

APPENDIX A

WATER AND WASTEWATER MANAGEMENT PLAN

Water and Wastewater Management Plan

Altamont Landfill Covered
Aerated Static Pile
Compost Facility

August 2016

Prepared for:

Waste Management of Alameda County, Inc.
10840 Altamont Pass Road
Livermore, CA 94551

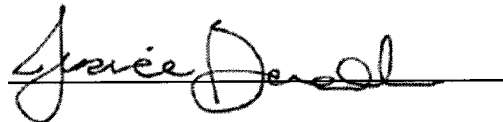
REPORT CERTIFICATION

Water and Wastewater Management Plan

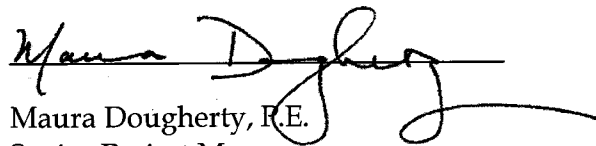
Altamont Landfill CASP Facility Livermore, California

The material and data in this report were prepared under the supervision and direction of the undersigned.

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Figure 2 – Covered Aerated Static Pile Conceptual Design Conceptual Grading prepared by Geosyntec Consultants, Inc. dated May 2016

1 INTRODUCTION

This Water and Wastewater Management Plan (WWMP) has been prepared for the Covered Aerated Static Pile (CASP) compost facility (Facility) to be built within the landfill property boundary of the Altamont Landfill and Resource Recovery Facility (ALRRF), located in Livermore, California. The facility will operate in accordance with the California State Water Quality Control Board General WDRs for Composting Operations dated August 4, 2015.

The following requirements are to be met by the facility design:

- *Facility to have working surface capable of preventing degradation of waters of the state.*

The Facility will be operated within the ALRRF property boundary. The design includes controls to manage precipitation from areas used for receiving, processing or storage of feedstock under conditions of a 25-year, 24-hour peak storm event. The facility will also be designed to have a working surface with a hydraulic conductivity of 1.0×10^{-5} centimeters per second (cm/s) or less. Therefore, the Facility meets this requirement based on the designed stormwater controls and working surface improvements.

- *Facility is greater than 100 feet from surface water.*

There are no surface waters located within 100 feet of the CASP facility location.

- *Facility is greater than 100 feet from nearest water supply well.*

There are no water supply wells located within 100 feet of the CASP facility location.

This WWMP was prepared to describe how the wastewater generated from the Facility operations will be managed to prevent discharge to waters of the state. Descriptions of the Facility design, operations, and maintenance of the wastewater collection and conveyance systems have been included in this plan.

2 DESIGN

2.1 Stormwater / Wastewater Handling System

Stormwater structures are to be designed to control precipitation generated from a 25-year, 24-hour storm event. Based on "Point Precipitation Frequency Estimates" presented in the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, a 25-year, 24-hour event at Livermore, California would generate 3.4 inches of rainfall. This rainfall depth was used to adequately size the wastewater conveyance system for the Facility. As described in the sections below, the wastewater handling system will be comprised of a gravel (or other improved surface such as asphalt or concrete) pad underlying the active composting area, drainage channels and berms at the perimeter of the gravel pad, a contact water pond, and downchutes to convey wastewater from the gravel pad to the contact water pond. Conceptual layouts and grading for the CASP compost facility are included as Figures 1 and 2.

2.1.1 Pads

The active compost area of the CASP facility will have an approximately 10 acres gravel (or other improved surface) pad. The pad has been adequately sized to accommodate the areas required for the active composting piles, for tipping and storage of the inbound feedstock, and mixing and grinding.

The gravel pad will be constructed within the entire area proposed for active composting. A minimum of one foot compacted to 1.0×10^{-5} cm/s clay liner will be placed beneath the gravel pad. The gravel pad will be graded to control and manage run-off and precipitation from operational and storage areas for a 25-year, 24-hour storm event; minimize ponding; and convey run-off to the perimeter drainage channels and ultimately to the contact water pond. The gravel pad will slope down to the north to direct run-off from the active compost piles into the drainage conveyance system located along the boundary of the active compost area.

2.1.2 Drainage/Conveyance

The gravel pad will be graded to convey water into the drainage channels located at the center and along the boundary of the active compost area. The drainage channels and berms will direct run-off into downchutes to be constructed to the contact water pond.

The drainage channels and downchutes have been designed to convey precipitation and runoff from a 25-year, 24-hour peak storm event and will be constructed with compacted soils with a minimum thickness of one foot meeting a hydraulic conductivity of

1.0×10^{-5} cm/s or less. The channel and downchute will be properly sloped to prevent ponding and kept free and clear of debris to prevent a decrease in conveyance capacity.

2.1.3 Pond

As described above, runoff from the active compost area and the curing area will be directed via drainage channels and downchutes to an onsite pond. The contact water pond will be constructed to manage 3.4 inches of precipitation expected from a 25-year, 24-hour storm event. It is assumed that the active composting piles will absorb approximately 50 percent of the rainfall on the active composting pad. Additionally, the pond will be designed based on an annual water balance study, which will consider the storage necessary for an average-year return annual total precipitation and use of the water in the dry periods for dust control and moisture conditioning of the inbound feedstocks as necessary. The average-year annual total precipitation is estimated to be 14.8 inches (see Appendix A for Water Balance Calculations). The pond will be designed with a geosynthetic liner system, such as a 60-mil high density polyethylene (HDPE) geomembrane underlain with a geosynthetic clay liner (GCL) to achieve a hydraulic conductivity of 1.0×10^{-6} cm/s or less. The contact water pond will be designed and constructed with a pan lysimeter monitoring device under the lowest point of the pond, and will be fabricated with a section of six-inch HDPE perforated pipe placed within a gravel trench encased by 60-mil HDPE geomembrane with an access port that will be installed to monitor the lysimeter below the contact water pond geosynthetic liner system. The pond will be operated to maintain a dissolved oxygen (DO) concentration of at least 1.0 milligram per liter (mg/L) to prevent anaerobic conditions. An aeration device is proposed for installation to prevent anaerobic conditions and increase aeration within the pond.

Contact water collected in the pond will be pumped back up to the active compost pad with the use of a pump(s), which will then be utilized for moisture conditioning of the active compost and for irrigation of the biofilter on the active compost piles. The contact water will also be used for dust control as needed throughout the composting operation.

3 OPERATIONS

Management of the contact pond water and stormwater utilized in the CASP compost facility operations are described below.

3.1 Quench Water

Quench water for the incoming feedstock will be supplied by the contact water pond. The quench water will consist of process (compost contact water) and non-process wastewater (precipitation) collected from the compost pad that has not been absorbed into the compost piles. Contact water in the pond will be pumped up to the active pad by a pump(s) and utilized for moisture conditioning of feedstock, prior to the processed material being placed in the active composting piles. This contact water will be used for processing of the feedstock material to prevent drying out of the feedstock, which could lead to the microbes going dormant. Therefore, moisture is added as needed in order to maintain the proper water content of the feedstock material.

Other than rainfall, quench water is generally not added to the feedstock during the winter months depending on the rainfall frequency. During the warmer summer and fall months, contact pond water is used to spray on an as-needed basis for the composting materials handling operations (loading, unloading, stockpiling, and mixing), and moisture content management during feedstock processing.

3.2 Irrigation Water

On-site stormwater, contact water pond supply, and fresh water will all be utilized as irrigation water for maintaining moisture content within the biofilter layer of the active compost piles, as necessary. Precipitation from rainfall events will be contained in ponds for reuse. This water will be pumped to the active pad, and with the use of a sprinkler system, will moisture condition the biofilters of the active compost piles. Freshwater is also obtained from either of the Alameda County Water Agency, Zone 7 aqueduct supplies, with ALRRF's existing water rights. Irrigation water runoff from the active compost area, if any, will be directed back to the contact water pond via the drainage channels and downchute as previously described.

4 MAINTENANCE

4.1 Pumps

Maintenance of the pumps will be scheduled as per the requirements of the pump manufacturers' installation, operational and maintenance manual. If the pump performance does not satisfy the process requirements the pumps will be inspected and adjusted and/or repaired as necessary.

4.2 Pads

Working surfaces of the active compost area pad will be capable of resisting damage from typical daily activities of operating equipment and weight of piles. If reduction in gravel thickness or cracks are observed, action will be taken immediately to prevent the intrusion of compost run-off water into the subsurface.

4.3 Ponds

The contact water pond will be properly maintained to ensure adequate capacity and to control odors. If necessary, practices such as aeration of the pond or the addition of stormwater will be implemented to achieve the DO limit. The pond will be routinely cleaned in order to remove settled solids from the pond floor as necessary. Care will be taken during maintenance activities to prevent damage to the pond's HDPE liner system.

The pan lysimeter monitoring device installed at the lowest point of the pond will monitor for potential leakage resulting from damage to the pond's geosynthetic liner. The pan lysimeter will be inspected monthly during the wet season for liquids. Should liquids be detected, the Regional Water Quality Control Board (RWQCB) will be notified, and testing and reporting procedures will be carried out per the site specific WDRs.

4.4 Drainage/Conveyance

Channels must be inspected and cleaned out as necessary prior to the rainy season every year. The drainage channels will be constructed with compacted soils, and therefore, will be maintained to repair potential settling and/or significant cracks. The drainage channel will be maintained to prevent ponding and kept free and clear of debris to prevent reduced capacity. Capacity of down chutes will be checked using the same procedures as described for the drainage channels.

4.5 Facility Inspections

4.5.1 Quarterly Inspections

Quarterly inspections will be performed for the working surfaces, drainage channels, facility perimeter, erosion control best management practices (BMPs), and any other operational surfaces. Observations recorded during the inspections will include the following:

- The overall condition of the wastewater management system (i.e. pond liner);
- The available capacity within storage systems and the current volume of wastewater (gallons) or solids (cubic yards) contained;
- Presence of odors from the wastewater management system - characterization, source, and distance from source;
- Volume of wastewater treated and discharged, if applicable; and
- Volume of wastewater disposed at an off-site treatment system and name and location of the wastewater treatment facility, if applicable.

The quarterly inspection results will be included in the Annual Monitoring and Maintenance Report, as outlined in Section 5.

4.5.2 Annual Inspection

An annual survey of the CASP facility will be performed to confirm that containment structures are prepared for the pending wet season. The annual survey will be conducted prior to the anticipated wet season, but no later than August 31 and any necessary construction, maintenance, or repairs are completed by October 31. The annual inspection results will be included in the Annual Monitoring and Maintenance Report, as outlined in Section 5.

4.5.3 Storm Event Inspections

Inspections will also take place following major storm events. The Facility shall inspect all precipitation, diversion, and drainage facilities for damage within seven days following major storm events. Necessary repairs shall be completed within 30 days of the inspection. Any recorded damage and subsequent repairs will be included in the Annual Monitoring and Maintenance Report, as outlined in Section 5.

4.6 Water Quality

Quarterly sampling will be conducted of the wastewater collected in the contact water pond, when there is sufficient water to sample. The liquids will be sampled for pH (United States Environmental Protection Agency (EPA) 150.1), dissolved oxygen (EPA 360.2), total dissolved solids (EPA 160.1), fixed dissolved solids (EPA 160.4), total nitrogen (EPA 353.2), and specific conductance (EPA 120.1). An annual monitoring report will be prepared and submitted to the RWQCB as described in Section 5.

The leak detection monitoring device for the contact water pond (i.e. pan lysimeter) will be checked monthly during the wet season for liquid. Upon detection of liquid, the RWQCB will be contacted within 48 hours. A sample of the liquid will be collected and analyzed for pH (EPA 150.1), dissolved oxygen (EPA 360.2), total dissolved solids (EPA 160.1), fixed dissolved solids (EPA 160.4), total nitrogen (EPA 353.2), and specific conductance (EPA 120.1). The liquids will be removed (e.g., pumped) from the pan lysimeter and monitoring will be done weekly for the remainder of the season. If liquid reappears in the same season, a new sample is to be collected and analyzed for the same list of constituents as listed above. If the liquid is confirmed to be wastewater, a Response Action Plan will be prepared and submitted to RWQCB within 30 days for review and approval.

5 REPORTING

5.1 Annual Monitoring and Maintenance Report

An Annual Monitoring and Maintenance Report (Annual Report) will be submitted to RWQCB by April 1 of each year. The report will include at a minimum, the following:

- The transmittal letter shall identify any violations found since the last report was submitted and a description of the actions taken or planned for correcting those violations, including any references to previously submitted time schedules. If no violations have occurred since the last submittal, this shall be stated in the transmittal letter;
- A map or aerial photograph showing the locations of observation stations and monitoring points;
- Tabular and graphical summaries of all water quality data collected during the year, including storm water monitoring, if applicable;
- All historical monitoring data collected during the previous five years, and for which there are detectable results, including data for the previous year, shall be submitted in tabular form and in a digital file format;
- Monitoring forms including field instrument calibration logs;
- Copies of the laboratory analytical reports;
- Results and discussion from the annual survey;
- A summary and certification of completion of inspections and maintenance on the effectiveness of the wastewater handling facilities including results of the annual testing of wastewater, capacity issues, nuisance conditions, and system problems;
- A comprehensive discussion of the compliance record, and the result of corrective actions taken or planned; and
- A discussion of data gaps and potential deficiencies/redundancies in the monitoring system or reporting program.

5.2 Violation Notification Requirements

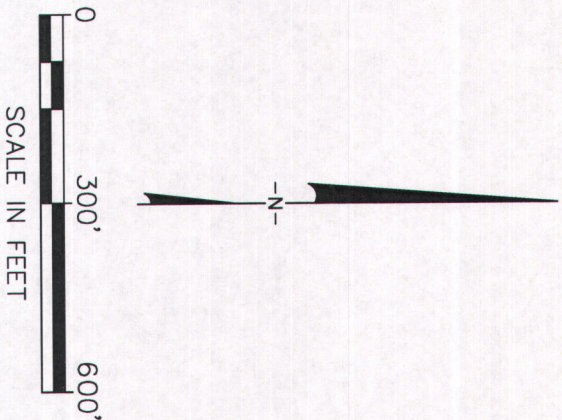
In the event of a violation, proper notification requirements will be followed. A description of the violation that occurred, the date of occurrence, actions being taken to correct the violation, and when the violation is expected to be resolved will be properly documented. The RWQCB will be notified of the violation accompanied with the proper documentation in accordance with the site specific WDRs.

REFERENCES

California State Water Resources Control Board, 2015. Draft Order WQ2015-0121-DWQ
General Waste Discharge Requirements for Composting Operations. August 4.

National Oceanic and Atmospheric Administration (NOAA), 2015. Atlas 14,
Volume 6, Version 2, LIVERMORE, Station ID: 04-4997, Point Precipitation
Frequency Estimates. Accessed May 6.

Figures



LEGEND

- EXISTING GROUND MAJOR CONTOUR (25- FEET)
- EXISTING GROUND MINOR CONTOUR (5- FEET)
- PAD/ POND BOUNDARY

NOTES:

1. PRELIMINARY LAYOUT SHOWN IS BASED ON CONCEPTUAL DESIGN PREPARED FOR DISCUSSION PURPOSES ONLY, NOT FOR CONSTRUCTION.
2. SITE TOPOGRAPHY PROVIDED BY MILLER CREEK AERIAL MAPPING, LLC. AERIAL PHOTO DATED 29 DECEMBER 2016.

