Stormwater Division

MEMORANDUM

DATE: July 23, 2014
TO: Michael J. Gillis, Virginia Correctional Enterprises Document Management Services
FROM: Jacob Smith, Stormwater Intern
PO: 110426
RE: Files Approved for Scanning

NAME PDF/SCANNED FILE:	BUSCH GARDENS 2012 EXPANSION FOREBAY		
BMP ID OR GEN FILE NUMBER:	JR071	**OWNER NAME:**	BUSCH PROPERTIES (INCLUDES KINGSMILL)
PIN:	5140100009	**SITE ADDRESS:**	7851 POCAHONTAS TRAIL
		LEGAL DESCRIPTION:	N/A

MAINTENANCE AGREEMENT IN FILE:	N/A	**BOOK/PAGE OR DOCUMENT NO.:**	N/A	**OTHER DESCRIPTION:**	N/A

BOX NO.:	1	**COMMENTS:**	TRANSMITTAL

TRANSMITTAL SHEET

ENGINEERING & RESOURCE PROTECTION → STORMWATER

Project: **Busch Gardens 2012 Expansion**

County Plan No.: **SP-21-13 and SP-14-11**

Assigned BMP No: **JR071**

BMP Type: **Four Bay**

Information Enclosed:

X Computations

X Other: Camera inspection results

Name: **Greg Johnson**

Date: **03/14/2014**

Signature:

7851 Pocahontas Trail
Wmbg 23185
5140100009
Zoned M1

James City County Environmental Division Stormwater Management/BMP Record Drawing and Construction Certification Review Tracking Form

Project Name: Busch Gardens 2012 Expansion
County Plan No.: ~~SP-44-01~~ SP-21-13; SP-14-71 (VERBOTEN)
Stormwater Management Facility: Storm Pipe
BMP Phase #: ☐ I ☐ II ☒ III
☒ Information Package Received. Date/By: NOV 19, 2013
☒ Completeness Check:
- ☒ Record Drawing Date/By: NOT REQUIRED - Pipes Camered
- ☒ Construction Certification Date/By: NOT REQUIRED - Pipes Camered
- ☒ RD/CC Standard Forms (Required for all BMPs after Feb 1st 2001Only)
- ☒ Insp/Maint Agreement # / Date:
- ☒ BMP Maintenance Plan Location: NA
- ☐ Other:

☐ Standard E&SC Note on Approved Plan Requiring RD/CC or County comment in plan review
- ☐ Yes ☐ No Location:

☒ Assign **County BMP ID Code #**: Code: ~~[illegible]~~ JR071
☒ Preliminary Input/Log into Division's "As-Built Tracking Log"
☒ Add Location to GIS Map. Obtain basic site information (GPIN, Owner, Address, etc.)
☒ Preliminary Log into Access Database (BMP ID #, Plan No., GPIN, Project Name, etc.)
☒ Active Project File Review (correspondence, H&H, design computations, etc.).
☒ Initial As-Built File setup (File label, folder, copy plan/details/design information, etc.).
☐ Inspector Check of RD/CC (forward to Inspector using transmittal for cursory review).
☒ Pre-Inspection Drawing Review of Approved Plan (Quick look prior to Field Inspection).
☒ Final Inspection (FI) Performed Date: 1/13/2014
☒ Record Drawing (RD) Review Date: 1/13/2014 - NA
☒ Construction Certification (CC) Review Date: 1/13/2014 - NA
☒ Actions:
- ☒ No comments.
- ☐ Comments. Letter Forwarded. Date:
- ☐ Record Drawing (RD)
- ☐ Construction Certification (CC)
- ☐ Construction-Related (CR)
- ☐ Site Issues (SI)
- ☐ Other :

☒ Second Submission:
☒ Reinspection (if necessary):
☒ Acceptable for SWM Purposes (RD/CC/CR/Other). Ok to proceed with bond release.
☒ Complete "Surety Request Form".
☒ Check/Clean active file of any remaining material and finish "As-Built" file.
☒ Add to County BMP Inventory/Inspection schedule (Phase I, II or III).
☒ Copy Final Inspection Report into County BMP Inspection Program file.
☒ Obtain Digital Photographs of BMP and save into County BMP Inventory.
☒ Request mylar/reproducible from As-Built plan preparer.
☐ Complete "As-built Tracking Log".
☒ Last check of BMP Access Database (County BMP Inventory).
☒ Add BMP to JCC Hydrology & Hydraulic database (optional).
☒ Add BMP to Municipal BMP list (if a County-owned facility)
☒ Add BMP to PRIDE BMP ratings database.

Note: SJT felt this stormsystem and forebay were of such significance, it should be assigned a County BMP ID # for long-term tracking + inspection.
JR071

Final Sign-Off

Inspector: [signature] Date: 1/21/2014
Chief Engineer: [signature] Date: 03/10/14

*** See separate checklist, if needed.

TRANSMITTAL

Environmental Division

MAR 19 2013

RECEIVED

DATE: March 19, 2013

TO: Environmental (1)
JCSA
Landscape Planner
Fire

FROM: Leanne Reidenbach, Senior Planner

SUBJECT: **SP-0021-2013, Busch Gardens Oktoberfest Attraction Expansion SP Amend.**

Amends SP-14-11

ITEMS ATTACHED: Site plan
Supporting engineering calculations (1)

ACTION: Please review and return comments by **April 2, 2013.**

NOTES: **Subject to conditions associated with SUP-0028-2010/HW-0004-2010. Amends SP-0014-2011.**

Plan amendment is approved by the Engineering and Resource Protection Division. Work under this amendment is covered under Existing Land-Disturbing Permit #11-49 as issued under approved County Plan No. SP-14-11. The provisions of approved Chesapeake Bay Exception CBE-11-078 apply to the amended plan.

04-08-13

TRANSMITTAL

DATE: May 5, 2011

TO: Environmental

FROM: Leanne Reidenbach, Senior Planner

SUBJECT: **SP-0014-2011, Busch Gardens 2012 Oktoberfest Attraction (resubmittal)**

ITEMS ATTACHED: Site plan
Comment response letter

ACTION: Please review and return comments by **May 19, 2011**.

NOTES: **Subject to conditions associated with SUP-0028-2010/HW-0004-2010.**

Plan is approved by the Environmental Division. A Land-Disturbing Permit and Siltation Agreement with surety is required for this project. Stormwater facility inspection fees and an Inspection/Maintenance Agreement is required for this project. The provisions of approved Chesapeake Bay Exception CBE-11-078 and steep slope waiver CBS-11-021 apply to this project. Registration for a state VSMP general permit for construction activities is required through the Virginia DCR.

