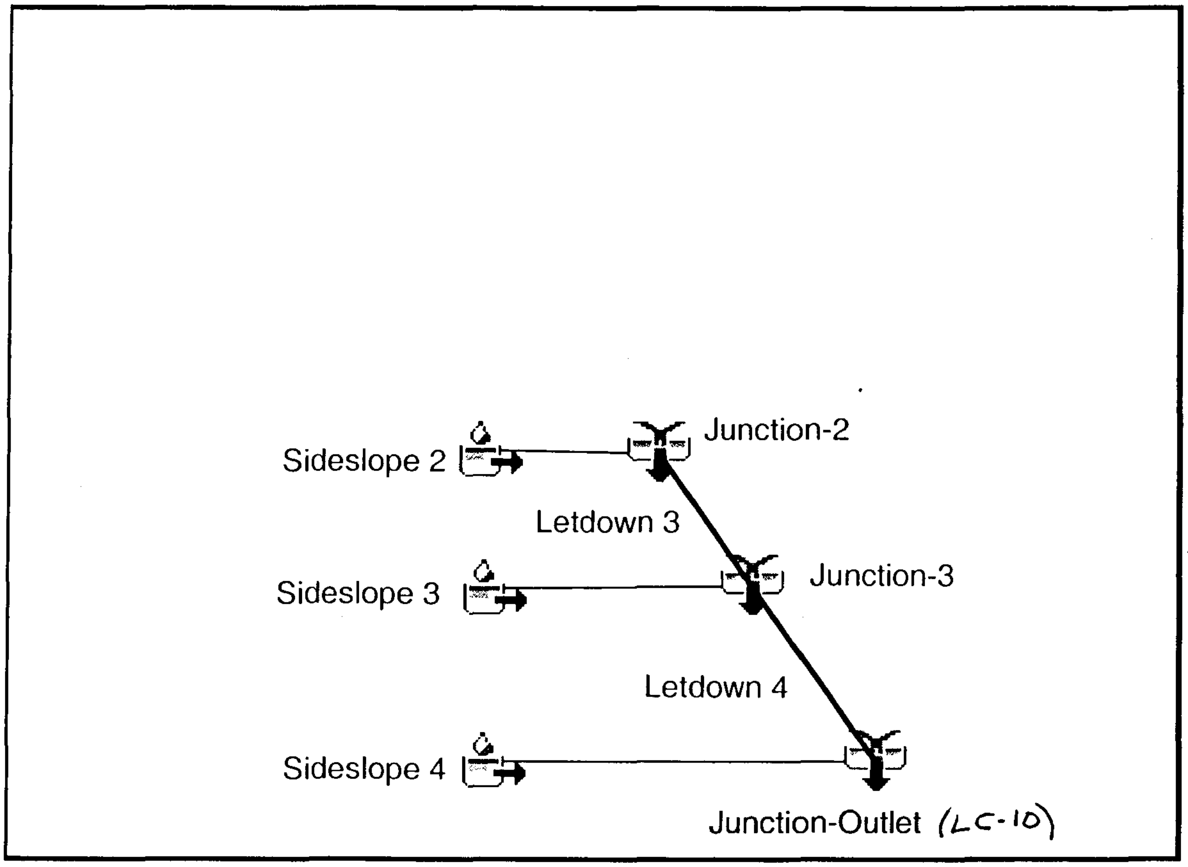
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0066	10.18	02Jun2006, 00:25	1.25
(LC-9) Junction-Outlet	0.0066	10.13 *	02Jun2006, 00:25	1.25
Letdown - 1	0.0043	6.38	02Jun2006, 00:30	0.81
Letdown 2	0.0066	10.13	02Jun2006, 00:25	1.25
Sideslope 1	0.0023	4.29	02Jun2006, 00:20	0.44
Top	0.0043	6.41	02Jun2006, 00:30	0.81

HEC-HMS

Project : Iatan landfill

Basin Model : SB-10

Jul 25 08:24:26 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 10

Start of Run: 01Jun2006, 12:00 Basin Model: SB-10
End of Run: 02Jun2006, 12:00 Meteorologic Model: 25-Yr
Execution Time: 13Jul2006, 17:46:10 Control Specifications: Control 1