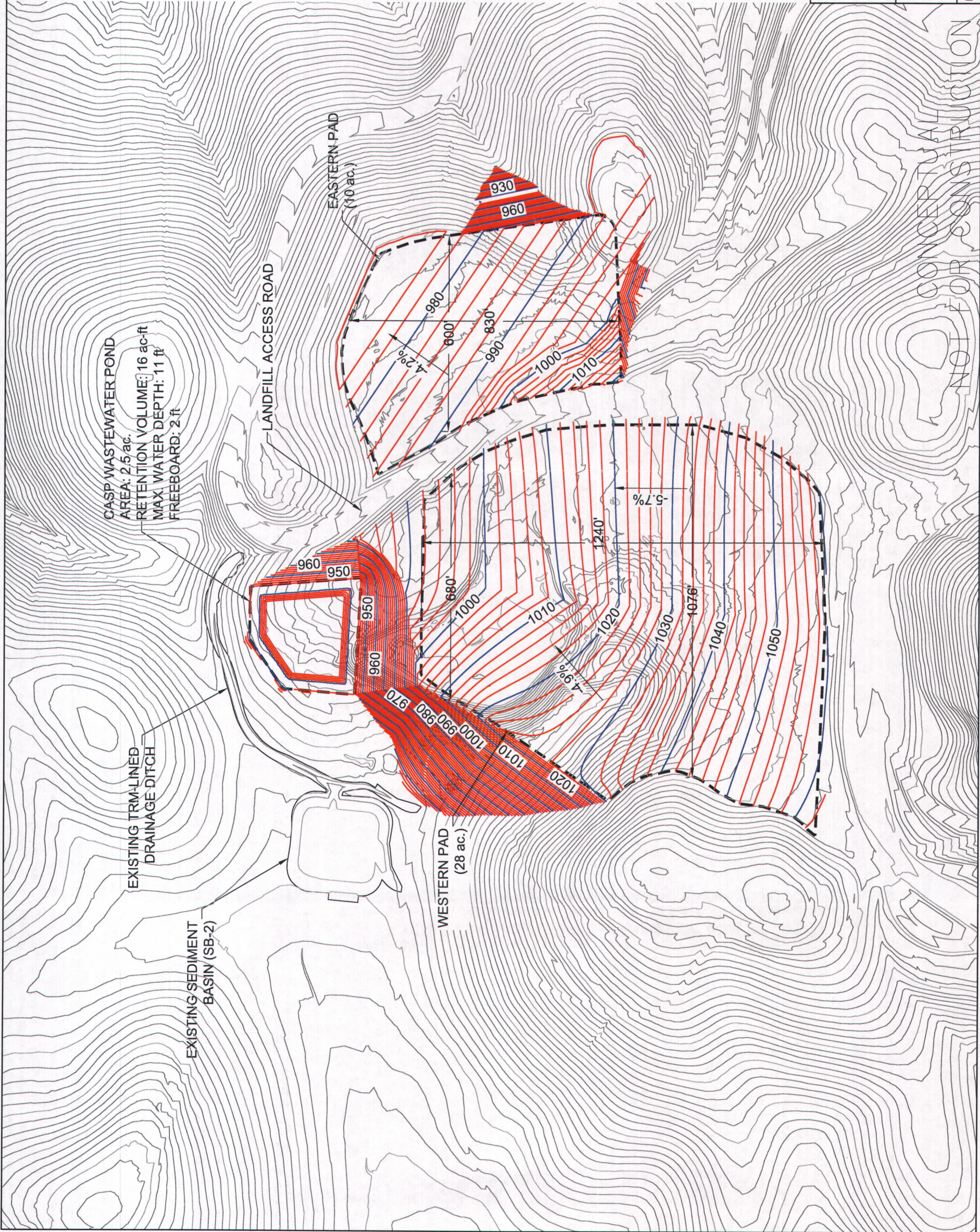
CONCEPTUAL CASP LAYOUT
ALTAMONT LANDFILL AND RESOURCE
RECOVERY FACILITY



FIGURE

1

PROJECT NO: WG1972 FEBRUARY 2017



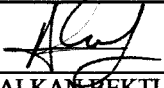
APPENDIX A

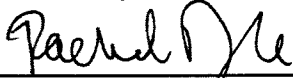
CASP WATER BALANCE CALCULATION PACKAGE

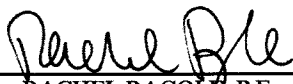
COMPUTATION COVER SHEET

Client: WMI Project: Altamont Landfill CASP Facility Project/
Proposal No.: WG1972
Task No.

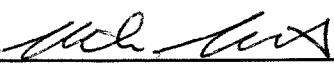
Title of Computations **ALTAMONT LANDFILL CASP FACILITY STORMWATER
RUNOFF AND WATER BALANCE CALCULATIONS**

Computations by: Signature  27 July 2016
Printed Name ALKAN BEKTUR, P.E. Date
Title Senior Engineer

Assumptions and Procedures Checked by: Signature  28 July 2016
(peer reviewer) Printed Name RACHEL RAGOLE, P.E. Date
Title Engineer

Computations Checked by: Signature  28 July 2016
Printed Name RACHEL RAGOLE, P.E. Date
Title Engineer

Computations backchecked by: Signature  28 July 2016
(originator) Printed Name ALKAN BEKTUR, P.E. Date
Title Senior Engineer

Approved by: Signature  28 July 2016
(pm or designate) Printed Name MIKE MINCH, P.E., G.E. Date
Title Senior Principal

Approval notes: _____

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval
_____	_____	_____	_____	_____	_____
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Written by: A. Bektur Date: 27 July 2016 Reviewed by: R. Ragole Date: 28 July 2016
Client: WMI Project: Altamont CASP Project No. WG1972 Task No.: 1

ALTAMONT LANDFILL CASP FACILITY STORMWATER RUNOFF AND WATER BALANCE CALCULATIONS

INTRODUCTION

The objective of this calculation package is to estimate the stormwater runoff and the required size for the drainage conveyance and wastewater management system for the proposed Covered Aerated Static Pile (CASP) facility at Altamont Landfill and Resource Recovery Facility (ALRRF). The wastewater management system includes a lined wastewater detention pond to store the compost contact and quench water generated from the proposed facility. Runoff, including storm water falling on the compost pad and contact water from compost operations on the pad will be conveyed to the wastewater pond. The conceptual CASP facility drainage conveyance system and wastewater detention pond layout is presented in Figure 1.

The proposed compost pad area is approximately 38 acres. 30% of the compost pad surface will be covered with gravel, and the remaining 70% will be compacted soil. As shown in Figure 1, drainage areas B and C will be graded to create the new pad. Runoff from the pad will be routed to the wastewater pond. ALRRF anticipates receiving up to 500 tons per day (tpd) of compostable feedstock. The processed green waste feedstock will be placed in piles on top of the compost pad. It is assumed that the compost piles will cover approximately 60% of the surface area of the compost pad.

Drainage areas A1 and A2 (Figure 1) will continue to flow to existing sediment basin SB-2, but as part of this project, new drainage ditches will be constructed to convey runoff from these two areas to the basin. Drainage area sizes measured in AutoCAD are summarized in Table 1 below.

Table 1. Drainage Area Summary

Drainage Area	Tributary Area (acres)
A1	8.9
A2	2.4
B	31.6
C	12.2

STORMWATER RUNOFF

General Waste Discharge Requirements for Composting Operations require drainage conveyance systems to be designed, constructed and maintained for conveyance of wastewater from the working surface in addition to direct precipitation from a 25-year, 24-hr peak storm event. According to the National Oceanic and Atmospheric Administration Atlas 14, Volume 6,

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Version 6, the estimated rainfall depth for the 25-year, 24-hr peak design storm event at ALRRF is 3.40 inches.

The following assumptions were made in order to estimate the runoff generated by the 25-year 24-hour peak storm event at the proposed compost pad:

- 30% of the compost pad surface will be covered with gravel (underlain by compacted soil)
- 70% of the compost pad surface will be compacted soil.
- 60% of the compost pad will be covered with compost piles. Compost piles will be stored on compacted soil portions of the pad only.
- NRCS (formerly SCS) Runoff hydrograph method was used to model runoff.
- The Curve Numbers (CN) used were;
 - CN = 89 for natural slopes (Tributary areas A1 and A2 as shown in Figure 1)
 - CN = 76 for the compost pad (composite CN reflecting 60% compost coverage and 30% gravel pad surface) (Tributary areas B and C as shown in Figure 1)
- Type I rainfall distribution was assumed per TR-55, Appendix B.

Based on the assumptions listed above, the 25-year, 24-hr peak storm event runoff volume was estimated¹ as 202,931 cubic feet or 4.66 acre-feet (ac-ft). The supporting hydrology calculations are attached at the end of this report.

WATER BALANCE CALCULATIONS

General Waste Discharge Requirements for Composting Operations require wastewater handling ponds to be designed to be capable of containing, without overflow or overtopping (taking into consideration the crest of wind-driven waves and water reused in the composting operation), all wastewater from the working surfaces in addition to precipitation that falls into the detention pond from a 25-year, 24-hour peak storm event at a minimum, or equivalent alternative approved by the Regional Water Board.

As summarized in the Stormwater Runoff Section above, the direct precipitation to the pond during the 25-year, 24-hr storm event is estimated to be 3.4 inches. The runoff generated at the compost pads during the same design event is estimated to be 4.66 ac-ft. In addition to the direct precipitation and runoff associated with the design storm event, it is assumed that there may be standing water in the pond prior to the beginning of the design storm event. Geosyntec performed water balance calculations to estimate the maximum predicted standing water volume in the pond during the average wet-year. The average wet-year precipitation was based on

¹ Calculated using Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2016.

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National Climatic Data Center (NCDC) data from 83 years of weather monitoring at the Livermore weather station². The Livermore weather station data was used to model annual rainfall at Altamont because of its close proximity to the site and similar average annual precipitation (14.8 inches at Livermore weather station versus 13.0 inches at ALRRF. The average wet-year annual total precipitation value was estimated as 14.8 inches. The average wet-year annual total precipitation monthly distribution was done in accordance with average (mean) precipitation values provided by the California Department of Water Resources for Livermore Station³ in the San Francisco Bay Hydrologic Region.

The following assumptions were made in estimating the required storage capacity for the proposed compost pad contact water impoundment (wastewater pond):

1. The area of the compost pad covered with compost was assumed to be 60% of the total surface area. The runoff from precipitation falling on the compost windrows was assigned a runoff coefficient of 0.50.
2. The area of the compost pad not covered with active compost piles is assumed to be 40% of the surface area. The runoff from the uncovered gravel portion of the compost pad area was assigned a runoff coefficient of 0.60. The runoff from precipitation falling on the compacted soil compost pad not covered with compost was assigned a runoff coefficient of 0.70.
3. The pond will be lined to meet requirements in the General WDRs. Zero infiltration is assumed.
4. Moisture management and water requirement estimates during CASP system operations were provided by WMI based on experience with similar size CASP operations⁴. The water use estimates include initial feedstock wetting, pile surface irrigation for odor control, and water use for moisture reconditioning of the feedstock after active composting. The average surface irrigation water use is variable, and is reduced in months of high precipitation. Geosyntec understands that runoff generated during surface irrigation of the compost piles is expected to be negligible.

It is estimated that approximately 5,000 gpd of water is required for initial feedstock wetting, and between approximately 1,700 and 8,500 gpd are required for yearly variable pile surface irrigation. This required water is assumed to be extracted from the wastewater pond when water is available in the pond. If no water is available in the pond

² National Climatic Data Center (NCDC), (Weather Station COOP: 044997). <http://gis.ncdc.noaa.gov/>. January 2015.

³ http://www.dwr.water.ca.gov/floodmgmt/hafoo/csc/climate_data/sfbay.cfm

⁴ Oxbow Covered Aerated Static Pile Facility, Redwood Landfill, Novato, California

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in a particular month, the required water for CASP operations will be extracted elsewhere.

Approximately 21,000 gpd of water is required for moisture reconditioning of the feedstock after active composting.

Seasonal water requirements at the CASP system based on these assumptions are summarized in Table 2 below.

5. Based on the methodology described in the WDRs (Order No. R5-2016-0042), Simon (1998) collected evaporation data for the site between 1991 and 1997. He estimated a "mean inferred evaporation" of 65.86 in. (1,673 mm) per year. For that time period (1991-1997), the highest "mean monthly-inferred evaporation" calculated by Simon was 10.85 in. (276 mm) for July and the lowest "mean monthly-inferred evaporation" calculated was 1.13 in. (29 mm) for December⁵.

The closest weather station recording continuous evaporation data is Antioch Pump Plant 3, located approximately 18 miles north of the site, in Contra Costa County. The annual total average evaporation recorded at this station between 1955 and 2005 was 71.11 inches, with mean evaporation of 11.6 inches in July and 1.22 inches in December.

For this study, the "mean inferred annual total evaporation" data estimated for the site (65.86 in.) was distributed monthly in accordance with average (mean) monthly precipitation distribution at the Antioch Pump Plant 3, and was used as effective evaporation at the wastewater pond.

6. A starting volume of 2.6 ac-ft in the pond was assumed at the beginning of the average wet-year water balance (January through December).
7. As required by Title 27 of the California Code of Regulations, a 2-ft freeboard above highest pond water level was assumed for pond capacity.

Estimates of the seasonal water requirements of the CASP system are provided in Table 2 below.

Table 2. Seasonal Water Requirements

	Fall	Winter	Spring	Summer
Estimated Total Water Use (ac-ft/month)	2.40	2.21	2.40	2.74

Note: Estimated total water use volume includes water required for initial feedstock wetting, pile surface irrigation and water use after active composting.

⁵ Simon, R.L., "Altamont Landfill Meteorological Station Annual Data Summaries for 1997," submitted to Mr. William Gilmour, Altamont Landfill, 10840 Altamont Pass Road, Livermore, California, February 1998.

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The volume of compost contact water in the proposed impoundment is estimated on a monthly basis for the average wet-year as follows:

$$(1) \quad S = V_i + V_R + V_P - V_E - V_{out}$$

$$(2) \quad V_R = C_{Gravel} \times (P_{avg}) \times A_{Gravel} + C_{Compost} \times (P_{avg}) \times A_{Compost} + C_{uncovered bare soil} \times (P_{avg}) \times A_{uncovered bare soil}$$

$$(3) \quad V_P = A_I \times P_{avg} \quad \text{(Average wet year)}$$

$$(4) \quad V_E = A_I \times E_{avg} \quad \text{(Average year)}$$

S (ac-ft) = Net volume of fluid stored in proposed pond. The water balance assumes an initial volume of fluid stored in the pond of 2.6 ac-ft prior to the start and at the end of the average wet year (to satisfy continuity). The initial storage volume is based on continuous modelling of back to back average wet year events.

V_i (ac-ft) = Initial (starting) volume in pond;

V_R (ac-ft) = Net runoff from compost pad;

V_P (ac-ft) = Contribution from direct precipitation during the average year or the average wet year;

V_E (ac-ft) = Volume lost due to evaporation based on average evaporation rates for the wastewater pond;

V_{out} (ac-ft) = Quantity of water extracted from compost contact water pond for initial feedstock wetting and pile surface irrigation;

A_{Gravel} (acres) = Surface area of compost pad covered by Gravel (assumed to be 11.4 acres);

Written by: A. Bektur Date: 27 July 2016 Reviewed by: R. Ragole Date: 28 July 2016
 Client: WMI Project: Altamont CASP Project No. WG1972 Task No.: 1

A_{Compost} (acres) = Surface area of compost pad covered by Compost (assumed to be 22.8 acres);

$A_{\text{uncovered bare soil}}$ (acres) = Surface area of compacted soil compost pad not covered by compost (assumed to be 3.8 acres);

C_{Gravel} = Runoff coefficient for Gravel (assumed to be 0.60);

C_{Compost} = Runoff coefficient for compost windrows (assumed to be 0.50);

$C_{\text{uncovered bare soil}}$ = Runoff coefficient for compacted soil pad that is not covered with compost (assumed to be 0.70);

A_I (acres) = Surface area for proposed pond;

P_{avg} (in.) = Average wet year monthly total precipitation;

E_{Avg} (in.) = Average monthly evaporation rate.

Calculations for estimating the stored water volume in the proposed pond on a monthly basis are provided in the attached Table 6. Based on the water balance calculations, the maximum volume stored at the wastewater pond during the average wet-year is 10.8 ac-ft.

COMPOST PAD CONTACT WATER POND SIZING

The wastewater pond needs to be designed to handle all wastewater from the working surfaces in addition to the precipitation that falls into the detention pond from a 25-year, 24-hour peak storm event. The maximum standing wastewater stored in the pond generated from the working surfaces during an average wet-year is estimated to be 10.80 acre-feet based on the water balance calculations. As shown in Table 3 below, the volume from direct precipitation to the 2.4 acre pond during the 25-year 24-hr peak storm event (3.4 inches) is estimated as 0.68 ac-ft. The runoff volume that will discharge to the pond during the same peak design event is estimated as 4.66 ac-ft. The total required storage volume excluding the 2-ft freeboard is 16.09 ac-ft.

The proposed wastewater pond has a total depth of 15 feet, 2.5H:1V side slopes and a top area of 2.4 acres. Not including the 2 feet of freeboard, the volume provided in the proposed wastewater handling pond is 16.40 ac-ft, which is greater than the required volume of 16.09 ac-ft.

Written by: A. Bektur Date: 27 July 2016 Reviewed by: R. Ragole Date: 28 July 2016
 Client: **WMI** Project: **Altamont CASP** Project No. **WG1972** Task No.: **1**

Table 3. Wastewater Pond Sizing Summary

Water Source	Maximum Stored Volume (ac-ft)	Water depth in pond (ft)
Wastewater from working surfaces (runoff during average wet-year operations)	10.75	10.20
Direct precipitation to pond during the 25-yr, 24-hr peak storm (3.4 in*2.4 ac)	0.68	0.40
Runoff from the 25-yr, 24-hr peak storm	4.66	2.20
Total required Storage	16.09	12.80
Total provided Storage excluding 2ft freeboard	16.40	13.00

The pond sizing schematic is also presented in Figure 2.

DRAINAGE CONVEYANCE STRUCTURES

Calculations for the permit level preliminary sizing of drainage ditches, downchutes and culvert are attached to this report. Drainage ditches will be constructed by compacting soil and covering with an erosion control mat (ECM). Downchutes will be constructed of HDPE and the culvert will be corrugated metal pipe (CMP). Design parameters (inputs) are summarized in Table 4 and results are summarized in Table 5 presented below.