05-05-11

Environmental Division

RECEIVED

4.93 acres disturbed
JR watershed
HUC code JL35

WAC/ZML

ENVIRONMENTAL DIVISION REVIEW COMMENTS
Busch Gardens 2012 Oktoberfest Attraction
COUNTY PLAN # SP-014-11
March 4, 2011

General:

1. A Land-Disturbing Permit and Siltation Agreement, with surety, are required for this project.

2. A Standard Inspection / Maintenance agreement is required to be executed with the County due to the proposed stormwater conveyance systems and Stormwater Management/BMP facilities associated with this project.

3. Record Drawing and Construction Certification. The stormwater management/BMP facility and associated stormwater conveyance systems as proposed for this project will require submission, review, and approval of a record drawing (as-built) and construction certification prior to release of the posted bond/surety. Provide notes on the plan accordingly to ensure this activity is adequately coordinated and performed before, during and following construction in accordance with current County guidelines.

4. Wetlands. Provide evidence that any necessary wetlands permits have been obtained, have not expired, or are not necessary for this project. Refer to Chapter 23 Chesapeake Bay Preservation ordinance, Section 23-9(b) (9) and 23-10(7) (d). *(Note: This includes securing necessary wetland permits through the U.S. Army Corps of Engineers Norfolk District and under the Virginia Department of Environmental Quality non-tidal wetlands programs, which became effective October 1st 2001.)*

5. VSMP. It appears disturbed area for the site exceeds 2,500 square feet. Therefore, it is the owner's responsibility to register for coverage under the General Permit for Discharge of Stormwater from Construction Activities, in accordance with current requirements of the Virginia Department of Conservation and Recreation and the Virginia Stormwater Management Program. Visit http://www.dcr.virginia.gov/sw/vsmp.htm or contact the DCR Central Office at 804-371-7330 for additional information. *(Note: Evidence of VSMP registration will be required by the County prior to or concurrently with a preconstruction meeting and must be provided prior to issuance of a local land-disturbing permit and start of land-disturbing activities.)*

6. Plan Number. Please reference the assigned County plan number SP-014-11 on all subsequent submissions.

7. Retaining Walls. Be advised that all retaining walls 2' and taller must be cleared through the James City County Codes Compliance Division. Please provide a note indicating this requirement on the cover sheet of the application.

Supporting Engineering Documents

Oktoberfest Attraction Expansion

Williamsburg, Virginia

Prepared for

SeaWorld Parks & Entertainment LLC
d/b/a Busch Gardens Williamsburg
Represented by: Mr. Larry Giles
7851 Pocahontas Trial
Williamsburg, VA 23185
Phone # 757.253.3426

Prepared by

Piotr Swietuchowski/Vanasse Hangen Brustlin, Inc.
Transportation, Land Development, Environmental Services
351 McLaws Circle, Suite 3
Williamsburg, VA 23185-6316
Phone # 757.220.0500

Environmental Division
MAR 24 2011
RECEIVED

COMMONWEALTH OF VIRGINIA
PIOTR SWIETUCHOWSKI
Lic. No. 044606
03/23/11
PROFESSIONAL ENGINEER

03/09/2011

JCC Case No. SP-0014-2011

TABLE OF CONTENTS

TABLE OF CONTENTS i

PROJECT NARRATIVE 1

EROSION AND SEDIMENT CONTROL AND STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST 11

STEEP SLOPES WAIVER REQUEST 27

DRAINAGE AREA CALCULATIONS 29

RHINE RIVER BMP CALCULATIONS 34

SEDIMENT TRAP #1 SIZING CALCULATIONS 42

SEDIMENT TRAP #2 SIZING CALCULATIONS 48

TEMPORARY SLOPE DRAIN SIZING CALCULATIONS 55

SEDIMENT FOREBAY WATER QUALITY CALCULATIONS 58

SEDIMENT FOREBAY OUTFALL CALCULATIONS 64

STORM SEWER CALCULATIONS 10-YEAR STORM EVENT 70

STORM SEWER CALCULATIONS 100-YEAR STORM EVENT 109

INLET SPREAD CALCULATIONS 148

CULVERT CALCULATIONS 158

GRASS SWALES CALCULATIONS 161

OUTLET PROTECTION CALCULATIONS 191

HYDRANT FLOW TEST REPORT 193

DRAINAGE AREA MAPS 195

PROJECT NARRATIVE

Oktoberfest Attraction Expansion

Project Narrative

Project Description:

The purpose of this project is the new family thrill ride attraction to replace the removed Big Bad Wolf coaster and a new amphitheatre at the former Drachen Fire site. The major focus of this project is an installation of the new ride along with the construction of a building with a footprint area of approximately 22,515 square feet for the indoor part of the ride and grading for outdoor amphitheatre. In addition, a renovation of the Big Bad Wolf existing station and gift shop is proposed as a part of this project.
Design issues include ADA compliance, utility conflicts, stormwater management, erosion and sediment control and water quality impact assessment.
The site is located in Oktoberfest to the South-East form the existing Bumper Carts Ride.

Existing Site Conditions:

The site is approximately 9.29 acres in size and approximately 4.93 Ac of the site will be disturbed as a part of this project. The site has been previously developed as a part of the Busch Gardens Oktoberfest expansion for the Big Bad Wolf and Drachen Fire rides. The proposed new attraction is located within the Chesapeake Bay Preservation Area (CBPA) as defined in the James City County Chesapeake Bay Preservation Ordinance. The attraction will encroach into the RPA Buffer and Corps of Engineers Jurisdictional Wetlands within the property. The impact to those critical parts of the Chesapeake Bay preservations areas has been minimized by reusing where possible existing footing that previously served the Big Bad Wolf Ride.
The site is located within the drainage waterway/channel of the existing Rhine River BMP. Slopes vary from moderately steep to very steep with elevations ranging from a low of 30.00+ feet to a high of 85.00+ feet. Existing and proposed site elevations, grading and additional details are shown on the attached site plan drawings.

Demolition:

The demolition will include removal of the existing Big Bad Wolf Ride footing that interfere with the proposed buildings, ride and Erosion and Sediment Control measures. The existing waterfall, South from the Italy Bridge will need to be partially demolished to provide room for the proposed maintenance road. "Grass Pavers" will be used to minimize the permanent impact to the RPA buffer and reduce overall impervious surface within the project.