Volume Units: AC-FT

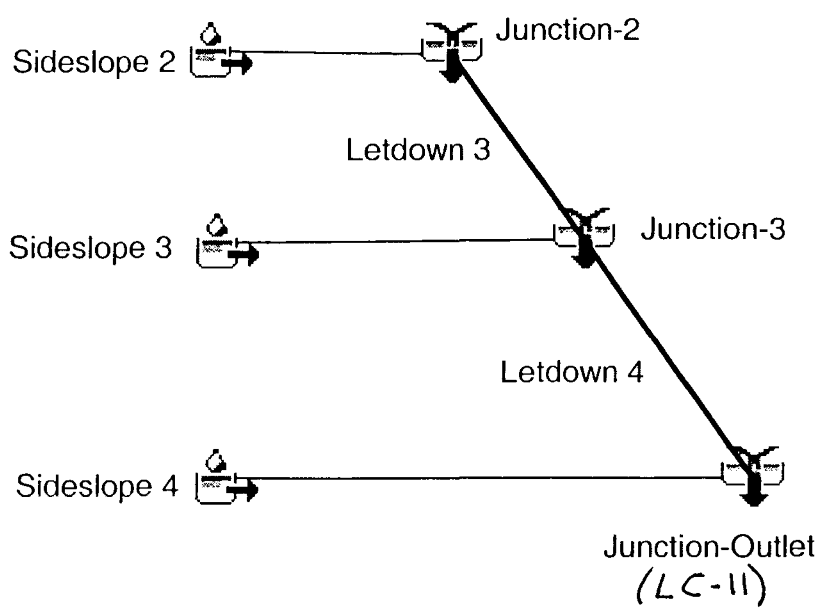
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-2	0.0023	4.71	02Jun2006, 00:15	0.44
Junction-3	0.0049	9.50	02Jun2006, 00:20	0.93
(LC-10) Junction-Outlet	0.0084	15.82 *	02Jun2006, 00:20	1.59
Letdown 3	0.0023	4.66	02Jun2006, 00:15	0.44
Letdown 4	0.0049	9.50	02Jun2006, 00:20	0.93
Sideslope 2	0.0023	4.71	02Jun2006, 00:15	0.44
Sideslope 3	0.0026	4.95	02Jun2006, 00:20	0.49
Sideslope 4	0.0035	6.32	02Jun2006, 00:20	0.66

HEC-HMS

Project : Iatan landfill

Basin Model : SB-11

Jul 25 08:25:29 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 11

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-11
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:51:43	Control Specifications:	Control 1

Volume Units: AC-FT

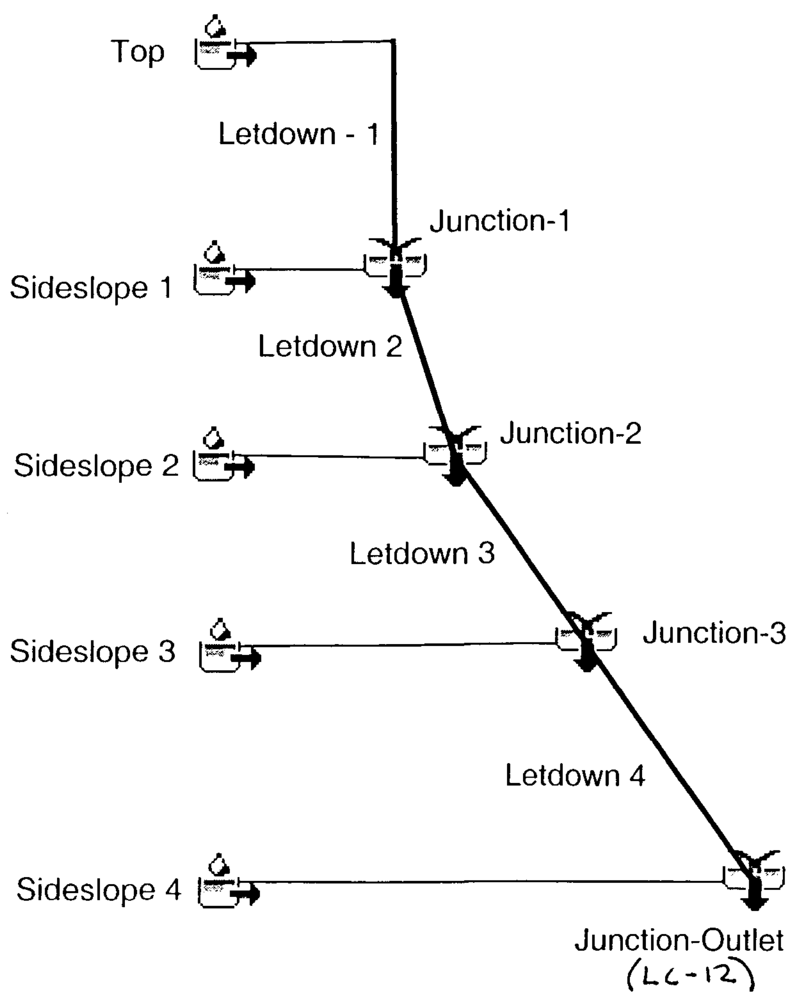
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-2	0.0022	4.57	02Jun2006, 00:15	0.43
Junction-3	0.0046	9.51	02Jun2006, 00:15	0.88
(LC-11) Junction-Outlet	0.0074	15.43 *	02Jun2006, 00:15	1.41
Letdown 3	0.0022	4.52	02Jun2006, 00:15	0.43
Letdown 4	0.0046	9.48	02Jun2006, 00:15	0.88
Sideslope 2	0.0022	4.57	02Jun2006, 00:15	0.43
Sideslope 3	0.0024	4.98	02Jun2006, 00:15	0.45
Sideslope 4	0.0028	5.95	02Jun2006, 00:15	0.53