Table 4. Design Parameters for Drainage Conveyance Structures

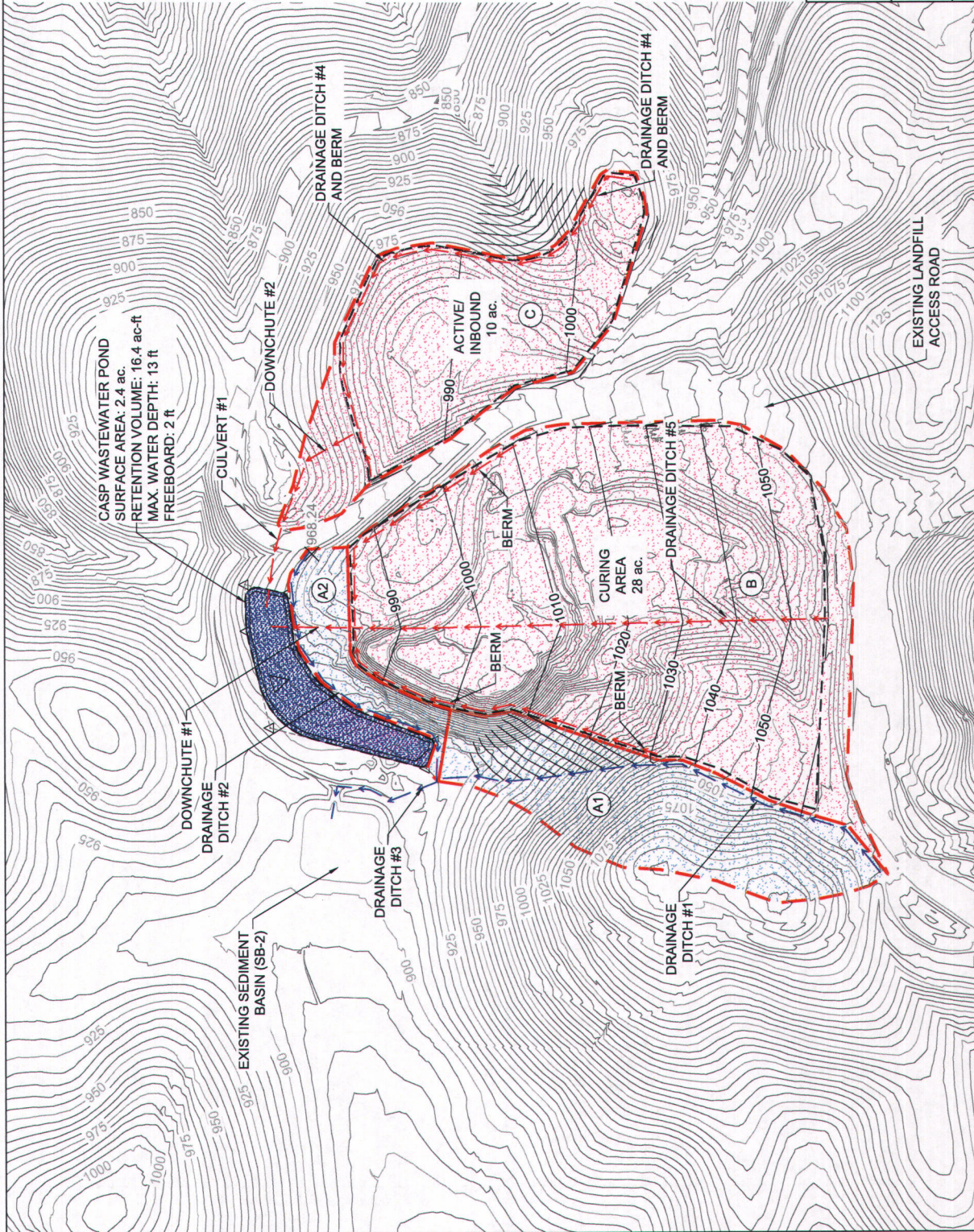
Drainage Structure	Slope (%)	Material	Manning's n-value	Flow (cfs)
Ditch #1	10	ECM	0.025	17.28
Ditch #2	4.8	ECM	0.025	4.66
Ditch #3	6.9	ECM	0.025	21.94
Ditch #4	1.5	ECM	0.025	10.57
Ditch #5	5.2	ECM	0.025	29.33
Downchute #1	4	HDPE (ADS-12)	0.012	29.33
Downchute #2	4	HDPE (ADS-12)	0.012	10.57
Culvert #1	3	CMP	0.018	10.57

Written by: A. Bektur Date: 27 July 2016 Reviewed by: R. Ragole Date: 28 July 2016

Client: WMI Project: Altamont CASP Project No. WG1972 Task No.: 1

Table 5. Preliminary Sizing Summary of Drainage Conveyance Structures

Drainage Structure	Side slope (Z:1)	Channel depth (ft)	Pipe diameter (in)
Ditch #1	2	1.5	--
Ditch #2	2	1.5	--
Ditch #3	2	1.75	--
Ditch #4	2	1.75	--
Ditch #5	5	1.5	--
Downchute #1	--	--	21
Downchute #2	--	--	18
Culvert #1	--	--	24



COMPOSTING OPERATIONS
 PRELIMINARY DRAINAGE
 CONVEYANCE LAYOUT
 ALTMONT LANDFILL AND RESOURCE
 RECOVERY FACILITY

Geosyntec
 consultants

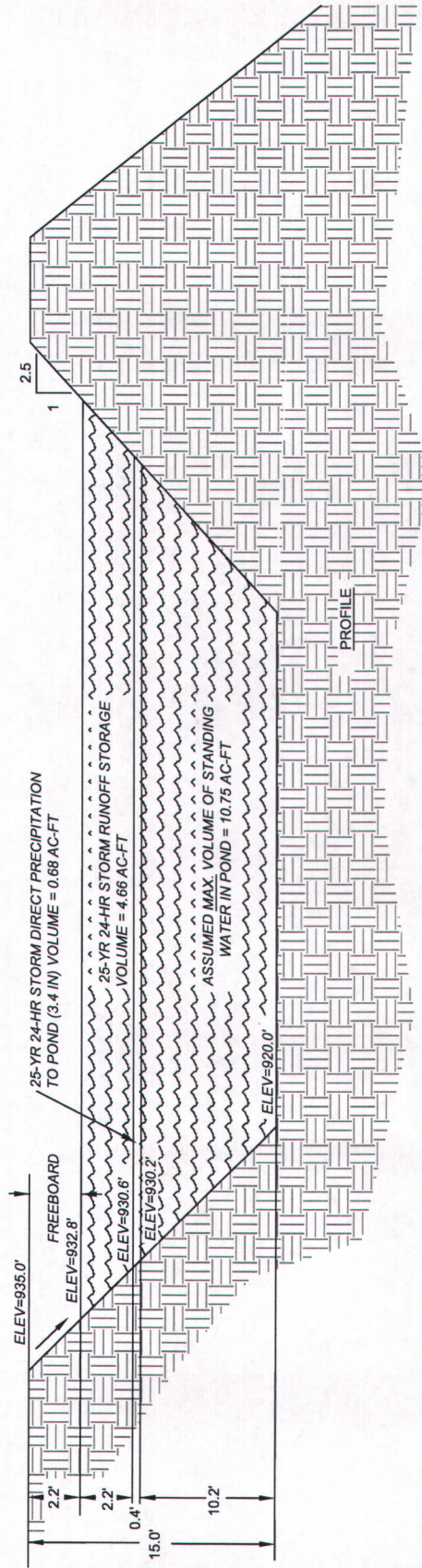
FIGURE

1

PROJECT NO: WG1972

JULY 2016

COMPOSTING OPERATIONS POND SCHEMATIC



COMPOSTING OPERATIONS
PRELIMINARY DRAINAGE
POND SCHEMATIC
ALTAMONT LANDFILL AND RESOURCE
RECOVERY FACILITY

Geosyntec
consultants

FIGURE

2

PROJECT NO: WG1972

JULY 2016

WATER BALANCE CALCULATIONS

Flood Management

- Hydrology & Flood Operations
- Flood Projects
- Levee Repairs & Floodplain Management
- Flood Maintenance

Hydrology & Flood Operations

- California State Climatologist
- Flood Operations
- Flood Project Integrity & Inspection
- Hydrology

California State Climatologist

- Climate Change
- Climate Data & Information
- Documents

- Organization
- Questions & Comments
- Publications & Videos
- Related Links

CALIFORNIA STATE CLIMATOLOGIST

3310 El Camino Avenue
Suite 200
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P O Box 215000
Sacramento CA 95821-5000

Flood & Safety Topics > Flood Management > Hydrology & Flood Operations > California State Climatologist > Climate Data > San Francisco Bay

SAN FRANCISCO BAY HYDROLOGIC REGION

Region Avg	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg Temp	49.2	51.8	53.4	56.0	59.6	63.5	66.1	66.5	65.4	61.1	53.9	45.1	58.0
Std Dev / T	1.9	2.1	2.3	2.2	2.2	1.7	1.3	1.1	1.9	1.7	2.2	2.3	0.9
Avg Precip	4.47	4.17	3.60	1.32	0.53	0.13	0.50	0.50	0.31	1.06	2.62	3.02	21.40
Std Dev / P	3.23	3.27	2.63	1.07	0.74	0.17	0.11	0.21	0.40	0.91	2.17	2.00	8.05
Location	ANGWIN PAC UNION COL												
Location	BERKELEY												
Location	BLACK MOUNTAIN 2 WSW												
Location	CALISTOGA												
Location	FAIRFIELD												
Location	HALF MOON BAY												
Location	KENTFIELD												
Location	LIVERMORE												
State	CA												
Lat	37.42°												
Long	-121.47°												
Elev	480												
ID	044597												
Normal	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Minimum	37.4	40.3	42.3	44.2	48.5	52.5	54.9	55	53.2	48.1	41.5	36.9	46.3
Maximum	56.9	61.8	65.3	71.2	77	84	89.1	98.7	85.9	77.9	64.8	57	73.3
Mean	47.2	51.1	53.8	57.7	62.8	68.3	72	71.9	65.6	53.2	43.2	37	52.8
Precip	2.59	2.77	2.47	0.65	0.43	0.05	0.03	0.03	0.24	0.64	1.85	2.04	14.52
HDD	555	351	349	238	130	31	6	1	19	111	358	450	2755
CDD	0	0	2	18	60	131	222	216	154	53	2	0	858

COMPOST PAD WATER IMPOUNDMENT ESTIMATE - TABLE 6
 ALTAMONT LANDFILL AND RESOURCE RECOVERY FACILITY, ALAMEDA COUNTY, CALIFORNIA

Date: 25 July 2016
 Prepared by: A. Bektur

Assumptions

Composting Pad Area	38.0 acres
Percentage of Compost Pad Area Covered with Gravel	30 %
Percentage of Compost Pad Area Covered with Compacted Soil	70 %
Percentage of Compost Pad Area Containing Compost	60 %
Proposed Impoundment Area (A _i)	2.4 acres
Maximum Surface Area of Water in Impoundment Area	2.3 acres
Berm Slope (H:1)	2.5
Average Annual Precipitation (P _{avg})	14.8 inches
25-yr 24-hr Storm Precipitation (P ₂₅)	3.4 inches
Compacted Soil Runoff Coefficient	0.70
Gravel Runoff Coefficient	0.60
Compost Runoff Coefficient	0.50
Assumed Starting Liquid Storage	2.6 acre-feet

TABLE 1. WATER BALANCE

Year 1

Month	Average Year Climatic Data		Inflow					Outflow			Storage
	Precipitation ¹ (in)	Evaporation ² (in)	V _P	V _{gravel}	V _{compost}	V _{soil}	V _R	V _E	V _Q	S	
			Direct Precip. (ac-ft)	Runoff From Gravel (ac-ft)	Runoff from Compost (ac-ft)	Runoff from Compact Soil (ac-ft)	Total Compost Pad Runoff (ac-ft)	Area for Evaporation (acre)	Evaporation (ac-ft)	Potential Water Use ³ (ac-ft)	Net Volume in Impoundment (ac-ft)
January	2.99	1.08	0.60	1.7	2.8	0.7	5.2	1.54	0.1	2.21	2.6
February	2.77	1.84	0.55	1.6	2.6	0.6	4.8	1.70	0.3	2.21	6.1
March	2.47	3.94	0.49	1.4	2.3	0.5	4.3	1.85	0.6	2.40	9.0
April	0.96	5.81	0.19	0.5	0.9	0.2	1.7	1.94	0.9	2.40	10.8
May	0.43	8.30	0.09	0.2	0.4	0.1	0.7	1.87	1.3	2.40	9.3
June	0.09	10.04	0.02	0.1	0.1	0.0	0.2	1.72	1.4	2.74	6.4
July	0.03	10.74	0.01	0.0	0.0	0.0	0.1	1.53	1.4	2.74	2.4
August	0.08	9.32	0.02	0.0	0.1	0.0	0.1	1.42	0.1	2.74	0.0
September	0.24	7.20	0.05	0.1	0.2	0.1	0.4	1.42	0.4	2.40	0.0
October	0.84	4.55	0.17	0.5	0.8	0.2	1.5	1.42	0.5	2.40	0.0
November	1.88	1.92	0.38	1.1	1.8	0.4	3.3	1.42	0.2	2.40	1.0
December	2.04	1.13	0.41	1.2	1.9	0.5	3.6	1.46	0.1	2.21	2.6
Totals	14.8	65.86	3.0	8.4	14.1	3.3	25.8	7.5	29.3		

Results

Maximum Volume in Impoundment Following Typical Wet Season

10.75 ac-ft
 468,399 cubic feet

Notes

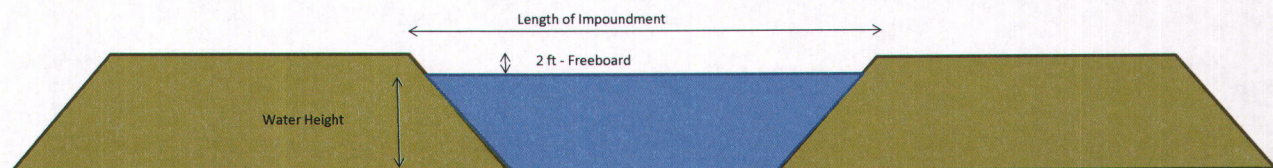
1. Average monthly precipitation values recorded at the Livermore Station. http://www.dwr.water.ca.gov/floodmgmt/hafo/csc/climate_data/sfbay.cfm
2. Based on average monthly evaporation rates from the Antioch Pump Plant 3 recorded between 1955 and 2005.
3. When available, water stored in the contact water pond will be used for CASP operations.

Calculation for impoundment dimensions

Assuming:

2. Berm has 2.5:1 slope
3. 2 feet of freeboard
4. Pond dimensions are measured from inner crest of levee

Top Area	98177 ft ²
Base Area	61669 ft ²
Water Height	13.00 ft
Volume	16.40 ac-ft



RUNOFF CALCULATIONS

Altamont Landfill
Rainfall

HYDROLOGY

Task: Select rainfall depths and intensities from NOAA 14, Volume 6, Version 2.



NOAA Atlas 14, Volume 6, Version 2
Location name: Livermore, California, US*
Latitude: 37.7561°, Longitude: -121.6525°
Elevation: 1105 ft*
* source: Google Maps



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Matlala, Deborah Martin, Sandra Pavlovic,
Sham Roy, Carl Trypauk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Borman, Daniel
Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchon

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps_&_aerials](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.099 (0.087-0.114)	0.121 (0.107-0.140)	0.153 (0.134-0.177)	0.181 (0.157-0.211)	0.222 (0.184-0.271)	0.257 (0.207-0.322)	0.295 (0.230-0.381)	0.337 (0.254-0.452)	0.401 (0.286-0.567)	0.457 (0.312-0.675)
10-min	0.142 (0.125-0.163)	0.174 (0.153-0.200)	0.219 (0.192-0.253)	0.259 (0.225-0.303)	0.318 (0.264-0.388)	0.368 (0.296-0.461)	0.422 (0.330-0.546)	0.483 (0.364-0.648)	0.575 (0.410-0.813)	0.654 (0.447-0.967)
15-min	0.172 (0.151-0.197)	0.210 (0.185-0.242)	0.265 (0.232-0.306)	0.314 (0.272-0.366)	0.385 (0.319-0.470)	0.445 (0.359-0.558)	0.511 (0.399-0.661)	0.584 (0.440-0.784)	0.695 (0.466-0.984)	0.791 (0.541-1.17)
30-min	0.234 (0.205-0.268)	0.287 (0.252-0.330)	0.361 (0.316-0.417)	0.427 (0.370-0.499)	0.524 (0.434-0.639)	0.606 (0.488-0.759)	0.695 (0.543-0.900)	0.796 (0.599-1.07)	0.946 (0.675-1.34)	1.08 (0.736-1.59)
60-min	0.330 (0.290-0.379)	0.404 (0.355-0.465)	0.510 (0.446-0.589)	0.603 (0.522-0.704)	0.740 (0.613-0.902)	0.855 (0.689-1.07)	0.981 (0.766-1.27)	1.12 (0.845-1.51)	1.34 (0.953-1.89)	1.52 (1.04-2.25)
2-hr	0.479 (0.421-0.550)	0.584 (0.513-0.672)	0.731 (0.640-0.844)	0.859 (0.743-1.00)	1.04 (0.865-1.27)	1.20 (0.965-1.50)	1.36 (1.06-1.77)	1.55 (1.17-2.08)	1.82 (1.30-2.57)	2.04 (1.40-3.02)
3-hr	0.594 (0.523-0.682)	0.725 (0.636-0.833)	0.906 (0.793-1.05)	1.06 (0.921-1.24)	1.29 (1.07-1.57)	1.48 (1.19-1.85)	1.68 (1.31-2.17)	1.90 (1.43-2.55)	2.22 (1.59-3.15)	2.49 (1.70-3.69)
6-hr	0.818 (0.719-0.938)	1.00 (0.881-1.15)	1.26 (1.10-1.45)	1.48 (1.28-1.73)	1.79 (1.49-2.19)	2.05 (1.65-2.57)	2.33 (1.82-3.01)	2.63 (1.98-3.52)	3.08 (2.18-4.33)	3.42 (2.33-5.05)
12-hr	1.06 (0.936-1.22)	1.33 (1.17-1.53)	1.70 (1.49-1.96)	2.01 (1.74-2.35)	2.46 (2.04-3.00)	2.82 (2.27-3.53)	3.20 (2.50-4.14)	3.61 (2.72-4.85)	4.20 (3.00-5.95)	4.69 (3.20-6.93)
24-hr	1.40 (1.25-1.61)	1.79 (1.59-2.06)	2.32 (2.06-2.67)	2.77 (2.44-3.21)	3.40 (2.91-4.06)	3.91 (3.28-4.75)	4.44 (3.65-5.52)	5.01 (4.01-6.38)	5.82 (4.50-7.69)	6.48 (4.85-8.82)