The existing maintenance roads within the RPA buffer will be demolished and replaced with pervious, "Grass Pavers" to reduce impervious area within the RPA buffer.
Existing concrete flumes to the South and East of the Rhine River drainage channel will be demolished and replaced by an underground storm sewer system.
Existing maintenance road between the Bumper Car building and proposed Ride Event Building and to the South and East form the proposed Ride Event Building will be demolished due to extensive grading in that area.
The locker structure, landscape planters and paving will be demolished as a part of new buildings, queue and planters.
Existing storm sewer system will need to be partially demolished on the south side of the proposed building to allow for connection to the storm system.
The storm system on the former Drachen Fire site will be abounded in place and fill with flowable concrete.

Proposed grading and paving:

Extensive grading is proposed within the location of the Ride Event Building, with proposed slopes at 2.0 to 1 and at the former Drachen Fire site. Majority of the cut material from the Ride Event location will be used for grading the outdoor amphitheatre at the former Drachen Fire site with unsuitable material being removed and disposed off site.
Additional grading is anticipated at the location of the proposed and existing maintenance roads for the Ride Event Building, Ride Attraction and queue building.
All grading within the RPA buffer will be limited to the minimum, possible.
It is anticipated that an excess of approximately 2,500 cubic yard of cut will be removed and disposed of offsite.
Additional grading will include a temporary sediment control traps at the bottom of the Rhine River drainage waterway/channel within the RPA buffer buffer and at the former Drachen Fire site.
New paving will be installed at new buildings and planters.
Proposed maintenance roads located on the North side of the queue building and within the RPA buffer will receive "Grass Pavers" to reduce the project impervious area.
Maintenance/drainage road around the Ride Event Building will receive concrete pavement.

Drainage:

The site naturally drains to the existing Rhine River drainage waterway/channel. As the Ride Event Building will be located at the bottom of the drainage waterway the proposed storm system will be installed to collect all runoff from upstream sides of the existing channel.
In addition to the proposed storm system a concrete swale, varying in width from 6 feet to 16 feet, is proposed on the perimeter of the Ride Event Building. The purpose of the

concrete channel is to collect and pond runoff water before it can be collected by the curb inlets installed along the swale as well as to provide fire and maintenance access to the building.
The existing storm system outfall located in the ravine will be connected to the proposed storm system limiting discharge directly on the slope. The discharge point from the storm system will be provided at the bottom of the proposed sediment forebay.
Runoff from the amphitheater site will be collected by grass swales and safely conveyed to proposed storm drain system for the building #80.

Utilities:

To provide fire suppression for the Ride Event Building an 8" DIP water line will be extended from the existing water line located at the South-East side of the Festhause building. The proposed line will also provide additional fire hydrants that will be located on the South and East side of the proposed Ride Event building as well as the fire department connection and post indicator valves. Additional fire hydrant, fire department connection and post indicator valve will be provided for renovated station building.
No additional utility extensions or connections are anticipated as part of this project.

Offsite Disturbed Area:

No offsite disturbance is anticipated with this project.

Soils:

The soils located on site are described and classified in the Soil Survey of James City and York Counties and the City of Williamsburg Virginia (Hodges *et al.*, 1985). Soil mapping units located within the project area are displayed in the plan set. Detailed descriptions of soil mapping units within the RMA impact areas are listed below.

11C - Craven-Uchee complex, 6-10 percent slopes: This complex is found on narrow ridgetops and side slopes, primarily in woodlands. The complex is composed of moderately well-drained Craven and well-drained Uchee soils. The surface layer for this complex is dark, grayish-brown, fine sandy loam and loamy fine sand 4 to 5 inches thick. The subsoil extends to a depth of 42 - 56 inches and is characterized by yellowish-brown clay atop strong brown sandy clay loam. The permeability of this complex is slow within the Craven component, but moderately slow to moderate within the Uchee component. The complex's water capacity is low to moderate and the erosion hazard is moderate. During the winter and early spring, the seasonal high water table for this complex is 2 to 3 feet for the Craven component, and 3 ½ to 5 feet for the Uchee component.

15F - Emporia complex, 25-50 percent slopes; This deep, very steep and well-drained complex formed over layers of fossil shells. It is found on side slopes along rivers, creeks, and drainageways. The surface layer of this complex is dark grayish brown fine sandy loam and about 3 inches thick. The subsurface layer is about 3 inches of pale brown loam. The subsoil reaches a depth of about 45 inches and consists of yellowish brown loam with mostly strong brown mottles on top of yellowish brown firm sandy clay loam and lastly, mottled gray and brown, firm sandy clay loam at the bottom. The moderately well-drained Slagle soils and very poorly drained Johnston soils are included in this complex. Permeability is moderate in the upper part of the subsoil and moderately slow in the lower portion, and surface runoff is very rapid. The erosion hazard for this complex is severe.

37 – Urban Land; This map unit consists of areas where more than 85 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. Examples are parking lots shopping centers, and industrials parks. Slopes range from 0 to 15 percent.
Included in this unit in mapping are areas of undisturbed soils commonly well drained emporia soils, and moderately well drained slagle soils. Also included in this unit are small areas of most soils in the survey area. These soils are between streets and sidewalks, in yards and in traffic islands. These areas generally are less than an acre. They make up about 15 percent of the unit.
Onsite investigation is needed to determine the suitability and limitations of the soils in this unit for any use. The soils in the map unit are not assigned to a capability subclass.

Critical Erosion Areas:

Areas with Craven-Uchee and Emporia Complex soils shall be monitored due to the high erodiability factor. All slopes 3:1 or steeper shall receive EC-2 (Type-1) blanket matting or as otherwise noted on the plans. Contractor shall monitor site condition on daily basis and take all necessary precautions to secure and prevent erosion and sediment disposition.