HEC-HMS

Project : Iatan landfill

Basin Model : SB-12

Jul 25 08:25:36 CDT 2006



Project: Iatan landfill	Simulation Run: subbasin 12

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-12
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:55:02	Control Specifications:	Control 1

Volume Units: AC-FT

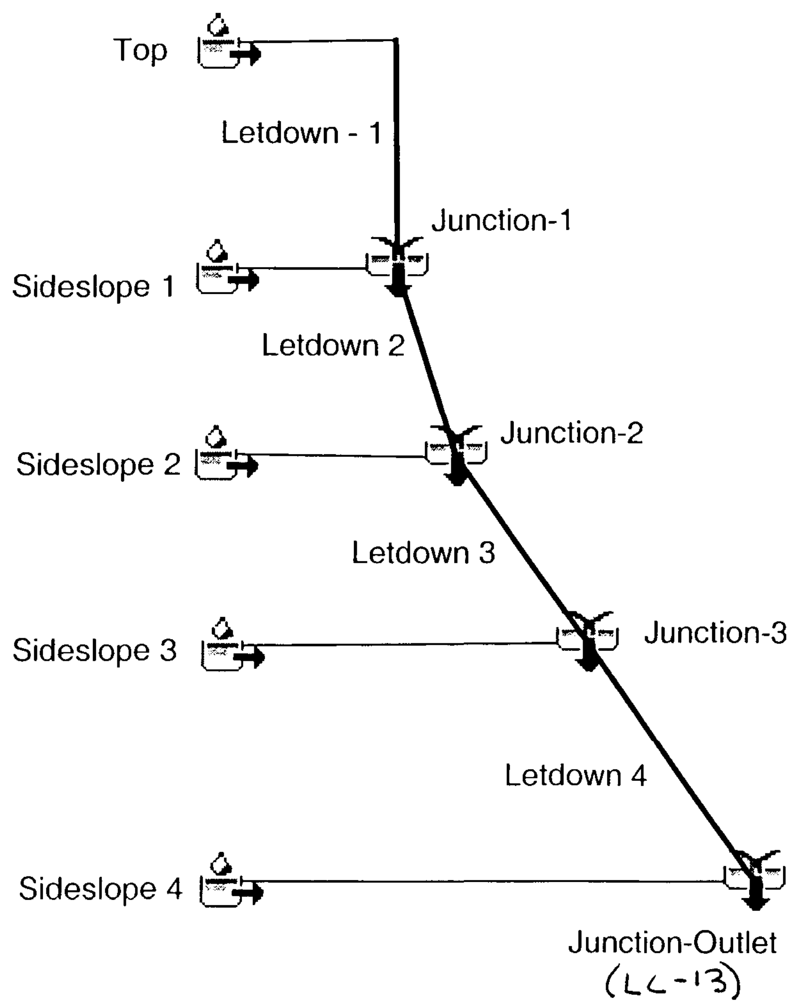
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0037	6.26	02Jun2006, 00:20	0.70
Junction-2	0.0055	10.09	02Jun2006, 00:15	1.05
Junction-3	0.0076	14.33	02Jun2006, 00:15	1.45
(LC-12) Junction-Outlet	0.0097	18.33 *	02Jun2006, 00:15	1.84
Letdown - 1	0.0027	4.53	02Jun2006, 00:25	0.50
Letdown 2	0.0037	6.24	02Jun2006, 00:20	0.70
Letdown 3	0.0055	10.04	02Jun2006, 00:15	1.05
Letdown 4	0.0076	14.29	02Jun2006, 00:15	1.45
Sideslope 1	0.0010	2.26	02Jun2006, 00:15	0.19
Sideslope 2	0.0019	4.28	02Jun2006, 00:10	0.35
Sideslope 3	0.0021	4.29	02Jun2006, 00:15	0.40
Sideslope 4	0.0021	4.04	02Jun2006, 00:20	0.40
Top	0.0027	4.55	02Jun2006, 00:25	0.50

HEC-HMS

Project : Iatan landfill

Basin Model : SB-13

Jul 25 08:25:44 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 13

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-13
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 17:59:55	Control Specifications:	Control 1