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Matlala, Deborah Martin, Sandra Pavlovic,
Sham Roy, Carl Trypauk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Borman, Daniel
Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchon

NOAA, National Weather Service, Silver Spring, Maryland

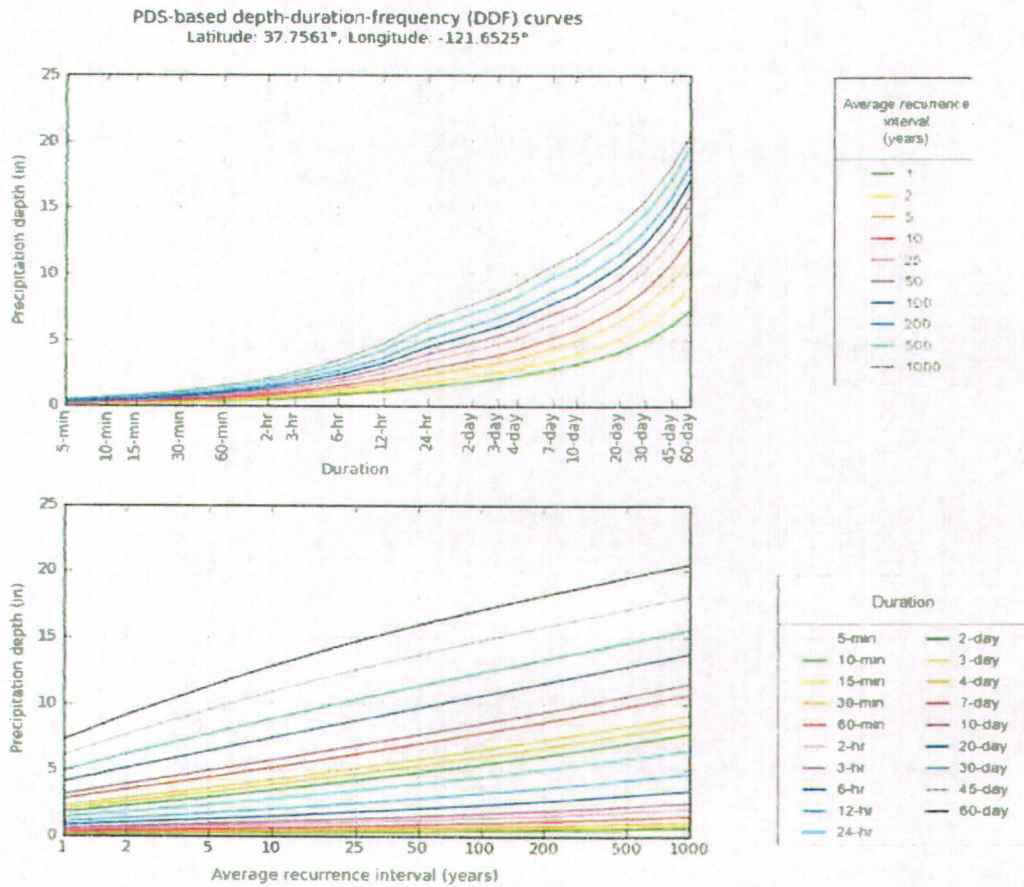
[PF_tabular](#) | [PF_graphical](#) | [Maps_&_aerials](#)

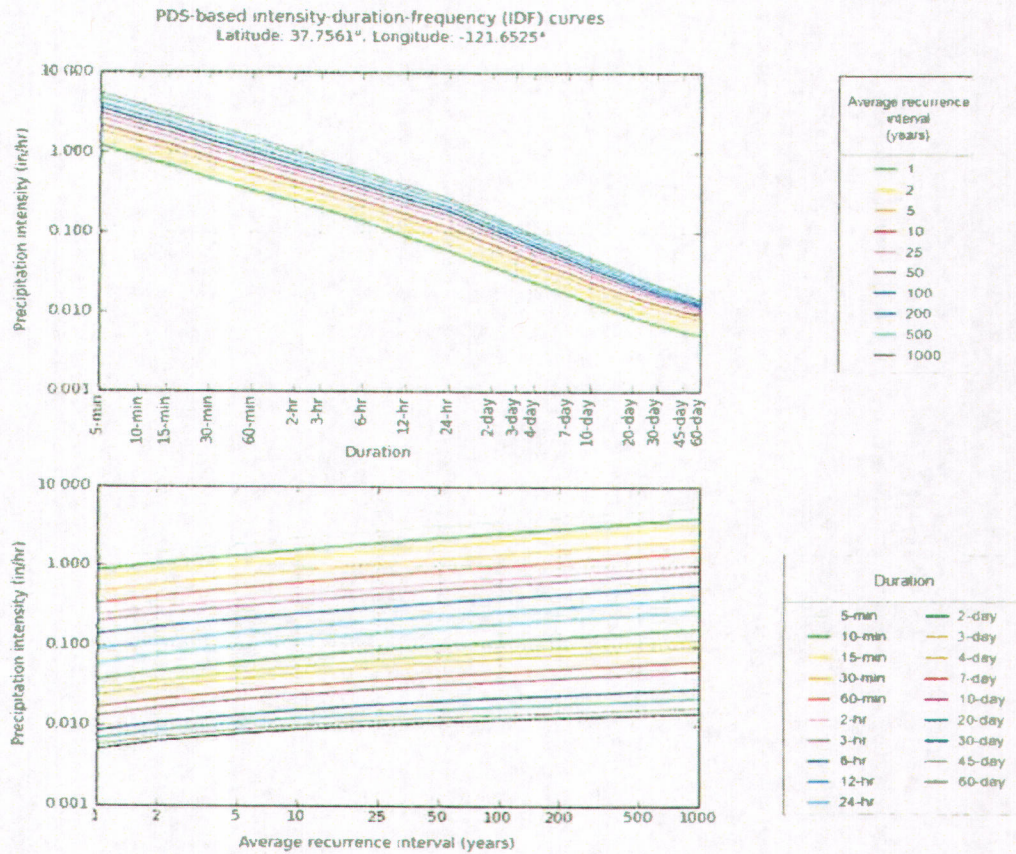
PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.19 (1.04-1.37)	1.45 (1.28-1.68)	1.84 (1.61-2.12)	2.17 (1.88-2.53)	2.66 (2.21-3.25)	3.08 (2.48-3.86)	3.54 (2.76-4.57)	4.04 (3.05-5.42)	4.81 (3.43-6.80)	5.48 (3.74-8.10)
10-min	0.852 (0.750-0.978)	1.04 (0.918-1.20)	1.31 (1.15-1.52)	1.55 (1.35-1.82)	1.91 (1.58-2.33)	2.21 (1.78-2.77)	2.53 (1.98-3.28)	2.90 (2.18-3.89)	3.45 (2.46-4.88)	3.92 (2.66-5.80)
15-min	0.688 (0.604-0.788)	0.840 (0.740-0.968)	1.06 (0.928-1.22)	1.26 (1.09-1.46)	1.54 (1.28-1.88)	1.78 (1.44-2.23)	2.04 (1.60-2.64)	2.34 (1.75-3.14)	2.78 (1.98-3.94)	3.16 (2.16-4.68)
30-min	0.468 (0.410-0.536)	0.574 (0.504-0.660)	0.722 (0.632-0.834)	0.854 (0.740-0.998)	1.05 (0.868-1.28)	1.21 (0.978-1.52)	1.39 (1.09-1.80)	1.59 (1.20-2.13)	1.89 (1.35-2.68)	2.15 (1.47-3.15)
60-min	0.330 (0.290-0.379)	0.404 (0.355-0.465)	0.510 (0.446-0.589)	0.603 (0.522-0.704)	0.740 (0.613-0.902)	0.855 (0.689-1.07)	0.981 (0.766-1.27)	1.12 (0.845-1.51)	1.34 (0.953-1.89)	1.52 (1.04-2.25)
2-hr	0.240 (0.210-0.275)	0.292 (0.256-0.336)	0.366 (0.320-0.422)	0.430 (0.372-0.501)	0.522 (0.432-0.637)	0.599 (0.482-0.751)	0.682 (0.532-0.883)	0.774 (0.582-1.04)	0.908 (0.648-1.29)	1.02 (0.698-1.51)
3-hr	0.198 (0.174-0.227)	0.241 (0.212-0.277)	0.302 (0.264-0.348)	0.354 (0.307-0.413)	0.430 (0.356-0.524)	0.492 (0.397-0.617)	0.559 (0.437-0.724)	0.633 (0.477-0.849)	0.741 (0.528-1.05)	0.839 (0.567-1.23)
6-hr	0.137 (0.120-0.157)	0.168 (0.147-0.193)	0.210 (0.184-0.243)	0.247 (0.214-0.288)	0.300 (0.248-0.366)	0.343 (0.276-0.430)	0.389 (0.303-0.503)	0.439 (0.330-0.588)	0.511 (0.364-0.722)	0.570 (0.390-0.843)
12-hr	0.088 (0.078-0.101)	0.110 (0.097-0.127)	0.141 (0.123-0.163)	0.167 (0.145-0.195)	0.204 (0.169-0.249)	0.234 (0.188-0.293)	0.266 (0.207-0.344)	0.300 (0.226-0.402)	0.349 (0.249-0.494)	0.389 (0.286-0.575)
24-hr	0.058 (0.052-0.067)	0.075 (0.066-0.086)	0.097 (0.086-0.111)	0.115 (0.101-0.134)	0.142 (0.121-0.169)	0.163 (0.137-0.198)	0.185 (0.152-0.230)	0.209 (0.167-0.265)	0.242 (0.187-0.320)	0.270 (0.202-0.368)

Altamont Landfill
Rainfall

HYDROLOGY





NOAA Atlas 14, Volume 6, Version 2

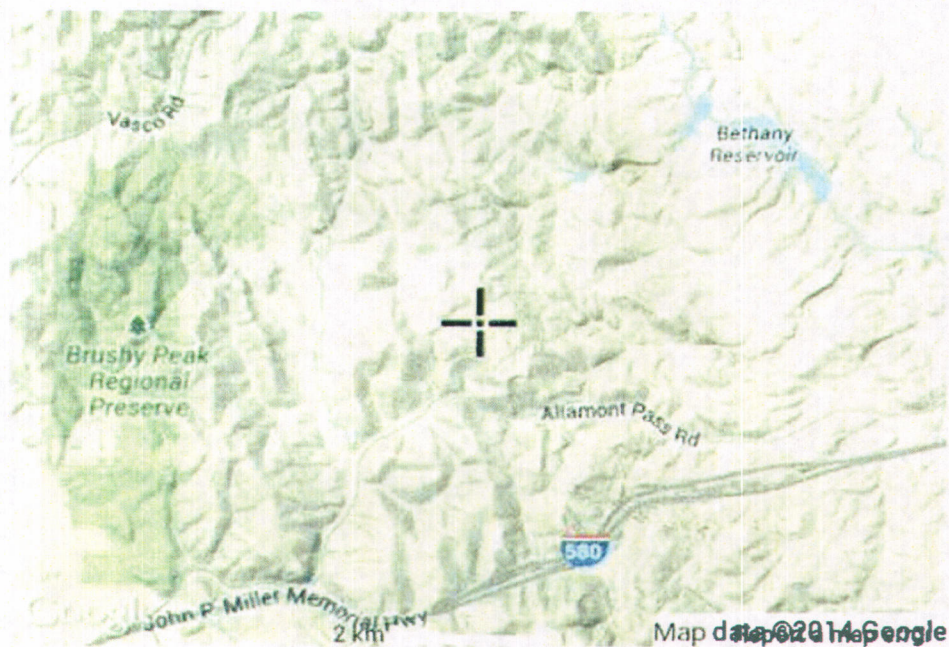
Created (GMT) Thu Feb 27 20 45:30 2014

[Back to Top](#)

Maps & aeriels

Small scale terrain





Large scale map



Altamont Landfill
Storm

HYDROLOGY

Task: Select Type I rainfall distribution from TR-55 Appendix B.

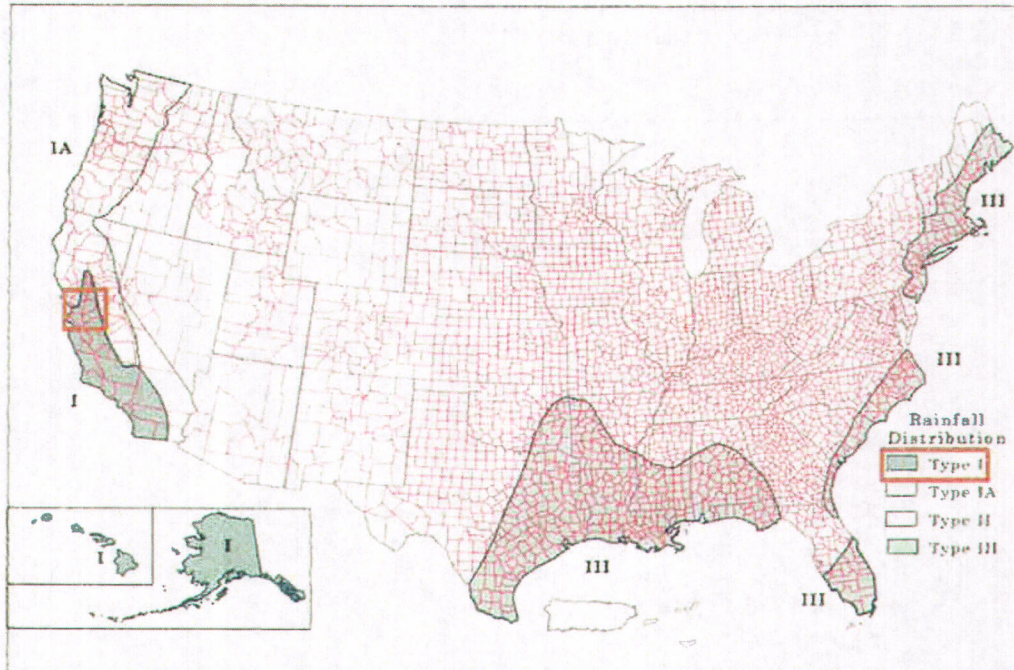
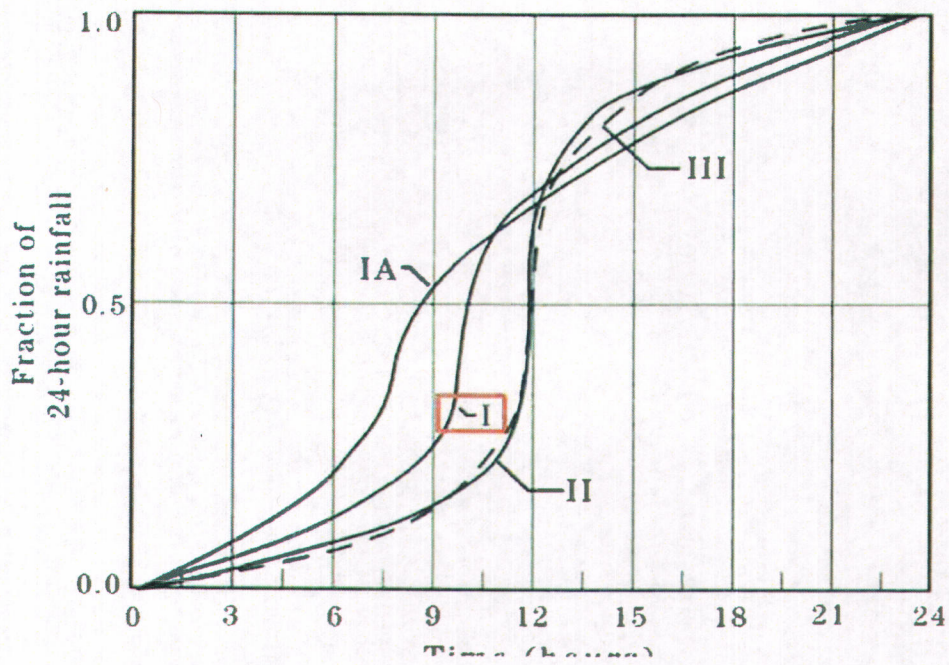