Erosion and Sediment Control Measures

To secure sediment transport during the construction process a two Sediment Traps at the bottom of the existing ravine and at former Drachen Fire site are proposed as an Erosion and Sediment Control measure. To limit the size of the Sediment Trap a 24" HDPE temporary slope drain will be installed in the upstream portion of the existing slopes around the Ride Event building. The proposed temporary slope drain pipe will connect all of outfalls in the upper portion of the ravine and convey clean water to the

bottom of the ravine, with the discharge point downstream from the proposed Sediment Trap.
On the East side of the ravine a Diversion Dike will be installed along the existing maintenance road with the temporary slope drain at the end of the dike to convey clean water to the bottom of the existing ravine.
Additional erosion and sediment control measures will include: inlet protection for all of the proposed curb and grate inlets, outlet protections at the storm system and temporary pipe outfalls, check dams at the existing concrete and grass swales, tree protection, silt fence and super silt fence along all of the earthwork activities that will not drain into the proposed Sediment Trap, turbidity curtain at the downstream portion of the existing waterway channel.
All slopes 3:1 or steeper will receive the EC-2 and EC-3 erosion blanket matting.

All vegetative and structural erosion and sediment control practices will be constructed and maintained in accordance with the minimum standards and specifications of the Virginia Erosion and Sediment Control Handbook, Third edition dated 1992.

Structural Practices:

1. Temporary Construction Entrance (3.02): Construction entrance will be installed to prevent tracking onto the existing roadway.

2. Silt Fence (3.05): Silt fence and silt fence with wire support shall be installed along the toe of all slopes and all other areas that may carry silt beyond the site. Silt fence shall also be installed on the downhill side of the utility extensions.

3. Storm Drain Inlet Protection (3.07): All existing and proposed inlets shall be protected from sediment prior to permanent stabilization of the disturbed areas.

4. Culvert Inlet Protection (3.08): All existing and proposed culverts inlets shall be protected from sediment prior to permanent stabilization of the disturbed areas.

5. Temporary Diversion Dikes (3.09): Will be utilized to minimize offsite drainage on to exposed areas.

6. Diversion (3.12): A channel constructed across a slope with supporting earthen ridge on the lower side will be utilized to minimize offsite drainage on to exposed area.

7. Temporary Sediment Trap (3.13): A temporary ponding area with stone outlet shall be installed below the disturbed area as shown on the plans to detain sediment-laden runoff and allow for sediment to settle out.

8. Temporary Slope Drain (3.15): A flexible tubing or conduit extended to the edge of water shall be installed to temporarily conduct concentrated stormwater runoff safely down to the bottom of the drainage way.

9. Outlet Protection (3.18): Will be utilized at all outfall points using Class I Riprap.

10. Rock Check Dam (3.20): Install rock check dams in ditches where shown on the plans.

11. Turbidity Curtain (3.27): To provide sedimentation protection of watercourse from up-slope land disturbance a floating geotextile material shall be used as specified on the plans.

12. Permanent Seeding (3.32): Permanent seeding shall be applied to all disturbed areas on the site once final grades have been established.

13. Slope Stabilization Blankets & Matting (3.36): All ditches shall be lined with treatment 1 matting (VDOT EC-2). All slopes steeper than 3:1 shall be treated with treatment 1 matting (VDOT EC-2) or as otherwise noted on the plans.

14. Tree Protection (3.38): Tree protection shall be installed prior to clearing operations.

Management Strategies and Sequence of Construction:

Suggested Sequence of Construction:

1. Notify James City County Environmental Division (JCCED) and Virginia Department of Conservation and Recreation (DCR) minimum 48-hours in advance of commencement of construction operations.
2. Conduct pre-construction meeting on-site between contractor, the owner the engineer and James City County Environmental Division inspector.
3. Sawcut and remove a portion of an existing pavement required for the installation of construction entrance. Install the construction entrance as indicated on Phase One of the Erosion and Sediment Control Plan (E&SC Plan).
4. Flag the limits of construction as indicated on Phase One of the E&SC Plan.
5. Clear and grub within the limits of clearing only what is required for installation of temporary Sediment Trap #1 (ST #1) and temporary slope drains as indicated on Phase One of the E&SC Plan.
6. Complete installation of the ST#1 and temporary slope drains.

7. Abandon in place, by filling with flowable concrete fill, portion of the existing storm drain system at the Former Drachen Fire site as shown on Phase One of the E&SC Plan.
8. Install inlet protection on the remaining portion of the storm drain system at the Former Drachen Fire site as shown on Phase One of the E&SC Plan.
9. Clear and grub only what is required for the installation of Sediment Trap #2 (ST #2).
10. Install ST #2 as indicated on Phase One of the E&SC Plan.
11. Complete installation of all erosion and sediment control measures as indicated on Phase One of the E&SC Plan.
12. Clearing, demolition and grading activities may proceed only upon inspection and approval of the construction entrance and all erosion and sediment control measures, indicated on Phase One of the E&SC Plan, by the JCCED inspector.
13. Clear, grub and grade the area necessary for the installation of the storm drainage system and conveyance channels as indicated on Phase One of the E&SC Plan.
14. Construction of the storm drainage system shall commence immediately after demolition and all necessary grading have been completed and an area has been cleared and left free of all roots, stumps and debris.
15. Install storm sewer system, conveyance channels, roof drain collector system and connect roof drains outfalls as shown on Phase Two of the E&SC Plan. Do not install drainage inlets at that stage of construction.
16. Installed structure manholes shall serve as runoff collection inlets for the temporary diversions installed on the perimeter of the proposed building #80 as indicated on Phase Two of the E&SC Plan.
17. Drainage from proposed amphitheatre site shall be convey to ST # 2 and grass channels and conveyed to the proposed storm drain system as indicated on the Phase Two of the E&SC Plan.
18. Complete installation of all temporary erosion and sediment control measures as indicated on Phase Two of the E&SC Plan.
19. Proceed with further construction activities only upon inspection and approval of all erosion and sediment control measures, indicated on Phase Two of the E&SC Plan, by the JCCED inspector.
20. Proceed with clearing, demolition and grading as shown on the plans. Rough grade and prepare subgrade for the crane access road on North side of the station building and in the RPA, to the east from proposed ride bridge, as indicated on the plans.