Volume Units: AC-FT

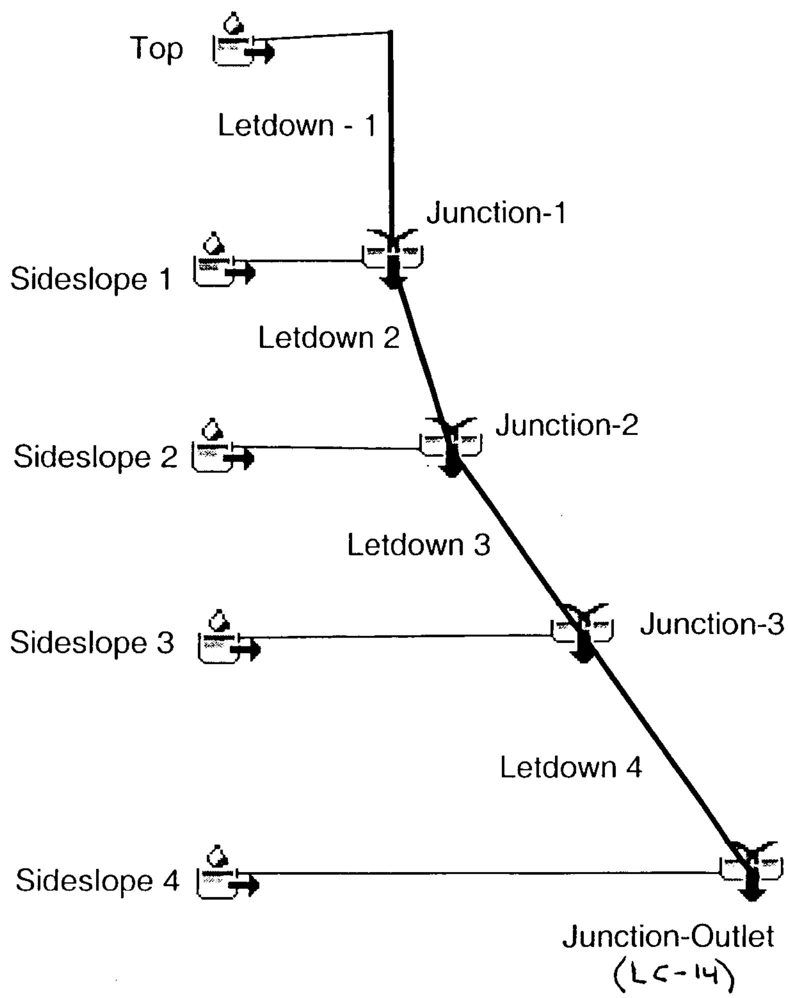
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0074	12.05	02Jun2006, 00:25	1.40
Junction-2	0.0092	15.13	02Jun2006, 00:20	1.73
Junction-3	0.0110	18.63	02Jun2006, 00:15	2.09
(LC-13) Junction-Outlet	0.0128	22.59 *	02Jun2006, 00:15	2.43
Letdown - 1	0.0061	10.10	02Jun2006, 00:25	1.16
Letdown 2	0.0074	12.04	02Jun2006, 00:25	1.40
Letdown 3	0.0092	15.10	02Jun2006, 00:20	1.73
Letdown 4	0.0110	18.58	02Jun2006, 00:15	2.09
Sideslope 1	0.0013	2.83	02Jun2006, 00:15	0.24
Sideslope 2	0.0018	3.89	02Jun2006, 00:15	0.33
Sideslope 3	0.0019	4.24	02Jun2006, 00:10	0.35
Sideslope 4	0.0018	4.36	02Jun2006, 00:10	0.34
Top	0.0061	10.15	02Jun2006, 00:25	1.16

HEC-HMS

Project : Iatan landfill

Basin Model : SB-14

Jul 25 08:25:55 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 14

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-14
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 18:20:31	Control Specifications:	Control 1

Volume Units:	AC-FT

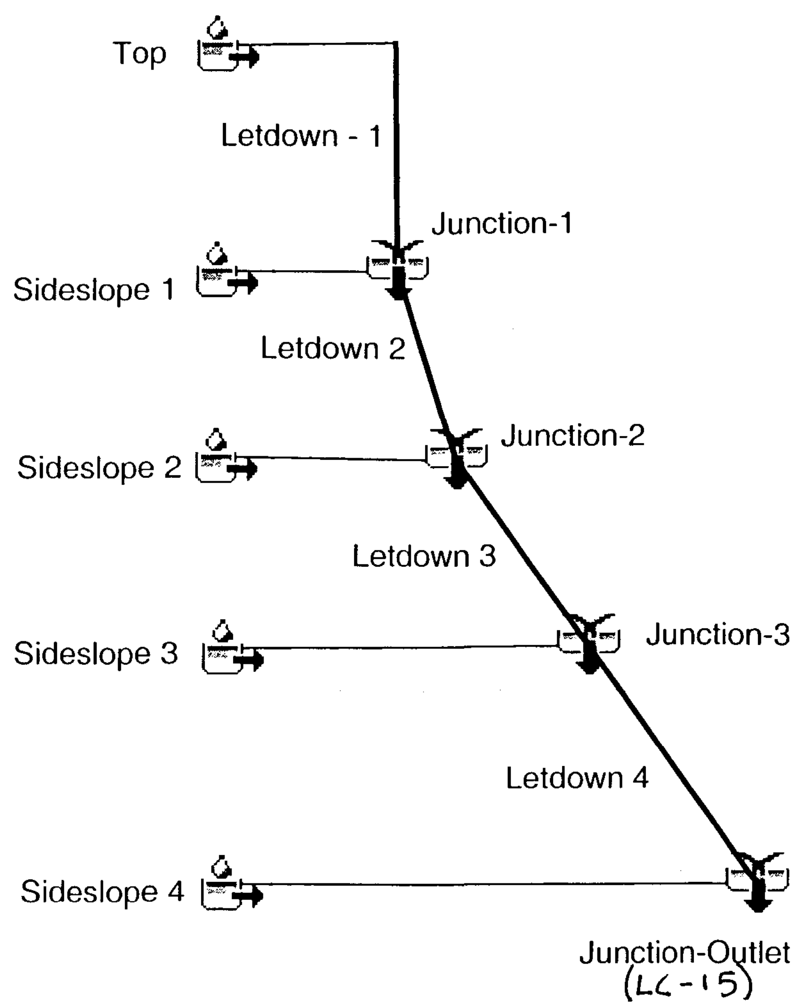
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0070	11.29	02Jun2006, 00:25	1.33
Junction-2	0.0086	13.66	02Jun2006, 00:20	1.62
Junction-3	0.0103	17.03	02Jun2006, 00:15	1.95
(LC-14) Junction-Outlet	0.0120	20.72 *	02Jun2006, 00:15	2.28
Letdown - 1	0.0060	9.70	02Jun2006, 00:25	1.13
Letdown 2	0.0070	11.27	02Jun2006, 00:25	1.33
Letdown 3	0.0086	13.63	02Jun2006, 00:20	1.62
Letdown 4	0.0103	16.98	02Jun2006, 00:15	1.95
Sideslope 1	0.0011	2.42	02Jun2006, 00:10	0.20
Sideslope 2	0.0015	3.50	02Jun2006, 00:10	0.29
Sideslope 3	0.0018	4.21	02Jun2006, 00:10	0.34
Sideslope 4	0.0017	4.29	02Jun2006, 00:10	0.32
Top	0.0060	9.76	02Jun2006, 00:25	1.13