Figure B-1 SCS 24-hour rainfall distributions



Tuesday, 07 / 26 / 2016

Hydrograph Report

2

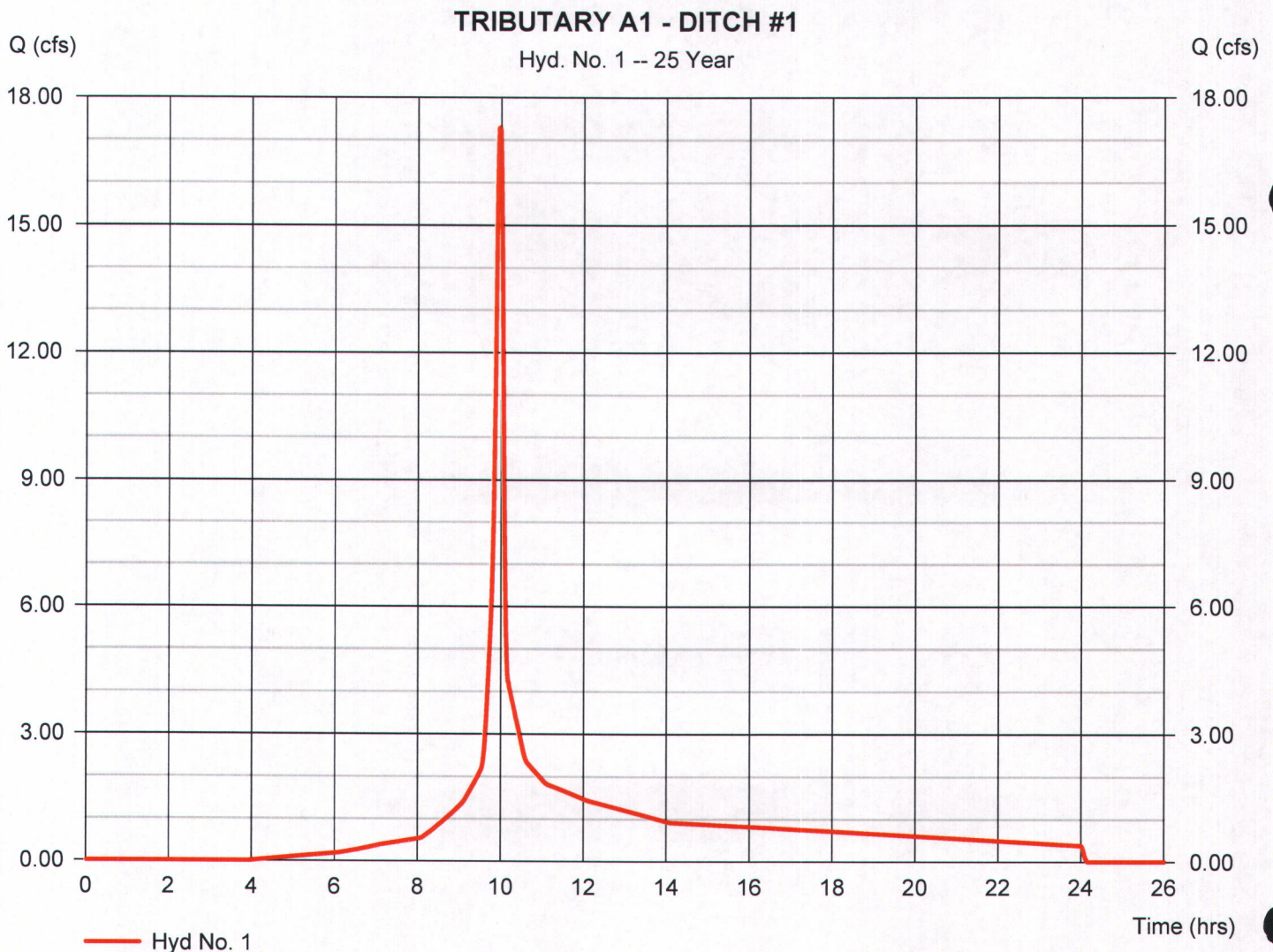
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Tuesday, 07 / 26 / 2016

Hyd. No. 1

TRIBUTARY A1 - DITCH #1

Hydrograph type	= SCS Runoff	Peak discharge	= 17.28 cfs
Storm frequency	= 25 yrs	Time to peak	= 9.95 hrs
Time interval	= 1 min	Hyd. volume	= 75,459 cuft
Drainage area	= 8.900 ac	Curve number	= 89
Basin Slope	= 10.4 %	Hydraulic length	= 1455 ft
Tc method	= KIRPICH	Time of conc. (Tc)	= 5.08 min
Total precip.	= 3.40 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

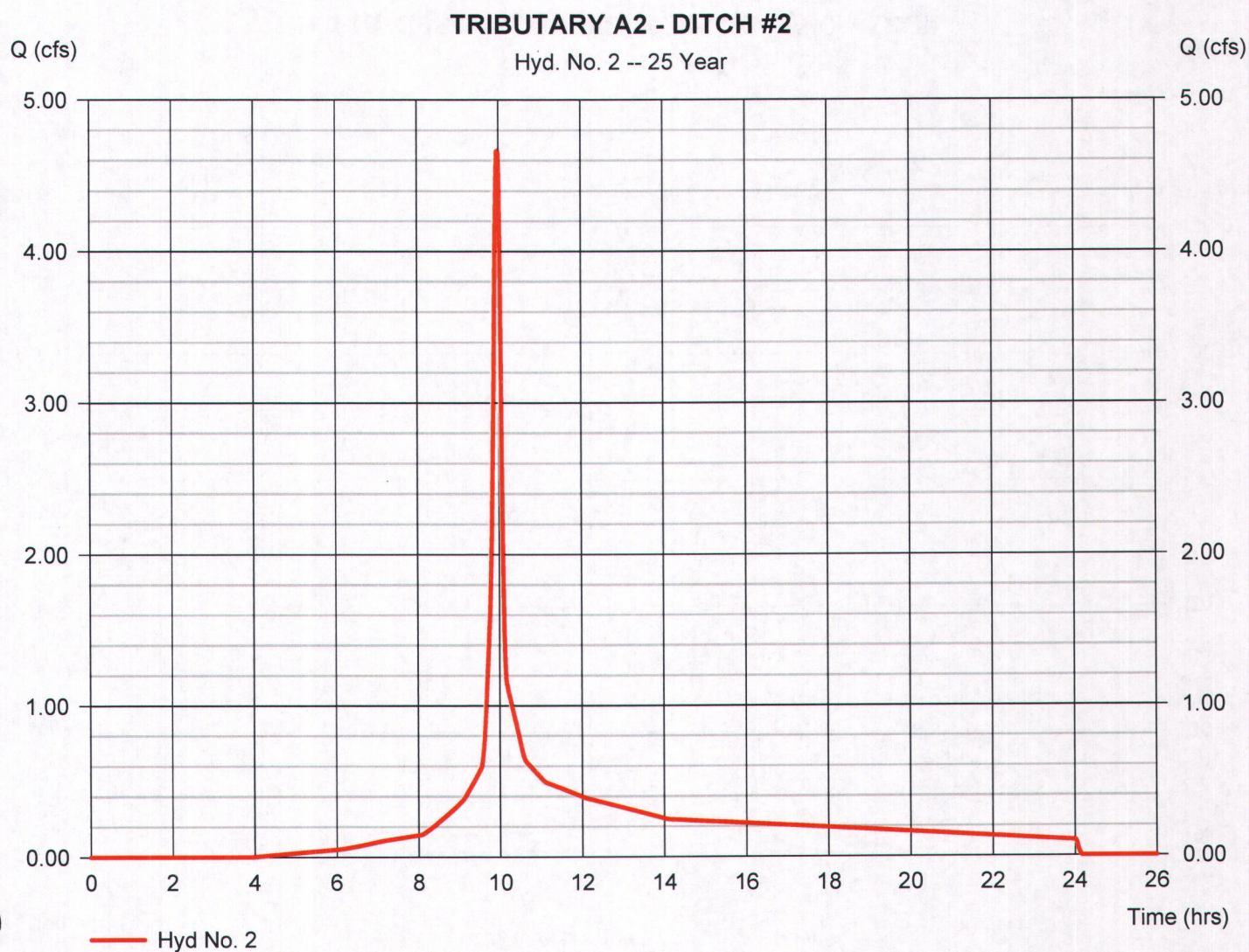
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Tuesday, 07 / 26 / 2016

Hyd. No. 2

TRIBUTARY A2 - DITCH #2

Hydrograph type	= SCS Runoff	Peak discharge	= 4.660 cfs
Storm frequency	= 25 yrs	Time to peak	= 9.95 hrs
Time interval	= 1 min	Hyd. volume	= 20,349 cuft
Drainage area	= 2.400 ac	Curve number	= 89
Basin Slope	= 4.8 %	Hydraulic length	= 956 ft
Tc method	= KIRPICH	Time of conc. (Tc)	= 4.95 min
Total precip.	= 3.40 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

4

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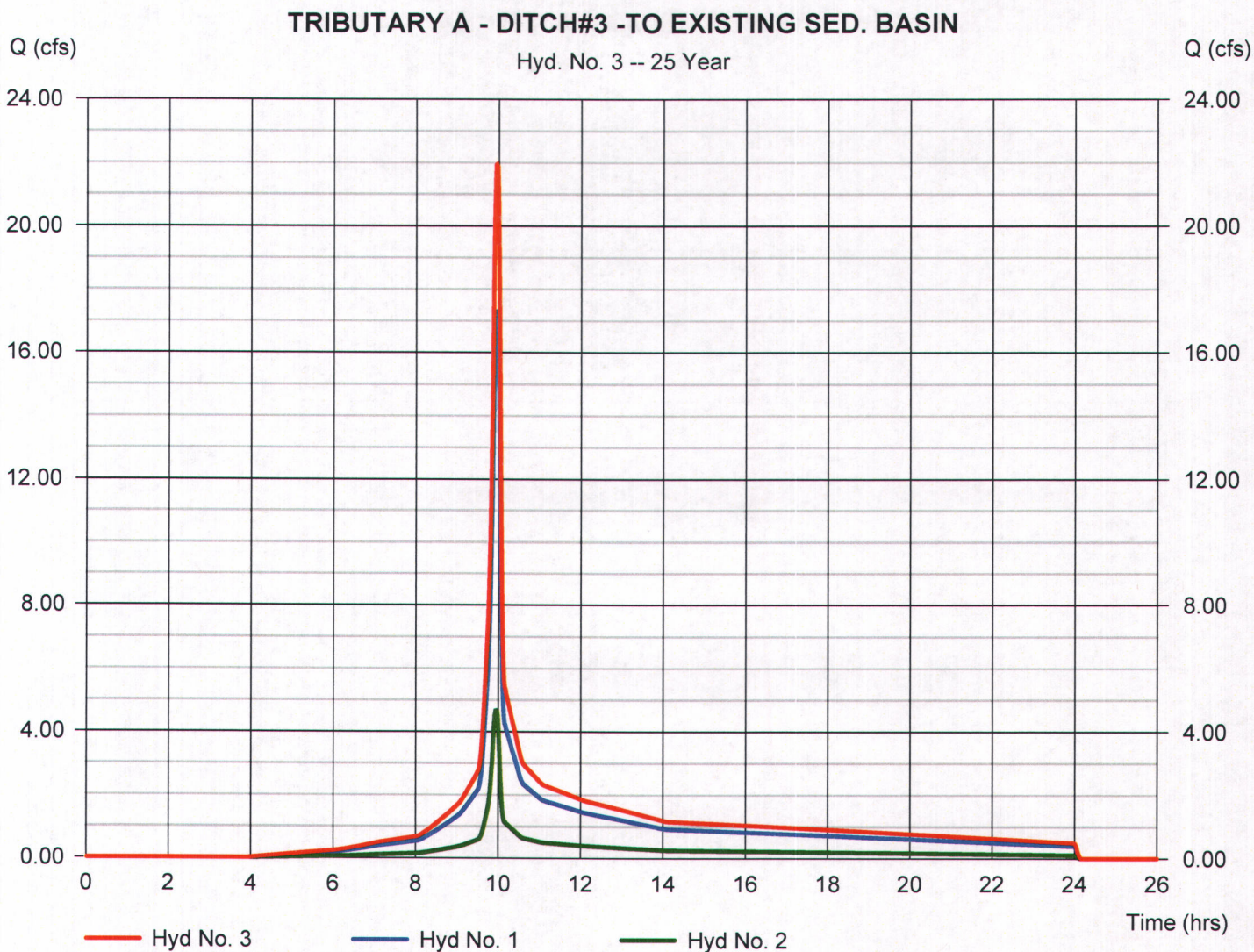
Tuesday, 07 / 26 / 2016

Hyd. No. 3

TRIBUTARY A - DITCH#3 -TO EXISTING SED. BASIN

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 1, 2

Peak discharge = 21.94 cfs
Time to peak = 9.95 hrs
Hyd. volume = 95,808 cuft
Contrib. drain. area = 11.300 ac



Hydrograph Report

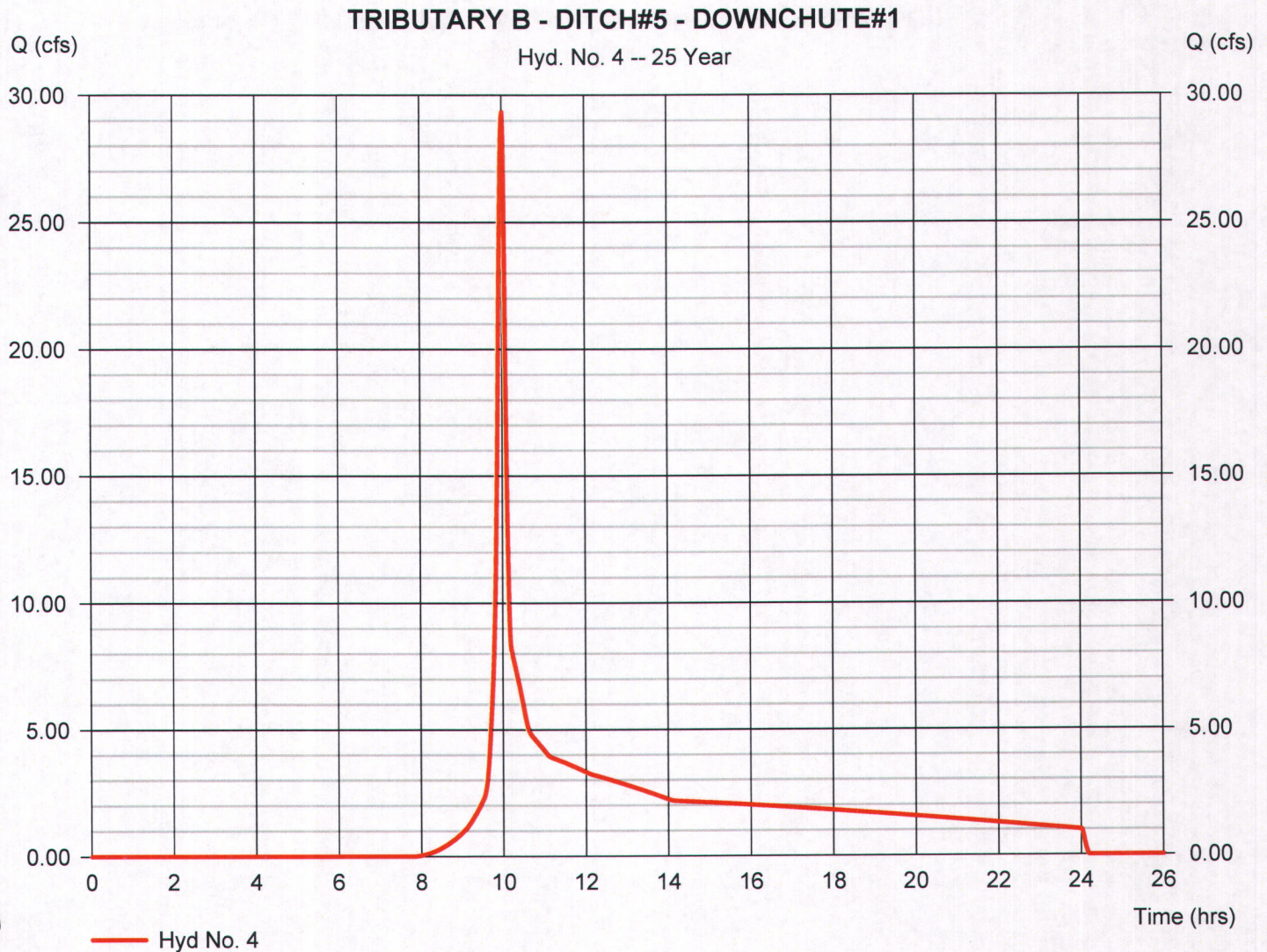
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Tuesday, 07 / 26 / 2016