21. Arrange meeting with Grass Pave 2 (or park approved equal) manufacture representative to coordinate proper installation of the Grass Pave 2 (or park approved equal) grass pavers.
22. Install Grass Pave 2 (or park approved equal) grass pavers as indicated on the plans.
23. Rough grade and prepare subgrade for any areas to be paved, retaining walls, buildings and ride foundations.
24. Complete installation of all temporary erosion and sediment control measures as shown on Phase Three of the E&SC Plan.
25. All disturbed slopes 3:1 or steeper shall be stabilized with EC-2/Type I, or as otherwise noted on the plans, soil stabilization matting.
26. Install and connect all utilities as indicated on plans.
27. Proceed with construction of building foundations, ride foundations and retaining walls.
28. Proceed with vertical construction of the proposed buildings, renovation of the existing station building and installation of the ride support and tracks.
29. Proceed with fine grading and installation of asphalt and concrete paving.
30. Upon completion of ride installation, building construction and fine grading, proceed with final site stabilization and application of permanent seeding.
31. Install landscaping as indicated on the landscape plans.
32. Complete permanent seeding, fertilize and mulch as required.
33. After final site stabilization and upon receiving authorization from the assigned JCCED inspector remove and dispose sediment accumulated in Sediment Traps in accordance with Virginia State Law and E&SC Handbook. Remove remaining temporary erosion and sediment control measures.
34. During all phases of construction, contractor shall perform daily inspections of all receiving drainage outfalls. Erosion and sediment control devices shall be inspected and repaired or replaced as necessary after each storm event.
35. Contractor shall be responsible for any additional sediment controls and removal o sediment caused by construction.

Determination of the schedule as to which areas will be cleared, demolished, graded etc. is at the contractor's option. Revised sequencing and erosion control methods shall be submitted to James City County Environmental Division for approval.

Stormwater Management:

The existing Rhine River is located to the East of the site and remains the water quality and quantity control BMP for the entire Busch Gardens facility including this new attraction site. The existing pond currently provides several times the required water quality volume for the entire watershed.

The stormwater system was developed to provide minimal increases in flow depth and velocity in the ravine systems.

EROSION AND SEDIMENT CONTROL AND STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST

James City County, Virginia
Environmental Division

Erosion and Sediment Control and Stormwater Management Design Plan Checklists

Table of Contents

Contents		Page
Erosion and Sediment Control Plan		
I.	General	1
II.	Site Plan	1
III.	Narrative	3
IV.	Calculations	4
Stormwater Management Design Plan		
I.	General	5
II.	Stormwater Conveyance Systems	7
III.	Stormwater Management / BMP Facilities	8
IV.	Outlet Protections	14
V.	Additional Comments and Information	14

GENERAL INFORMATION

Project Name: OKTOBERFEST ATTRACTION EXPANSION
Owner / Applicant: SEA WORLD PARKS & ENTERTAINMENT LLC
Plan Preparer: PIOTR SWIETUCHOWSKI, P.E. Email: pswietuchowski@VHB.COM
Project Location: JAMES CITY COUNTY
Tax Map / Parcel: 5140100009
County Plan No. (if known): JCC-SP-0014-2011
County BMP Type: RETENTION BASIN - RHINE RIVER LAKE (-)
Other information submitted in addition to this checklist (Check all that apply):

- ☑ Design or Construction Drawings (Plans, Profiles, Details, etc.).
- ☑ Erosion & Sediment Control Plan (Plans, Details, etc.).
- ☑ Erosion & Sediment Control Plan Design Report.
- ☑ Stormwater Management Design Plan (Plans, Profiles, Details, etc.).
- ☑ Stormwater Management Design Report.
- ☐ Other, List: _____

Issue Date
March 1, 2001

JAMES CITY COUNTY, VIRGINIA
ENVIRONMENTAL DIVISION

EROSION AND SEDIMENT CONTROL PLAN CHECKLIST

I. *GENERAL:*

Yes	No	N/A	
☑	☐	☐	*FAMILIARITY* with current versions of Chapter 8, Erosion and Sedimentation Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia and the Virginia Erosion and Sediment Control Handbook (VESCH).
☑	☐	☐	*LAND DISTURBING PERMIT AND SILTATION AGREEMENT* with surety are required for the project.
☑	☐	☐	*VARIANCE* if necessary, requested in writing, for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site.

II. *SITE PLAN:*

Yes	No	N/A	
☑	☐	☐	*VICINITY MAP* locating the site in relation to the surrounding area. Include any major landmarks which might assist in physically locating the site.
☑	☐	☐	*INDICATE NORTH* direction in relation to the site.
☑	☐	☐	*LIMITS OF CLEARING AND GRADING* for the site including that required for implementation of erosion and sediment controls, stockpile areas and utilities.
☑	☐	☐	*DISTURBED AREA ESTIMATES* in acres or square feet for the project.
☑	☐	☐	*EXISTING TOPOGRAPHY* or contours for the site at no more than 5 foot contour interval.
☑	☐	☐	*FINAL TOPOGRAPHY*, contours or proposed site grading in accordance with the design plan which indicates changes to existing topography and drainage patterns at no more than 2 foot contour interval (or 1 foot contours where required).
☑	☐	☐	*EXISTING AND PROPOSED SPOT ELEVATIONS* to supplement existing and proposed contours, topography or site grading information. Spot elevations may replace final contours in some instances, especially if terrain is in a low lying area or relatively flat.
☑	☐	☐	*EXISTING VEGETATION* including existing tree lines, grassed or unique vegetation areas.

Yes	No	N/A	
☑	☐	☐	*EXISTING SITE FEATURES* including roads, buildings, homes, utilities, streams, fences, structures and other important surface features of the site.
☑	☐	☐	*SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia.
☑	☐	☐	*ENVIRONMENTAL INVENTORY* in accordance with Section 23-10(2) of the Chesapeake Bay Preservation Ordinance of James City County. Inventory generally includes: tidal shores and wetlands, non-tidal wetlands, resource protection area, hydric soils and slopes steeper than 25 percent. For wetlands, provide a copy of issued permits or satisfactory evidence that appropriate permits are being pursued for the entire project.
☑	☐	☐	*100-YEAR FLOODPLAIN LIMITS* or any special flood hazard areas or flood zones based on appropriate Federal Management Agency Flood Insurance Rate Maps (FIRMs) or Flood Hazard Boundary Maps (FHBMs) of James City County, Virginia.
☑	☐	☐	*DRAINAGE AREAS* for offsite and onsite areas, existing or proposed as applicable. Include drainage divides and directional labels for all subareas at points of interest and size (in acres), weighted runoff coefficient or curve number and times of concentration for each subarea.
☑	☐	☐	*CRITICAL EROSION AREAS* which require special consideration or unique erosion and sediment control measures. Refer to the VESCH, Chapter 6 for criteria.
☑	☐	☐	*DEVELOPMENT PLAN* for the site showing all improvements such as buildings, structures, parking areas, access roadways, above and below ground utilities, stormwater management and drainage facilities; trails or sidewalks, proposed vegetation and landscaping, amenities, etc.
☑	☐	☐	*LOCATION OF PRACTICES* proposed for erosion and sediment control, tree protection and temporary stormwater management due to land disturbance activities at the site. Use standard abbreviations, labels and symbols consistent for plan views based on minimum standards and specifications in Chapter 3 of the VESCH.
☑	☐	☐	*TEMPORARY STOCKPILE AREAS* or staging and equipment storage areas as required for onsite or offsite construction activities or indicate that none are anticipated for this project.
☐	☐	☑	*OFFSITE LAND DISTURBING AREAS* including borrow sites, waste areas, utility extensions, etc. and required erosion and sediment controls. If none are anticipated for the project, then indicate on the plans by general or erosion and sediment control notes.
☑	☐	☐	*DETAILS* or alternately, appropriate reference to current minimum standards and specifications of the VESCH for each measure proposed for the project. Non-modified, standard duplicated details (silt fence, diversion dikes, etc.) may be referenced to the current version of the VESCH. Specific dimensional or modified standards (basins, traps, outlet protections, check dams, etc.) require presentation on detail sheets. Schedules or tables may be used for multiple site measures such as sediment traps, basins, channels, slope drains, etc. Any modification to standard details should be clearly defined, explained and illustrated.