HEC-HMS

Project : Iatan landfill

Basin Model : SB-15

Jul 25 08:26:07 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 15

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-15
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 18:07:07	Control Specifications:	Control 1

Volume Units:	AC-FT

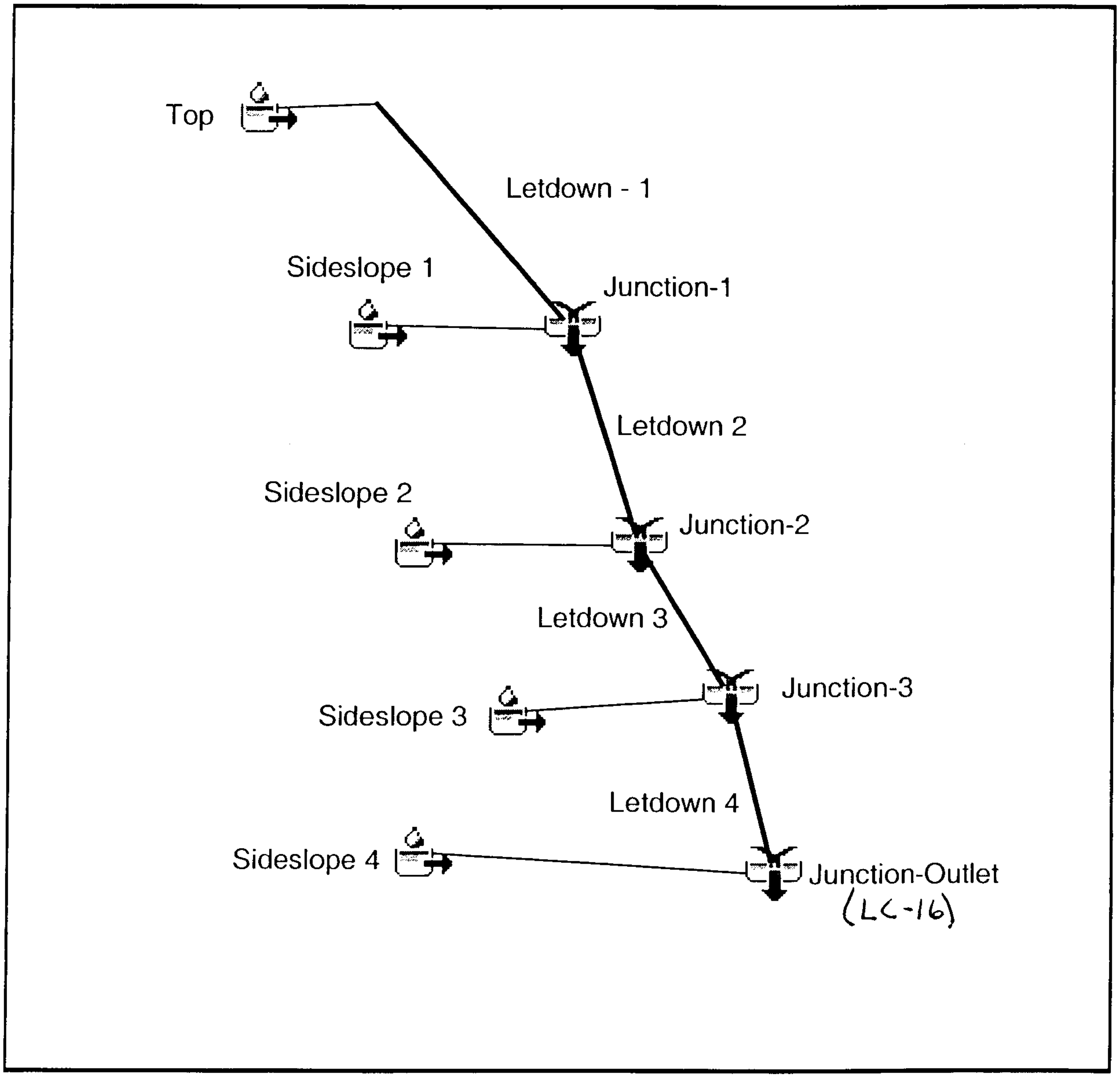
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0066	10.44	02Jun2006, 00:25	1.25
Junction-2	0.0082	13.17	02Jun2006, 00:20	1.55
Junction-3	0.0100	16.74	02Jun2006, 00:20	1.90
(LC-15) Junction-Outle	0.0122	21.23 *	02Jun2006, 00:15	2.30
Letdown - 1	0.0054	8.81	02Jun2006, 00:25	1.03
Letdown 2	0.0066	10.43	02Jun2006, 00:25	1.25
Letdown 3	0.0082	13.15	02Jun2006, 00:20	1.55
Letdown 4	0.0100	16.73	02Jun2006, 00:20	1.90
Sideslope 1	0.0012	2.70	02Jun2006, 00:10	0.22
Sideslope 2	0.0016	3.56	02Jun2006, 00:15	0.31
Sideslope 3	0.0018	3.99	02Jun2006, 00:15	0.35
Sideslope 4	0.0021	4.56	02Jun2006, 00:15	0.40
Top	0.0054	8.86	02Jun2006, 00:25	1.03