Hyd. No. 4

TRIBUTARY B - DITCH#5 - DOWNCHUTE#1

Hydrograph type	= SCS Runoff	Peak discharge	= 29.33 cfs
Storm frequency	= 25 yrs	Time to peak	= 9.98 hrs
Time interval	= 1 min	Hyd. volume	= 144,636 cuft
Drainage area	= 31.600 ac	Curve number	= 76
Basin Slope	= 5.2 %	Hydraulic length	= 1465 ft
Tc method	= KIRPICH	Time of conc. (Tc)	= 6.67 min
Total precip.	= 3.40 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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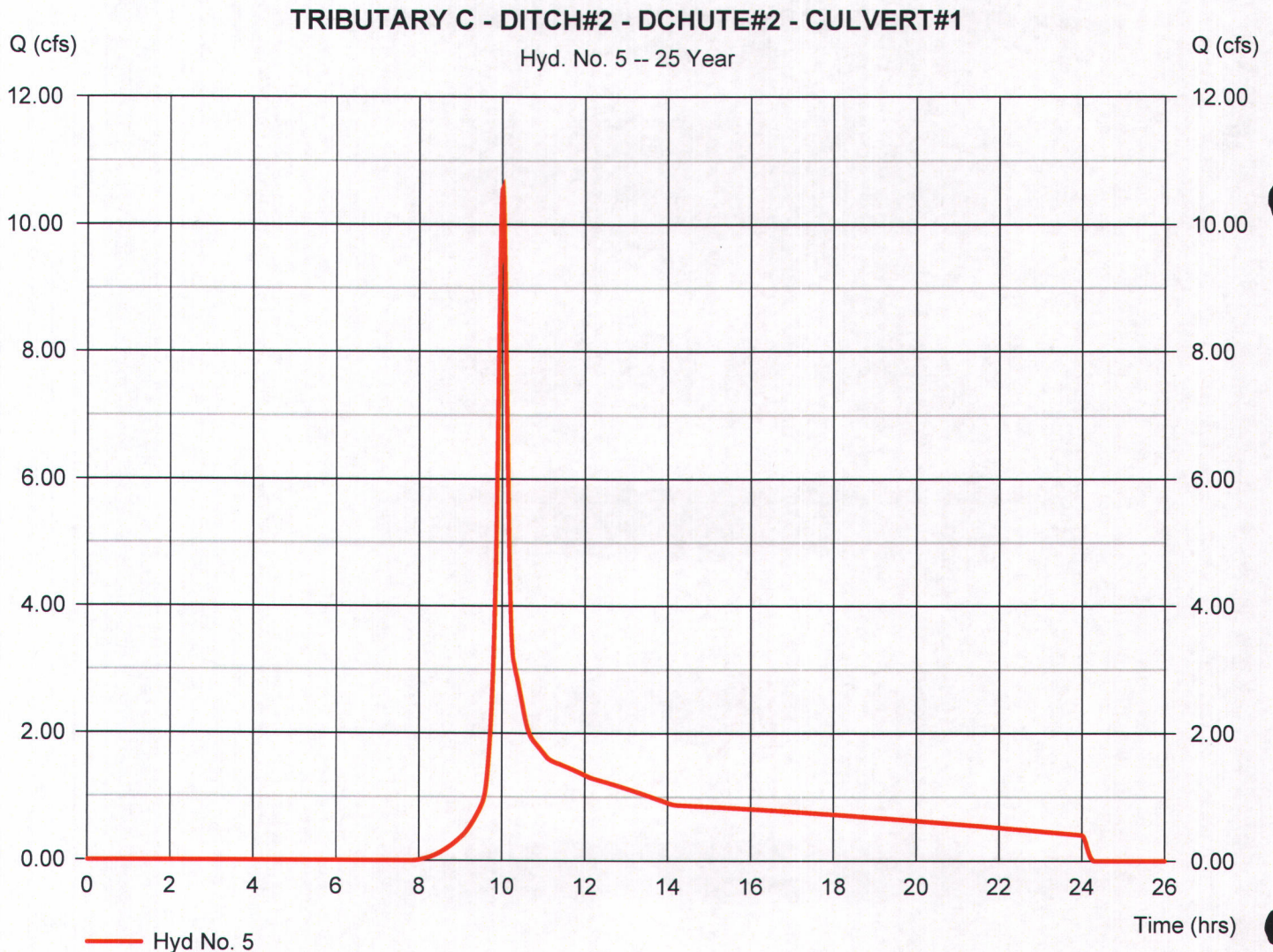
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Tuesday, 07 / 26 / 2016

Hyd. No. 5

TRIBUTARY C - DITCH#2 - DCHUTE#2 - CULVERT#1

Hydrograph type	= SCS Runoff	Peak discharge	= 10.57 cfs
Storm frequency	= 25 yrs	Time to peak	= 10.02 hrs
Time interval	= 1 min	Hyd. volume	= 58,295 cuft
Drainage area	= 12.200 ac	Curve number	= 76
Basin Slope	= 1.5 %	Hydraulic length	= 1455 ft
Tc method	= KIRPICH	Time of conc. (Tc)	= 10.71 min
Total precip.	= 3.40 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

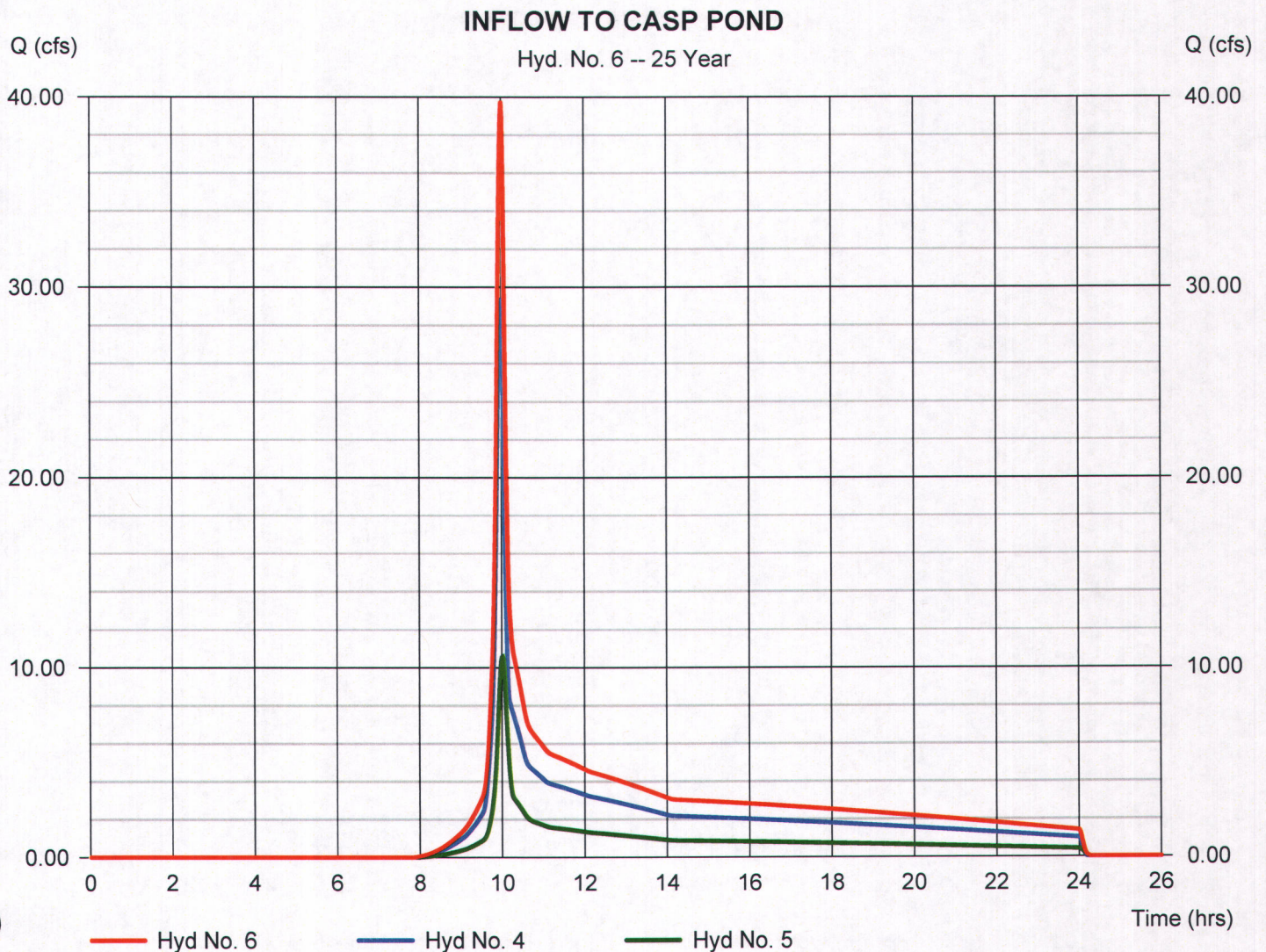
Tuesday, 07 / 26 / 2016

Hyd. No. 6

INFLOW TO CASP POND

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 4, 5

Peak discharge = 39.71 cfs
Time to peak = 9.98 hrs
Hyd. volume = 202,931 cuft
Contrib. drain. area = 43.800 ac



Hydrograph Report

8

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

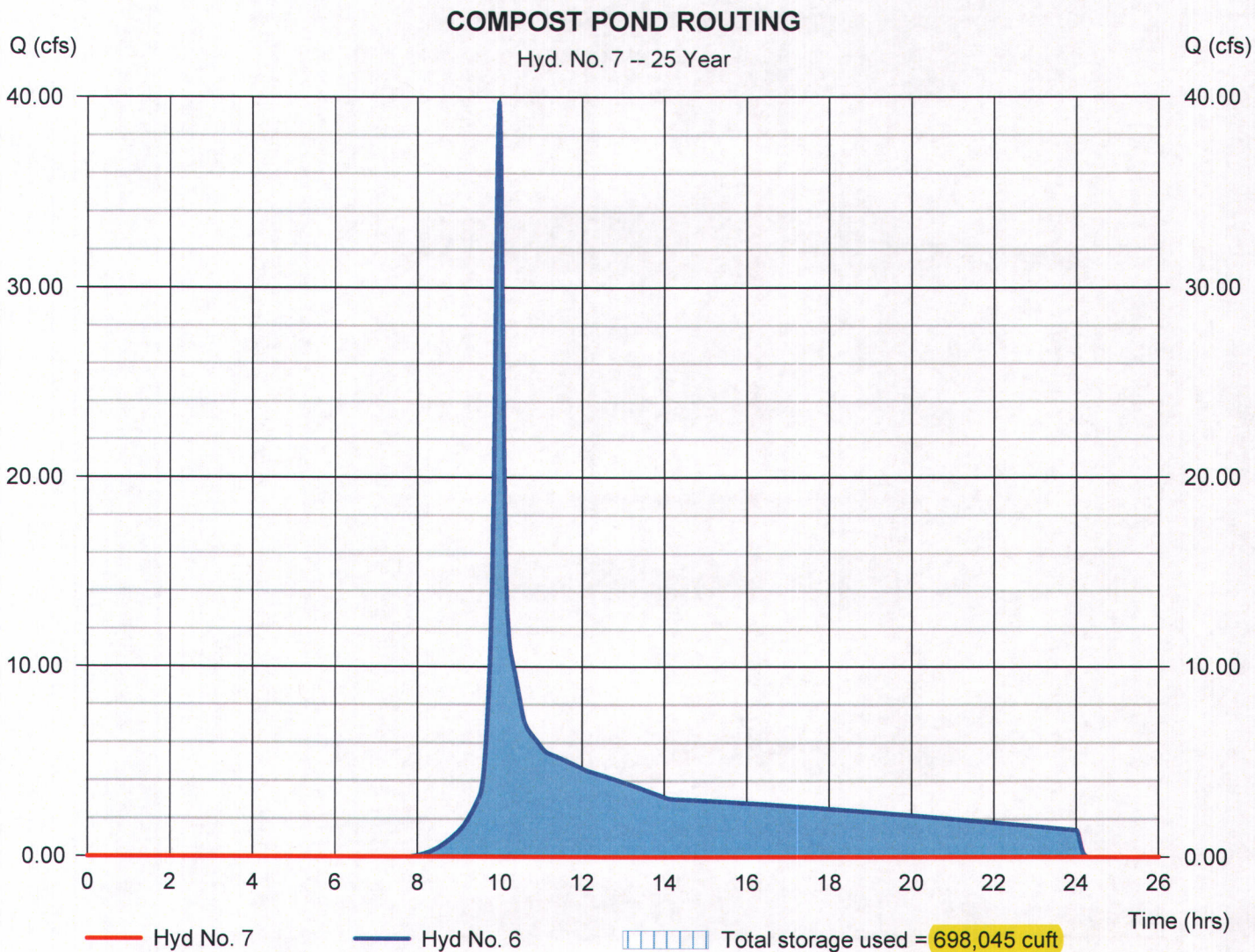
Tuesday, 07 / 26 / 2016

Hyd. No. 7

COMPOST POND ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 6 - INFLOW TO CASP POND	Max. Elevation	= 932.83 ft
Reservoir name	= COMPOST POND	Max. Storage	= 698,045 cuft

Storage Indication method used. Wet pond routing start elevation = 930.60 ft.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

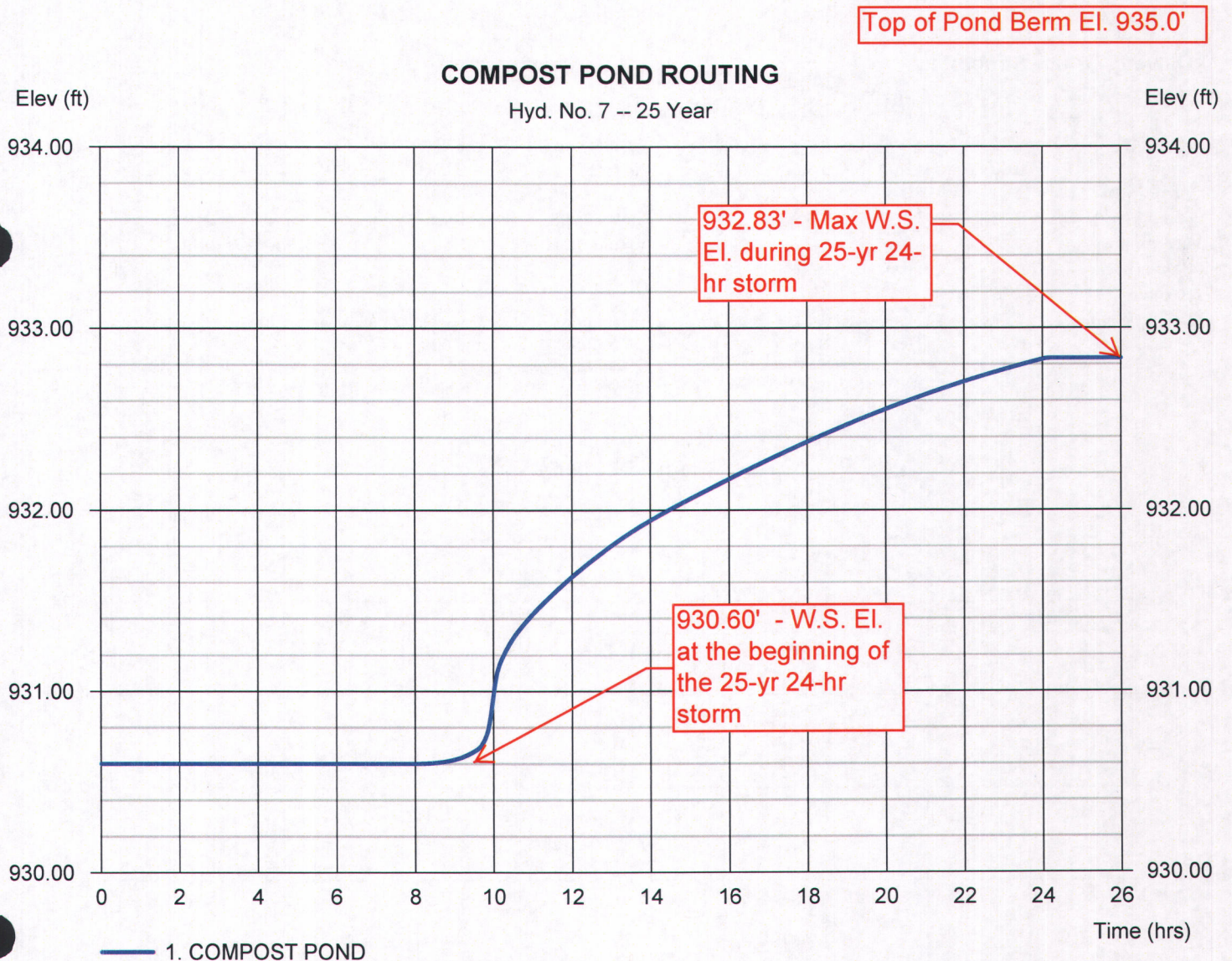
Tuesday, 07 / 26 / 2016

Hyd. No. 7

COMPOST POND ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 6 - INFLOW TO CASP POND	Max. Elevation	= 932.83 ft
Reservoir name	= COMPOST POND	Max. Storage	= 698,045 cuft

Storage Indication method used. Wet pond routing start elevation = 930.60 ft.