Yes	No	N/A	
☑	☐	☐	*MAINTENANCE PLAN* or alternately, appropriate reference to current minimum standards and specifications of the VESCH, outlining the inspection frequency and maintenance requirements for all erosion and sediment control measures proposed for the project.
☐	☐	☑	*TRENCH DEWATERING* methods and erosion and sediment controls, if anticipated for the project.
☑	☐	☐	*CONSTRUCTION SEQUENCE* outlining the anticipated sequence for installation of erosion and sediment controls and site, grading and utility work to be performed for the project by the site contractor.
☑	☐	☐	*PHASING PLAN* if required for larger project sites that are to be developed in stages or phases.
☑	☐	☐	*STANDARD COUNTY NOTES* are required to be placed on the erosion and sediment control plan. Refer to the standard James City County Erosion and Sediment Control Notes, latest version.
☑	☐	☐	*PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved plans, drawings, technical reports and specifications.

III. *NARRATIVE:*

Yes	No	N/A	
☑	☐	☐	*PROJECT DESCRIPTION* briefly describing the nature and purpose of the land disturbing activity and the acreage to be disturbed.
☑	☐	☐	*EXISTING SITE CONDITIONS* description of existing topography, land use, cover and drainage patterns at the site.
☑	☐	☐	*ADJACENT AREA* descriptions of neighboring onsite or offsite areas such as streams, lakes, property, roads, etc. and potential impacts due to concentrated flow or runoff from the land disturbing activity.
☐	☐	☑	*OFFSITE DISTURBED AREA* descriptions of proposed borrow sites, waste or surplus areas, utility extensions and erosion and sediment controls to be implemented.
☑	☐	☐	*SOILS DESCRIPTION* briefly summarizing site, disturbed area and drainage basin soils including name, unit, hydrologic soil group (HSG) classification, surface runoff potential, erodibility, permeability, depth, texture, structure, erosion hazards, shrink-swell potential, limitations for use and anticipated depths to bedrock and the seasonal water table, as applicable.
☑	☐	☐	*CRITICAL AREAS* on the site which many have potentially serious erosion and sediment control problems and special considerations required (ie. steep slopes, hydric soils, channels, springs, sinkholes, water supply reservoirs, groundwater recharge areas, etc.)

Yes No N/A

☑ ☐ ☐ *PROPOSED EROSION & SEDIMENT CONTROL MEASURES* inclusive to the specific erosion and sediment control plan as proposed for the land disturbing activity. Measures should be consistent with those proposed on the site drawings. Address general use, installation, limitations, sequencing and maintenance requirements for each control measure.

☑ ☐ ☐ *STABILIZATION MEASURES* required for the site, either temporary or permanent, and during and following construction including temporary and permanent seeding and mulching, paving, stone, soil stabilization blankets and matting, sodding, landscaping or special stabilization techniques to be utilized at the site.

☑ ☐ ☐ *STORMWATER MANAGEMENT CONSIDERATIONS* for the site, either of temporary or permanent nature, and strategies, sequences and measures required for control. May reference the stormwater management plan for the site, if prepared, for permanent stormwater management facilities and control of drainage once the site is stabilized.

IV. *CALCULATIONS:*

Yes No N/A

☑ ☐ ☐ *CALCULATIONS AND COMPUTATIONS* associated with hydrology, hydraulics and design of proposed temporary and permanent erosion and sediment control measures including: sediment traps and basins, diversions, stormwater conveyance channels, culverts, slope drains, outlet protections, etc. Computations are not required on the construction plan and may be attached in a supplemental erosion and sediment control plan design report, if presented in a clear and organized format.

☑ ☐ ☐ *TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET* submitted for each basin along with schematic or sketch cross-section showing applicable design and construction data, storage volumes (wet-dry), dimensions and elevations. Peak design runoff to be based on the 2- or 25-year design storm event based on maximum disturbed site conditions (existing, interim or proposed conditions) in accordance with Minimum Standard 3.14 of the VESCH.

JAMES CITY COUNTY, VIRGINIA
ENVIRONMENTAL DIVISION

STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST

I. *GENERAL:*

Yes	No	N/A	
☑	☐	☐	*FAMILIARITY* with current versions of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual; Chapter 8, Erosion and Sediment Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia; the Virginia Erosion and Sediment Control Handbook (VESCH); and the Virginia Stormwater Management Handbook (VSMH).
☑	☐	☐	*WAIVER OR EXCEPTION* if necessary, requested in writing, for the plan approving authority to waive or except the requirements of Chapter 23, Chesapeake Bay Preservation ordinance in accordance with procedure established in Sections 23-14 through 23-17 of the ordinance. Applies to this review case only.
☐	☐	☑	*VARIANCE REQUEST* if necessary, requested in writing for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site.
☑	☐	☐	*PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved stormwater management plans, drawings, technical reports and specifications.
☐	☐	☑	*WORKSHEET FOR BMP POINT SYSTEM* to ensure the stormwater management plan for the project attains at least 10 BMP points (New Development) or traditional pollutant load reduction computations per the Chesapeake Bay Local Assistance Manual (Redevelopment Only).
☐	☐	☑	*PROPOSED CONSERVATION EASEMENT AREAS* for any natural open space points claimed in the BMP worksheet.
☐	☐	☑	*INSPECTION/MAINTENANCE AGREEMENT* is required to be prepared and executed with the County for the project.
☑	☐	☐	*FEMA FIRM PANEL* reference with designated special flood hazard areas or zone designations associated with the site, as applicable.
☑	☐	☐	*DRAINAGE AREA MAP* at a maximum scale of 1"=200' scale showing drainage area boundaries for pre- and postdevelopment conditions and associated time of concentration flow paths. Labels to include drainage area size, runoff coefficient or curve number and time of concentration for each subarea shown on the map.