HEC-HMS

Project : Iatan landfill

Basin Model : SB-16

Jul 25 10:40:01 CDT 2006



Project: Iatan landfill Simulation Run: subbasin 16

Start of Run:	01Jun2006, 12:00	Basin Model:	SB-16
End of Run:	02Jun2006, 12:00	Meteorologic Model:	25-Yr
Execution Time:	13Jul2006, 18:15:42	Control Specifications:	Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0068	9.97	02Jun2006, 00:25	1.28
Junction-2	0.0089	13.72	02Jun2006, 00:25	1.69
Junction-3	0.0127	20.30	02Jun2006, 00:25	2.39
(LC-16) Junction-Outlet	0.0163	26.62 *	02Jun2006, 00:20	3.08
Letdown - 1	0.0052	7.59	02Jun2006, 00:30	0.97
Letdown 2	0.0068	9.92	02Jun2006, 00:25	1.28
Letdown 3	0.0089	13.71	02Jun2006, 00:25	1.69
Letdown 4	0.0127	20.29	02Jun2006, 00:25	2.39
Sideslope 1	0.0016	3.11	02Jun2006, 00:20	0.30
Sideslope 2	0.0022	4.15	02Jun2006, 00:20	0.41
Sideslope 3	0.0037	6.86	02Jun2006, 00:20	0.71
Sideslope 4	0.0036	6.45	02Jun2006, 00:20	0.68
Top	0.0052	7.63	02Jun2006, 00:30	0.97

Landfill Top Berm

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	100.0	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	5.600	ft^3/s

Results

Normal Depth	0.32	ft
Flow Area	5.39	ft^2
Wetted Perimeter	33.38	ft
Top Width	33.33	ft
Critical Depth	0.24	ft
Critical Slope	0.02679	ft/ft
Velocity	1.04	ft/s
Velocity Head	0.02	ft
Specific Energy	0.34	ft
Froude Number	0.46	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.24	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02679	ft/ft

planned berm height: 2'
ref: Permit App. Dwg pg C010

Upper 4:1 Side Slope Intermediate Bench

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	50.00	ft/ft (H:V)
Discharge	1.60	ft³/s

Results

Normal Depth		0.26	ft
Flow Area		1.79	ft²
Wetted Perimeter		13.95	ft
Top Width		13.92	ft
Critical Depth		0.19	ft
Critical Slope		0.02909	ft/ft
Velocity		0.89	ft/s
Velocity Head		0.01	ft
Specific Energy		0.27	ft
Froude Number		0.44	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.19	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02909	ft/ft

Upper Middle 4:1 Side Slope Intermediate Bench

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	2.150	ft³/s

Results

Normal Depth	0.19	ft
Flow Area	1.97	ft²
Wetted Perimeter	11.35	ft
Top Width	11.30	ft
Critical Depth	0.11	ft
Critical Slope	0.02772	ft/ft
Velocity	1.09	ft/s
Velocity Head	0.02	ft
Specific Energy	0.20	ft
Froude Number	0.46	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.19	ft
Critical Depth	0.11	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02772	ft/ft