Pond Report

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Tuesday, 07 / 26 / 2016

Pond No. 1 - COMPOST POND

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 920.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	920.00	1,440	0	0
1.00	921.00	9,643	4,936	4,936
2.00	922.00	18,445	13,807	18,743
3.00	923.00	27,936	23,025	41,767
4.00	924.00	37,928	32,802	74,569
5.00	925.00	47,866	42,796	117,366
6.00	926.00	54,927	51,351	168,716
7.00	927.00	61,652	58,251	226,968
8.00	928.00	68,637	65,107	292,075
9.00	929.00	75,883	72,223	364,297
10.00	930.00	83,161	79,486	443,783
11.00	931.00	87,979	85,550	529,333
12.00	932.00	92,329	90,136	619,470
13.00	933.00	96,716	94,505	713,974
14.00	934.00	101,142	98,911	812,885
15.00	935.00	105,607	103,356	916,241

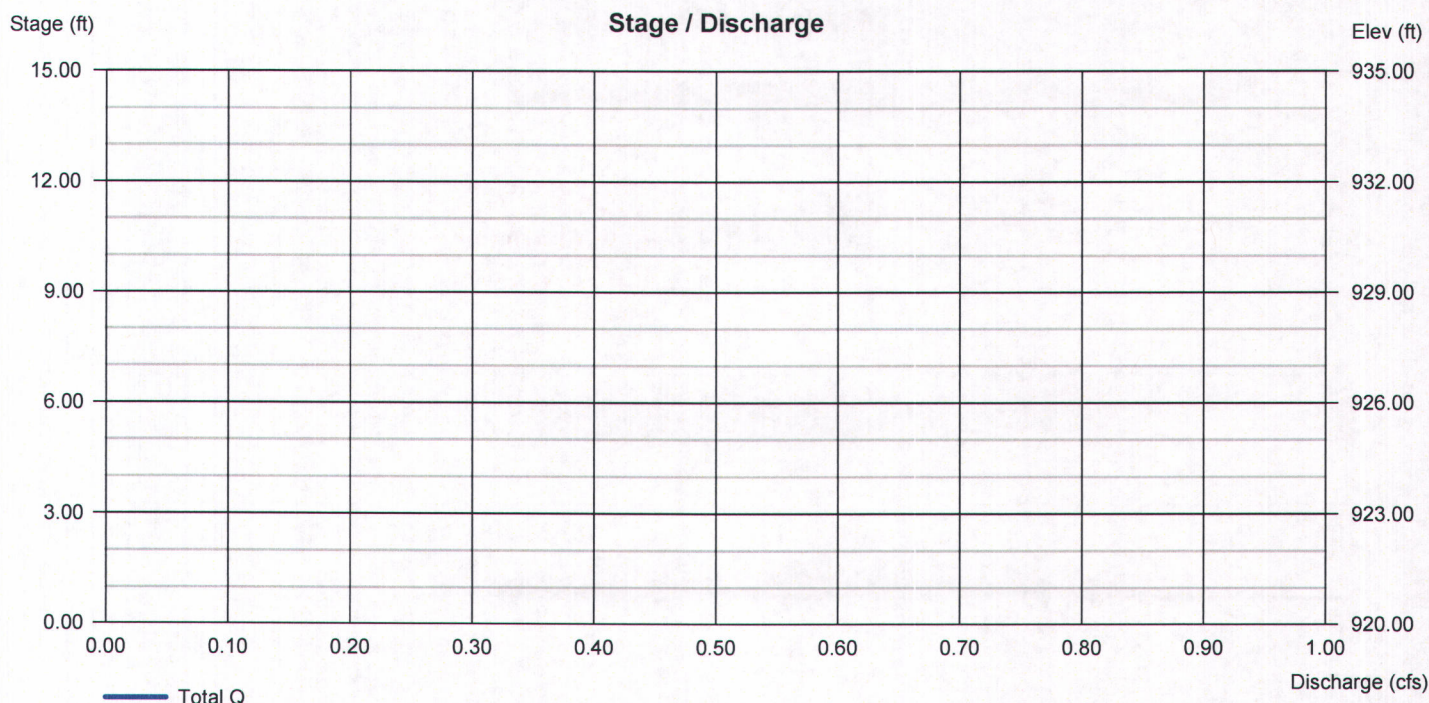
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRs]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 500.00	0.00	0.00	0.00
Crest El. (ft)	= 935.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



DRAINAGE CONVEYANCE SIZING
CALCULATIONS

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 26 2016

DRAINAGE DITCH #1

Triangular

Side Slopes (z:1) = 2.00, 2.00

Total Depth (ft) = 1.50

Invert Elev (ft) = 1070.00

Slope (%) = 10.00

N-Value = 0.025

Calculations

Compute by: Known Q

Known Q (cfs) = 17.28

Highlighted

Depth (ft) = 0.92

Q (cfs) = 17.28

Area (sqft) = 1.69

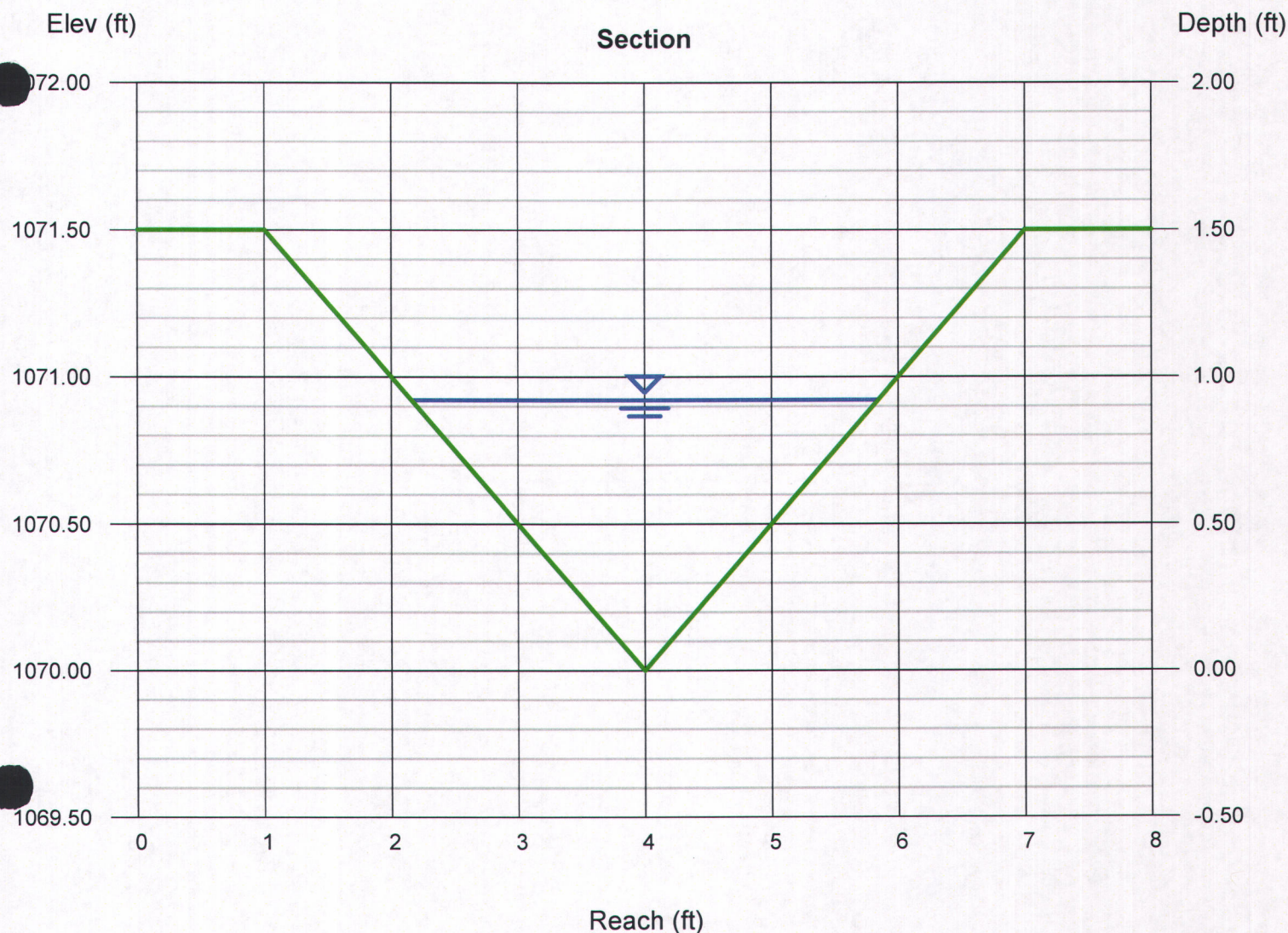
Velocity (ft/s) = 10.21

Wetted Perim (ft) = 4.11

Crit Depth, Yc (ft) = 1.36

Top Width (ft) = 3.68

EGL (ft) = 2.54



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

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DRAINAGE DITCH #2

Triangular

Side Slopes (z:1) = 2.00, 2.00
Total Depth (ft) = 1.50

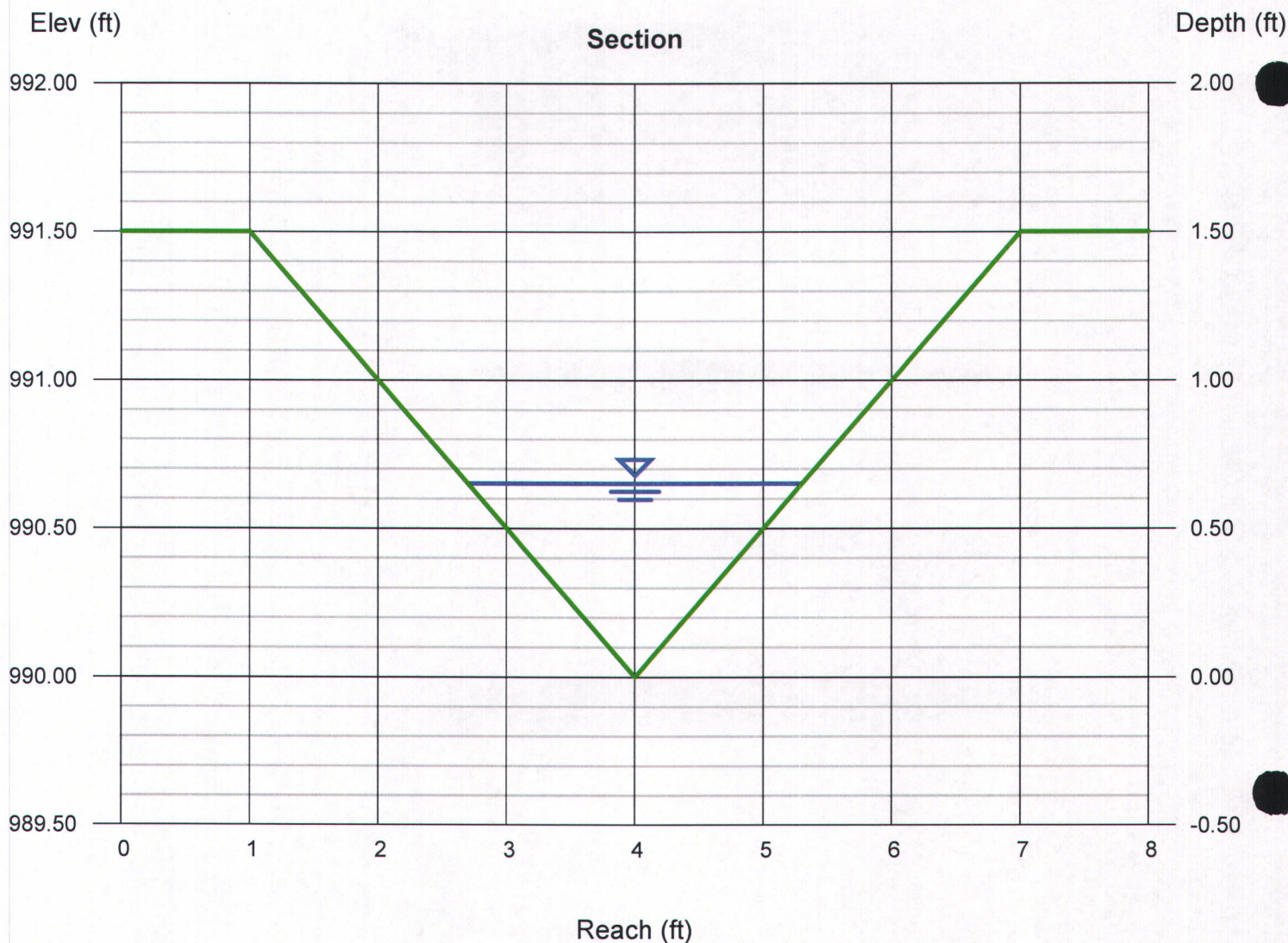
Invert Elev (ft) = 990.00
Slope (%) = 4.80
N-Value = 0.025

Calculations

Compute by: Known Q
Known Q (cfs) = 4.66

Highlighted

Depth (ft) = 0.65
Q (cfs) = 4.660
Area (sqft) = 0.84
Velocity (ft/s) = 5.51
Wetted Perim (ft) = 2.91
Crit Depth, Yc (ft) = 0.81
Top Width (ft) = 2.60
EGL (ft) = 1.12