Yes	No	N/A	
☑	☐	☐	*SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia with approximate locations of the project site, BMPs and applicable drainage basins.
☑	☐	☐	*STORMWATER MANAGEMENT NARRATIVE* in a brief and simple format which describes the project; location; site and drainage basin soil characteristics; receiving water or drainage facility; existing site and drainage basin conditions (topography, land use, cover, slopes, etc.); proposed site development; proposed stormwater management and drainage plan including County BMP type selected; summary of hydrology and hydraulics; maintenance program; and any special assumptions utilized for development of the stormwater management and drainage design plan or computations.
☑	☐	☐	*TEMPORARY STORMWATER MANAGEMENT* (if applicable) for control of stormwater runoff encountered during construction activities in addition to measures provided in the erosion and sediment control plan or stormwater management/drainage plan for the site. Adequate protection measures or sequencing provided.
☑	☐	☐	*MODIFICATION PLAN* clearly defined for temporary sediment control structures which will be converted to permanent SWM/BMP structures. Includes appropriate hydrologic and hydraulic computations, conversions, sequencing and cleanout information or details. Normally related to primary control structures associated with dry detention or wet retention ponds. Normally not permitted for Group C or D categories such as bioretention, infiltration and filtering system facilities.
☑	☐	☐	*STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT* in a bound 8-1/2 x 11 inch size format. Report shall generally include a title sheet, date, project identification, owner and preparer information, table of contents, narrative, summaries and computations as required. Computations may include: backwater, closed conduit, headwater, hydraulic, hydraulic grade line, hydrology, inlet, open channel, storm sewer, water quality, extended detention or stream channel protection and muti-stage storm routing calculations, as applicable, for the project. Computation data may include hand or computer generated computations, maps or schematics. All information should be presented in a clear, easy to follow format and should closely match construction plan information.
☑	☐	☐	*PLAN VIEW* at 1 inch = 50 ft. scale or less (1" = 40', 1" = 30', etc.)
☑	☐	☐	North arrow and plan legend.
☑	☐	☐	Property lines.
☑	☐	☐	Adjacent property information.
☑	☐	☐	Existing site features and existing impervious cover areas.
☑	☐	☐	Impervious cover tabulations.
☑	☐	☐	Existing drainage facilities (natural or manmade).
☑	☐	☐	Existing environmentally sensitive areas (RPA, wetlands, floodplain, steep slopes, critical soils, buffers, etc.).
☑	☐	☐	Existing and proposed contours (1' or 2' contour interval) and spot elevations as necessary to define high and low topography.
☑	☐	☐	Existing and proposed easement locations.

Yes	No	N/A	
☑	☐	☐	Proposed site improvements and proposed impervious cover areas.
☑	☐	☐	Proposed stormwater conveyance, drainage and management facilities with appropriate labeled construction data and information.
☑	☐	☐	Proposed landscaping and seeding plans (disturbed areas, pond interior, etc.).
☑	☐	☐	Proposed slope stabilization areas (riprap, blankets, mattings, walls, etc.).
☐	☐	☑	Delineation of permanent pools and the 1-, 2-, 10- and 100-year Design Water Surface Elevations.
☐	☐	☑	Delineation of ponding, headwater, surcharge or backwater areas which may affect adjacent existing or proposed buildings, structures or upstream adjacent properties.
☐	☐	☑	Test boring locations with reference surface elevations (if known).
☑	☐	☐	Risers, barrels, underdrains, overflows and outlet protections.
☑	☐	☐	Emergency spillway level section and outlet channel.
☑	☐	☐	Existing and proposed site utilities and protection measures.
☑	☐	☐	Erosion and sediment control measures (for site or BMP).
☐	☐	☑	Maintenance or access corridors to permanent stormwater management, BMP or drainage facilities.

II. *STORMWATER CONVEYANCE SYSTEMS:*

Yes	No	N/A	
☑	☐	☐	*PLAN VIEWS*
☑	☐	☐	Storm drain lengths, sizes, types, classes and slopes for all segments. Label directly on plan or use structure/pipe schedule.
☑	☐	☐	Access structure (inlets, manholes, junctions, etc.) rim elevations, inverts, type and required grate or top unit and lengths labeled.
☑	☐	☐	All structure numbers labeled.
☑	☐	☐	Adequate horizontal clearance from other site utilities or structures.
☐	☐	☑	*PROFILES* generally are not required but are encouraged to expedite review. If not provided, ensure all pipe segments have adequate minimum cover, do not exceed maximum depths of cover for the type/class of pipe specified and do not conflict with other site utilities or excavation areas.
☑	☐	☐	*DETAILS*
☑	☐	☐	Typical storm drain bedding details or reference note.
☑	☐	☐	Standard details or reference note for all proposed access structure types (inlets, manholes, junctions, etc.).
☑	☐	☐	Inlet shaping detail or applicable reference note.
☑	☐	☐	Step detail or applicable reference note (if depth 4 ft. or more).
☑	☐	☐	Typical open channel details with designation, location, shape, type, bottom width, top width, lining, slope, length, side slope, and installation depth required for construction. Channel design data as necessary may also be included.
☑	☐	☐	Outlet protections at all pipe outfalls.

Yes No N/A

☑ ☐ ☐ *STORMWATER CONVEYANCE SYSTEM COMPUTATIONS*

- ☑ ☐ ☐ Storm Sewer Design computations based on 10-year design event.
- ☑ ☐ ☐ Hydraulic Grade Line computations based on 10-year design event.
- ☑ ☐ ☐ Inlet computations based on current VDOT procedure for spread, ponding depth and grate size required.
- ☑ ☐ ☐ Culvert Headwater computations. Design based on 10-year design storm event and check only for 100-year storm event.
- ☑ ☐ ☐ Open Channel computations based on 2-year design event for velocity and 10-year design event for capacity.
- ☑ ☐ ☐ Standard outlet protection or special energy dissipators.
- ☑ ☐ ☐ Pipe thickness design computations, as required, for selected pipe type (live load, minimum cover, maximum height of cover, etc.).
- ☑ ☐ ☐ Adequate channel computations for receiving channels (based on field measured channel section data).