Lower Middle 4:1 Side Slope Intermediate Bench

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	50.00	ft/ft (H:V)
Discharge	4.20	ft^3/s

Results

Normal Depth	0.37	ft
Flow Area	3.70	ft^2
Wetted Perimeter	20.04	ft
Top Width	19.99	ft
Critical Depth	0.27	ft
Critical Slope	0.02557	ft/ft
Velocity	1.14	ft/s
Velocity Head	0.02	ft
Specific Energy	0.39	ft
Froude Number	0.47	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.37	ft
Critical Depth	0.27	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02557	ft/ft

maximum depth in benches

Lower 4:1 Side Slope Drainage Swale

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	4.250	ft³/s

Results

Normal Depth	0.28	ft
Flow Area	3.04	ft²
Wetted Perimeter	12.02	ft
Top Width	11.94	ft
Critical Depth	0.17	ft
Critical Slope	0.02408	ft/ft
Velocity	1.40	ft/s
Velocity Head	0.03	ft
Specific Energy	0.31	ft
Froude Number	0.49	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.28	ft
Critical Depth	0.17	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02408	ft/ft

Peak Letdown Channel (LC-4)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.25000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	27.500	ft^3/s

peak flow in any letdown channel

Results

Normal Depth	0.26	ft
Flow Area	2.85	ft^2
Wetted Perimeter	11.67	ft
Top Width	11.58	ft
Critical Depth	0.58	ft
Critical Slope	0.01677	ft/ft
Velocity	9.67	ft/s
Velocity Head	1.45	ft
Specific Energy	1.72	ft
Froude Number	3.44	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.58	ft
Channel Slope	0.25000	ft/ft
Critical Slope	0.01677	ft/ft

CURRENT DATE: 07-26-2006 FILE DATE: 07-26-2006
CURRENT TIME: 13:38:29 FILE NAME: IATAN

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.0

CULV NO.	SITE DATA: INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	784.00	783.00	50.01	2 CSP	2.00	2.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: IATAN DATE: 07-26-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
784.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
785.14	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.00	1
785.71	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.00	1
786.35	27.5	27.5	0.0	0.0	0.0	0.0	0.0	0.00	1
786.87	40.0	35.9	0.0	0.0	0.0	0.0	0.0	0.00	30
787.05	50.0	37.8	0.0	0.0	0.0	0.0	0.0	11.83	22
787.07	60.0	38.0	0.0	0.0	0.0	0.0	0.0	21.47	8
787.09	70.0	38.2	0.0	0.0	0.0	0.0	0.0	31.22	7
787.11	80.0	38.4	0.0	0.0	0.0	0.0	0.0	40.91	6
787.12	90.0	38.5	0.0	0.0	0.0	0.0	0.0	50.87	6
787.14	100.0	38.7	0.0	0.0	0.0	0.0	0.0	60.42	5
787.00	37.3	37.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: IATAN DATE: 07-26-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
784.00	0.000	0.00	0.00	0.00
785.14	0.000	10.00	0.00	0.00
785.71	0.000	20.00	0.00	0.00
786.35	0.000	27.50	0.00	0.00
786.87	-0.008	40.00	4.12	10.30
787.05	-0.001	50.00	0.40	0.80
787.07	-0.001	60.00	0.53	0.88
787.09	-0.001	70.00	0.58	0.83
787.11	-0.001	80.00	0.71	0.89
787.12	-0.001	90.00	0.58	0.64
787.14	-0.001	100.00	0.88	0.88

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

2

CURRENT DATE: 07-26-2006 FILE DATE: 07-26-2006

IATAN

CURRENT TIME: 13:38:29 ... AME: IATAN

stated in design, w/2.2' headwater depth

ÄÄÄ

PERFORMANCE CURVE FOR CULVERT 1 - 2(2.00 (ft) BY 2.00 (ft)) CSP

ÄÄÄ

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	784.00	0.00	-1.00	0-NF	0.00	0.00	0.00	-5.00	0.00	0.00
10.00	785.14	1.14	0.54	1-S2n	0.73	0.79	0.73	-5.00	4.84	0.00
20.00	785.71	1.71	1.16	1-S2n	1.09	1.13	1.03	-5.00	6.15	0.00
27.50	786.35	2.18	2.35	2-M2c	1.35	1.33	1.33	-5.00	6.20	0.00
35.88	786.86	2.86	2.76	2-M2c	1.73	1.52	1.52	-5.00	7.02	0.00
37.77	787.04	3.04	2.86	2-M2c	2.00	1.56	1.56	-5.00	7.19	0.00
38.00	787.07	3.07	2.90	2-M2c	2.00	1.56	1.56	-5.00	7.22	0.00
38.21	787.09	3.09	2.92	2-M2c	2.00	1.57	1.57	-5.00	7.23	0.00
38.38	787.11	3.11	2.94	2-M2c	2.00	1.57	1.57	-5.00	7.25	0.00
38.55	787.12	3.12	2.96	2-M2c	2.00	1.58	1.58	-5.00	7.26	0.00
38.70	787.14	3.14	2.97	2-M2c	2.00	1.58	1.58	-5.00	7.28	0.00