Channel Report

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DRAINAGE DITCH #3

Triangular

Side Slopes (z:1) = 2.00, 2.00

Total Depth (ft) = 1.75

Invert Elev (ft) = 910.00

Slope (%) = 6.90

N-Value = 0.025

Calculations

Compute by: Known Q

Known Q (cfs) = 21.94

Highlighted

Depth (ft) = 1.08

Q (cfs) = 21.94

Area (sqft) = 2.33

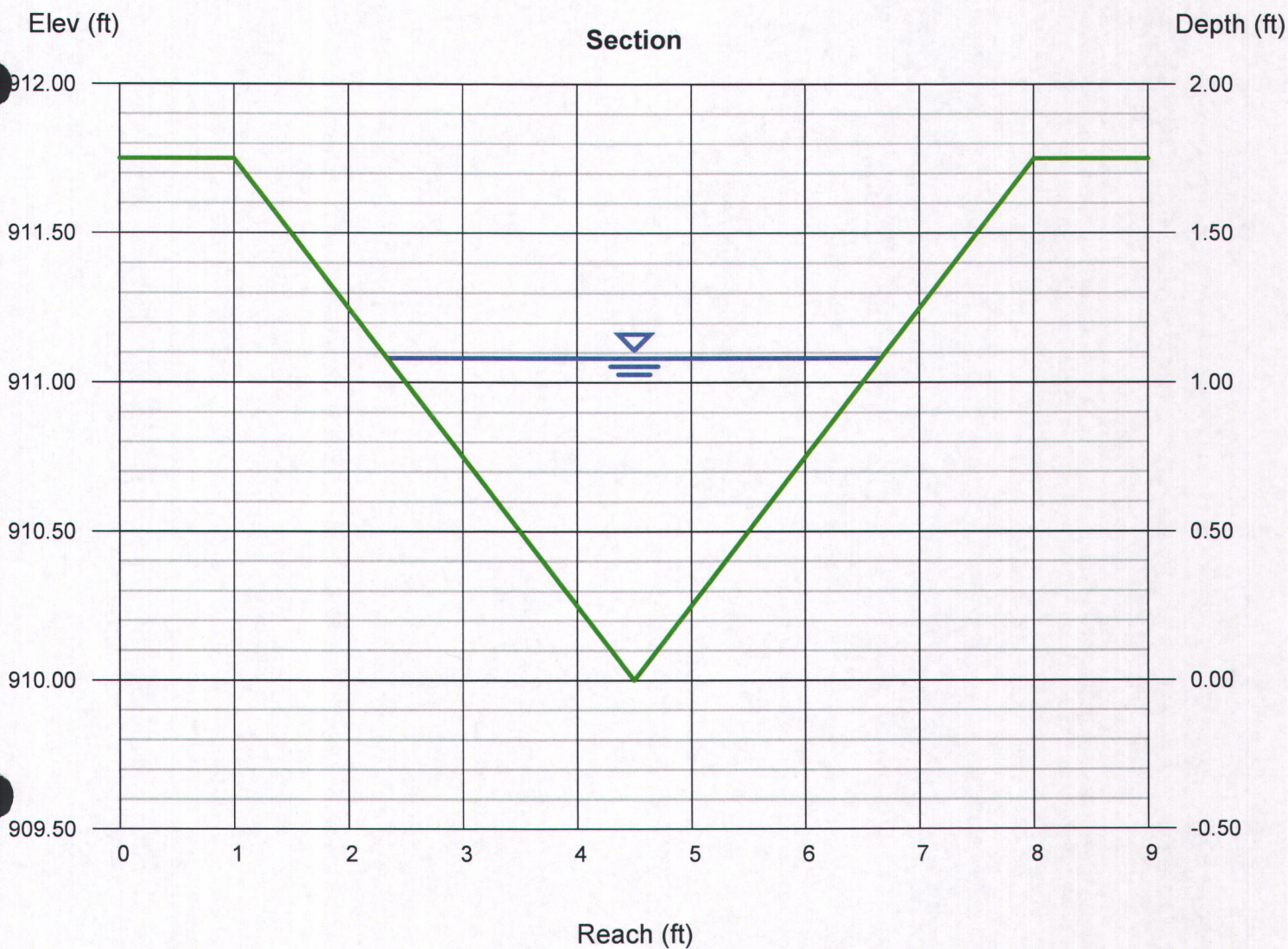
Velocity (ft/s) = 9.41

Wetted Perim (ft) = 4.83

Crit Depth, Y_c (ft) = 1.50

Top Width (ft) = 4.32

EGL (ft) = 2.46



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 26 2016

DRAINAGE DITCH #4

Triangular

Side Slopes (z:1) = 2.00, 2.00
Total Depth (ft) = 1.75

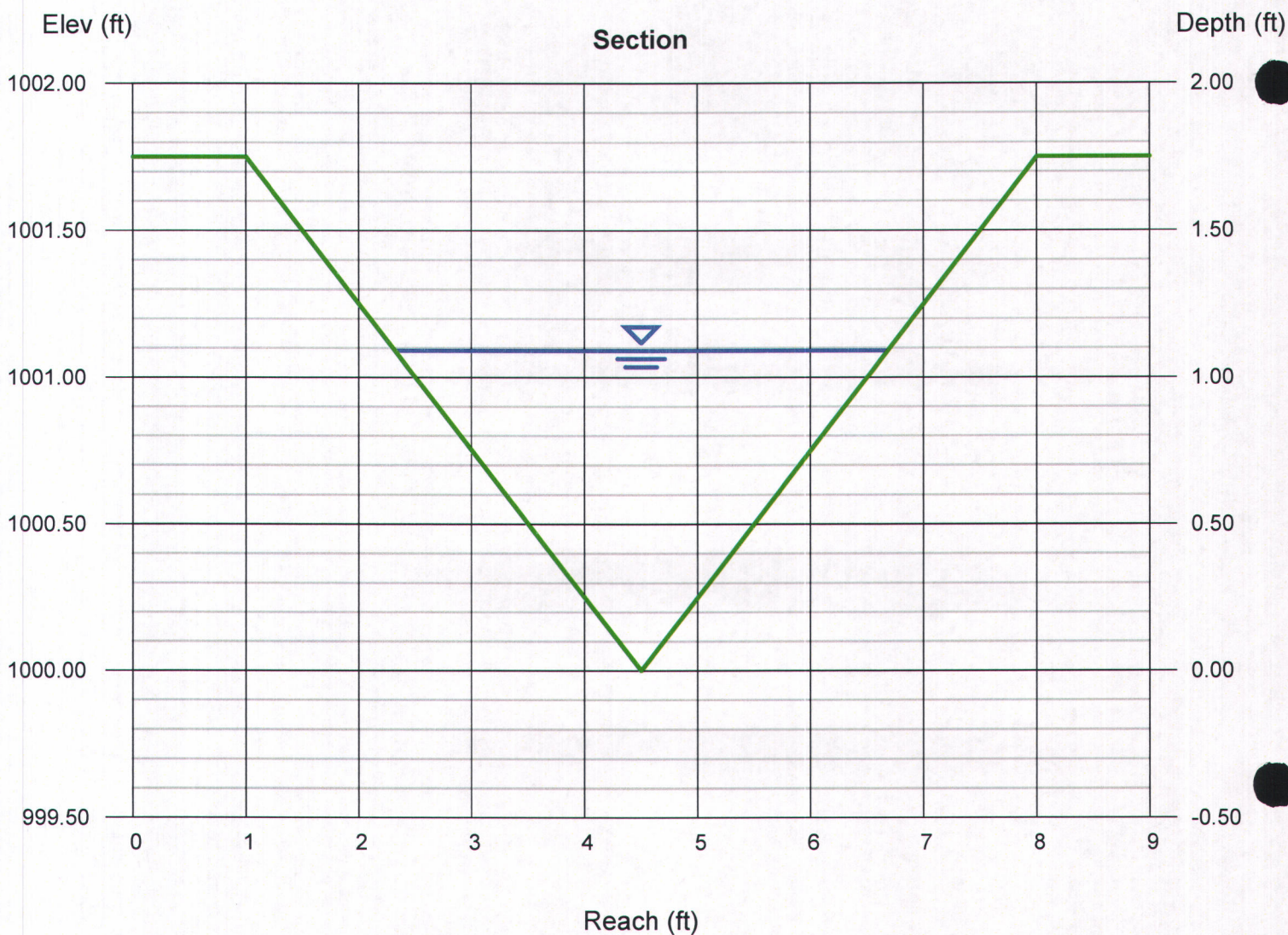
Invert Elev (ft) = 1000.00
Slope (%) = 1.50
N-Value = 0.025

Calculations

Compute by: Known Q
Known Q (cfs) = 10.57

Highlighted

Depth (ft) = 1.09
Q (cfs) = 10.57
Area (sqft) = 2.38
Velocity (ft/s) = 4.45
Wetted Perim (ft) = 4.87
Crit Depth, Yc (ft) = 1.12
Top Width (ft) = 4.36
EGL (ft) = 1.40



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 26 2016

DRAINAGE DITCH #5

Triangular

Side Slopes (z:1) = 5.00, 5.00

Total Depth (ft) = 1.50

Invert Elev (ft) = 1000.00

Slope (%) = 5.20

N-Value = 0.025

Calculations

Compute by: Known Q

Known Q (cfs) = 29.33

Highlighted

Depth (ft) = 0.88

Q (cfs) = 29.33

Area (sqft) = 3.87

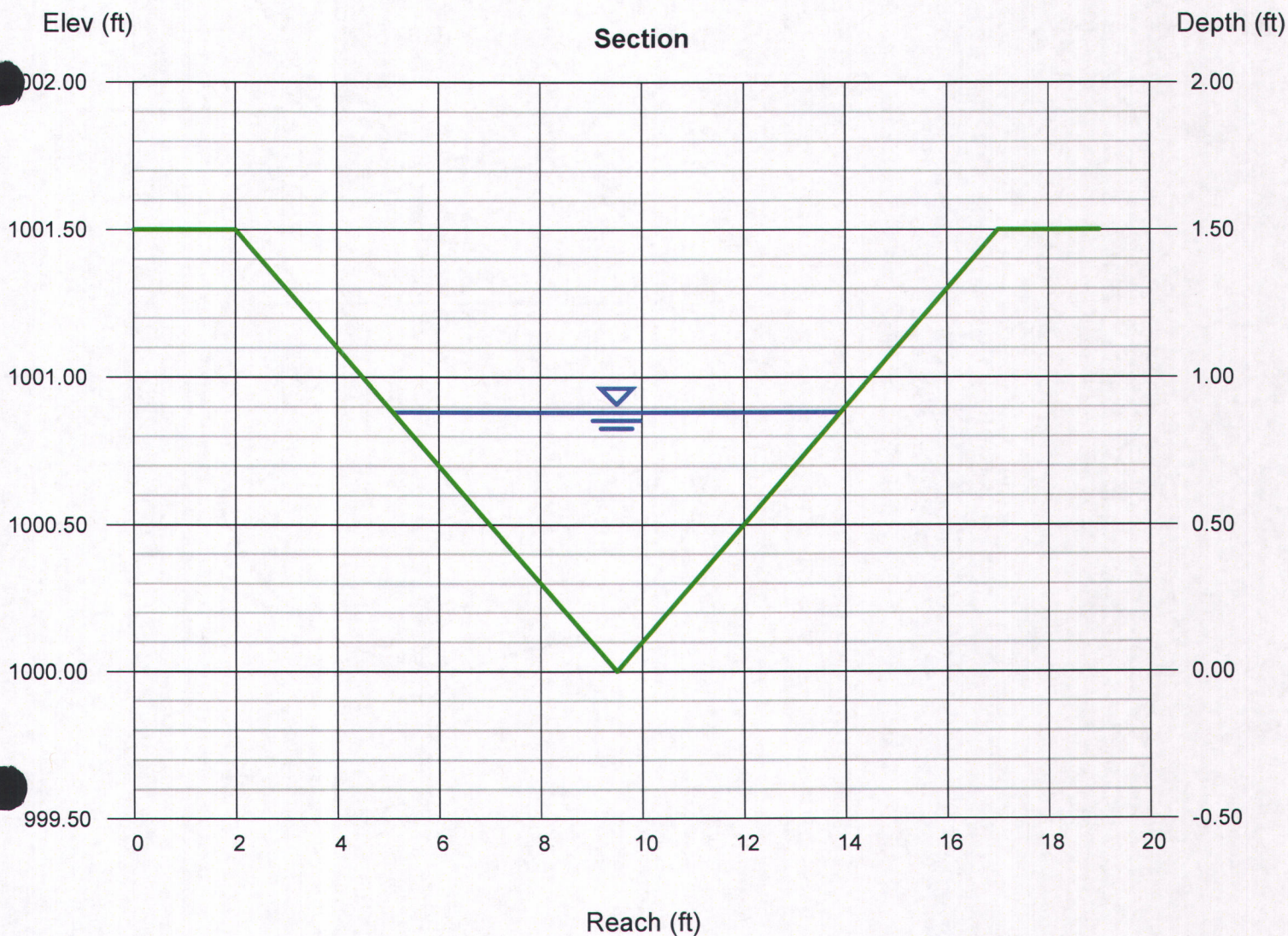
Velocity (ft/s) = 7.57

Wetted Perim (ft) = 8.97

Crit Depth, Y_c (ft) = 1.17

Top Width (ft) = 8.80

EGL (ft) = 1.77



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 26 2016

DOWNCHUTE#1

Circular

Diameter (ft) = 1.75

Invert Elev (ft) = 990.00

Slope (%) = 4.00

N-Value = 0.012

Calculations

Compute by: Known Q

Known Q (cfs) = 29.33

Highlighted

Depth (ft) = 1.25

Q (cfs) = 29.33

Area (sqft) = 1.84

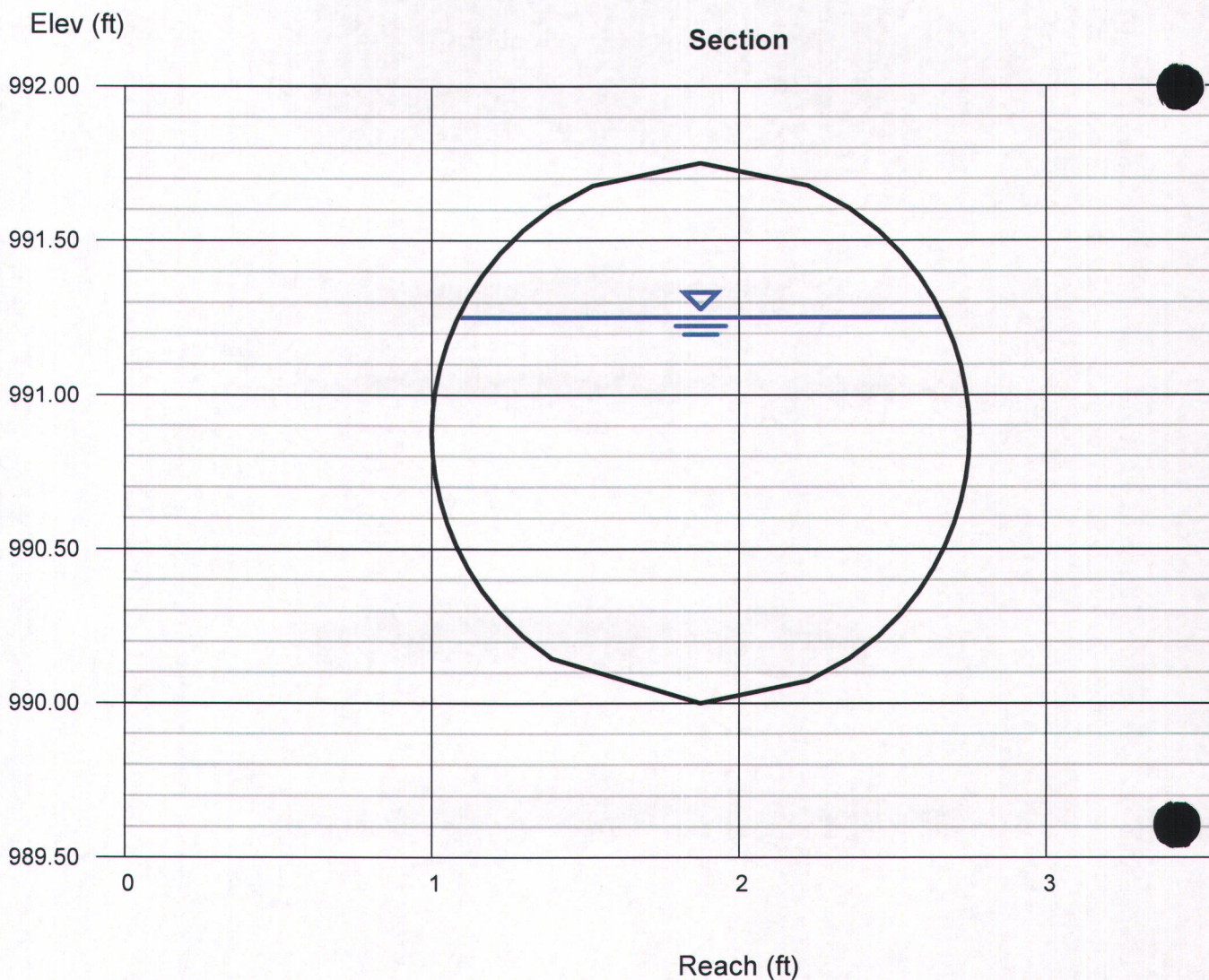
Velocity (ft/s) = 15.94

Wetted Perim (ft) = 3.53

Crit Depth, Yc (ft) = 1.72

Top Width (ft) = 1.58

EGL (ft) = 5.20



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 26 2016

DOWNCHUTE#2

Circular

Diameter (ft) = 1.50

Invert Elev (ft) = 980.00

Slope (%) = 4.00

N-Value = 0.012

Calculations

Compute by: Known Q

Known Q (cfs) = 10.57

Highlighted

Depth (ft) = 0.72

Q (cfs) = 10.57

Area (sqft) = 0.84

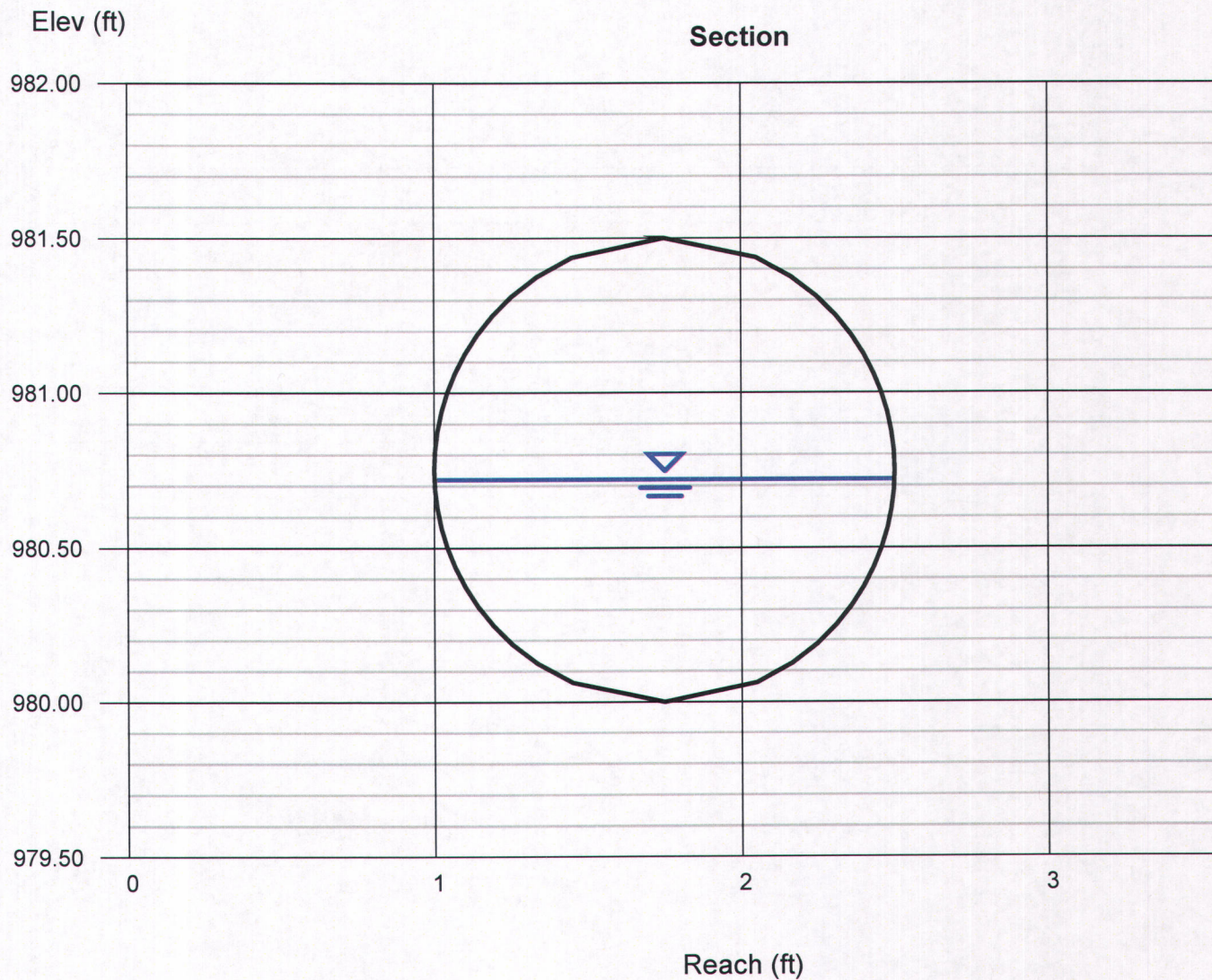
Velocity (ft/s) = 12.53

Wetted Perim (ft) = 2.30

Crit Depth, Y_c (ft) = 1.25

Top Width (ft) = 1.50

EGL (ft) = 3.16



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Jul 26 2016

CULVERT #1

Invert Elev Dn (ft) = 925.00
Pipe Length (ft) = 70.00
Slope (%) = 3.00
Invert Elev Up (ft) = 927.10
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.018
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Headwall
Coeff. K,M,c,Y,k = 0.0078, 2, 0.0379, 0.69, 0.5

Embankment

Top Elevation (ft) = 930.00
Top Width (ft) = 50.00
Crest Width (ft) = 100.00

Calculations

Qmin (cfs) = 10.57
Qmax (cfs) = 10.57
Tailwater Elev (ft) = (dc+D)/2

Highlighted

Qtotal (cfs) = 10.57
Qpipe (cfs) = 10.57
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 3.97
Veloc Up (ft/s) = 5.57
HGL Dn (ft) = 926.58
HGL Up (ft) = 928.26
Hw Elev (ft) = 928.80
Hw/D (ft) = 0.85
Flow Regime = Inlet Control