ÄÄÄ

El. inlet face invert 784.00 ft   El. outlet invert 783.00 ft
El. inlet throat invert 0.00 ft   El. inlet crest 0.00 ft

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***** SITE DATA ***** CULVERT INVERT **************

INLET STATION	0.00 ft
INLET ELEVATION	784.00 ft
OUTLET STATION	50.00 ft
OUTLET ELEVATION	783.00 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0200
CULVERT LENGTH ALONG SLOPE	50.01 ft

At LC-4, there's 3' headwater depth available (787.0-784.0, per Dwg C-14)
Approx capacity is about 37.7 CFS with 3' headwater depth

***** CULVERT DATA SUMMARY ************************

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	MITERED TO CONFORM TO SLOPE
INLET DEPRESSION	NONE

ÄÄÄ

CURRENT DATE: 07-26-2006   FILE DATE: 07-26-2006
CURRENT TIME: 13:38:29   FILE NAME: IATAN

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ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ TAILWATER ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
ÄÄÄ
ÄÄÄ

CONSTANT WATER SURFACE ELEVATION
778.00

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ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ROADWAY OVERTOPPING DATA ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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ROADWAY SURFACE   PAVED

IATAN

EMBANKMENT TOP WIDTH	40.00 ft
CREST LENGTH	400.00 ft
OVERTOPPING CREST ELEVATION	787.00 ft

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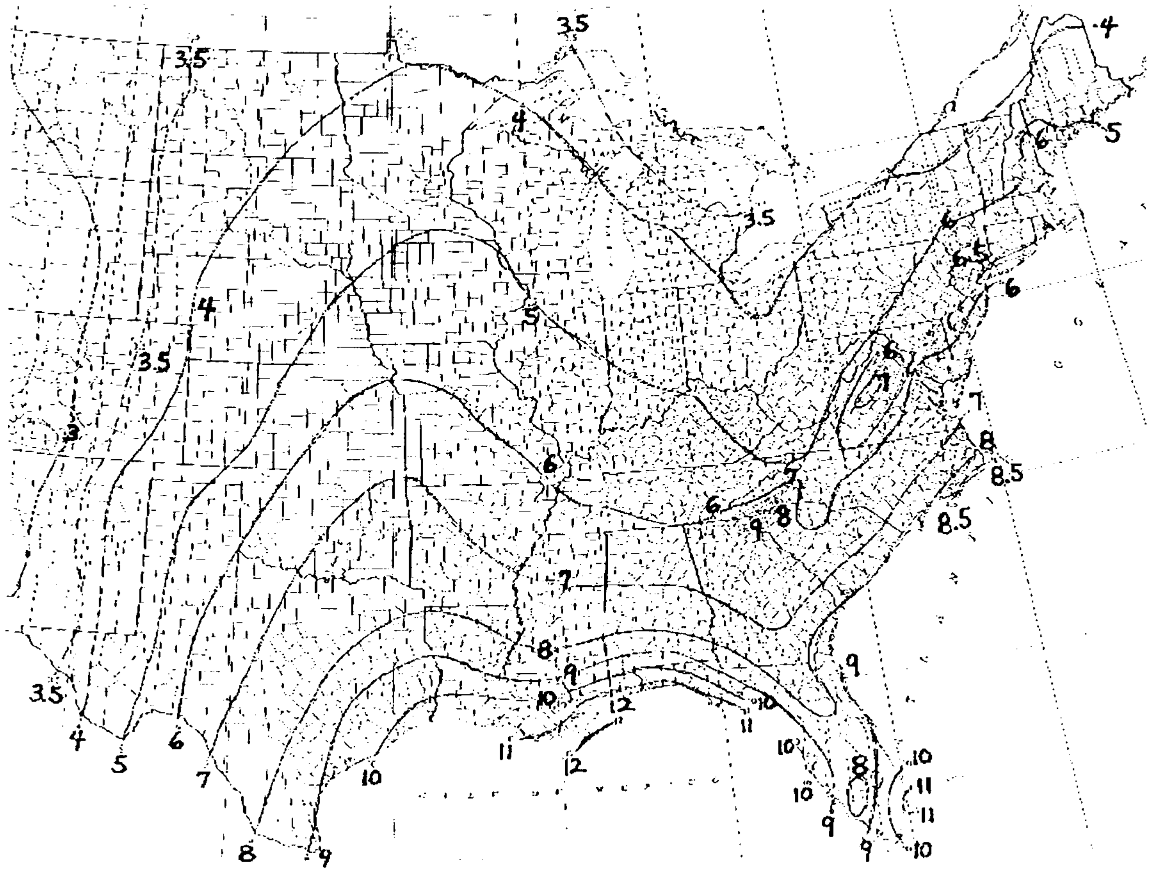
25-Year, 24-Hour Rainfall



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