III. *STORMWATER MANAGEMENT / BMP FACILITIES:*

Yes No N/A

☐ ☐ ☑ *HYDROLOGY* - An SCS based methodology is required for the design of stormwater management/BMP facilities with watersheds exceeding 20 acres. Under 20 acres, other generally accepted methodologies such as the modified rational, critical storm are allowable. Refer to Chapter 5 of the VESCH or Chapter 5 of the VSMH.

- ☐ ☐ ☐ Runoff Curve Number or Coefficient determinations: predeveloped and ultimate development land use scenarios.
- ☐ ☐ ☐ Time of concentration: predeveloped and ultimate development indicating overland, shallow concentrated, and channel flow components (200 ft. maximum length for overland flow).
- ☐ ☐ ☐ Hydrograph generation (tabular or graphical): pre- and postdevelopment conditions for the 1-, 2-, 10-, and 100-year design storm events.

☐ ☐ ☑ *FACILITY CONFIGURATION and MINIMUM SEPARATIONS*

- ☐ ☐ ☐ Screening and layout consistent with Section 24-98(d) of the Chapter 24 Zoning ordinance (landscaping, screening, visibility, etc.).
- ☐ ☐ ☐ Basic considerations for safety and unauthorized entry.
- ☐ ☐ ☐ Proper length to width ratio (Typically 2H:1V).
- ☐ ☐ ☐ Facilities with deep pools (4 feet or more in depth) provided with two benches. Fifteen (15) ft. safety bench outward from normal pool at maximum 6 percent slope and aquatic bench inward from normal shoreline below normal pool. Narrower widths may be considered on a case-by-case basis.
- ☐ ☐ ☐ Pond buffer minimum 25 feet outward from maximum design WSEL. Additional setbacks may be required to permanent structures.
- ☐ ☐ ☐ No trees, shrubs or woody plants within 15 feet of embankment toe or 25 feet from principal spillway structure.

Yes No N/A

☐ ☐ ☐ Infiltration and filtering system facilities generally located at least 100 feet horizontally from any water supply well; 100 feet from any downslope building; and 25 feet from any upslope buildings, unless site specific investigation allows for reduced separation.

Yes No N/A

☐ ☐ ☑ *HYDRAULIC COMPUTATIONS*

- ☐ ☐ ☐ Elevation- or Stage- Storage curve and/or tabular data.
- ☐ ☐ ☐ Weir / Orifice Control - Extended Detention.
- ☐ ☐ ☐ Weir / Orifice Control - riser 1-year control for channel protection.
- ☐ ☐ ☐ Weir / Orifice Control - riser 2-year control for quantity (if required).
- ☐ ☐ ☐ Weir / Orifice Control - riser 10-year control for quantity (if required).
- ☐ ☐ ☐ Inlet / Outlet (barrel) control - (All Storms).
- ☐ ☐ ☐ Check for barrel control prior to riser orifice flow to prevent slug flow-water hammer conditions.
- ☐ ☐ ☐ Emergency spillway capacity and depth of flow.
- ☐ ☐ ☐ Elevation - Discharge (Outlet Rating) curve and/or table. Provide all supporting calculations and/or design assumptions.
- ☐ ☐ ☐ Adequate channel computations for receiving channel. May be waived if facility is designed based on current Stream Channel Protection criteria.

☐ ☐ ☑ *POND or RESERVOIR ROUTING*

- ☐ ☐ ☐ Storage-Indication Routing of postdeveloped inflow hydrographs for the 1-, 2-, 10-, and 100-year design storms. Preference is for structure to discharge up to the 10-year storm through the principal spillway and pass the 100-year storm with a minimum 1 foot of freeboard through a combination principal and emergency spillways. If no emergency spillway is provided, riser must be large enough to pass the design high water flow and trash without overtopping the facility, have 3 square feet or more of cross-sectional area, contain a hood type inlet and have a minimum freeboard of 2 feet. Token spillways with minimum 8 ft. width are also recommended at or above the design 100-year storm elevation.
- ☐ ☐ ☐ Downstream hydrographs at established study points, if conditions warrant (ie. facility discharge combined with uncontrolled bypass).

☐ ☐ ☑ *MISCELLANEOUS COMPUTATIONS*

- ☐ ☐ ☐ Water quality volume for permanent pool based on selected BMP treatment volume (WQv).
- ☐ ☐ ☐ Water quality volume for extended detention based on selected BMP treatment volume (WQv) with drawdown computations.
- ☐ ☐ ☐ Drawdown computations for the 1-year, 24 hour detention for stream channel protection criteria.
- ☐ ☐ ☐ Pond drain computations (within 24 hours).
- ☐ ☐ ☐ Anti-seep collar design (concrete preferred) or match material type.
- ☐ ☐ ☐ Filter diaphragm design (or alternative method of controlling seepage).

Yes No N/A

☐ ☐ ☐ Riser / base structure flotation analyses. FS = 1.25 minimum.

☐ ☐ ☐ Downstream danger reach study and/or emergency action plan (if conditions warrant).

☐ ☐ ☐ Upstream backwater analyses onto offsite adjacent property (if conditions warrant).

☐ ☐ ☐ 100 year floodplain impacts (if conditions warrant).

Yes No N/A

☐ ☐ ☑ *GEOTECHNICAL REQUIREMENTS*

☐ ☐ ☐ Geotechnical Report with recommendations specific to BMP facility type selected. Report prepared by a registered professional engineer. Requires submission, review and approval prior to issuance of Land Disturbance Permit.

☐ ☐ ☐ Initial Feasibility Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).

☐ ☐ ☐ Concept Design Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).

☐ ☐ ☐ Minimum Boring locations: borrow area, pool area, principal control structure, top of facility near one abutment and emergency spillway if provided.

☐ ☐ ☐ Boring logs with Unified Soil Classification (ASTM D2487), soils descriptions and depths to bedrock and the seasonal water table indicated.

☐ ☐ ☐ Standard County Record Drawing/Construction Certification note provided on plan. *Note: It is understood that preparation of record drawings and construction certifications as required for project facilities may not necessarily be performed by the plan preparer. These components may be performed by others.*

☐ ☐ ☑ *PRINCIPAL SPILLWAY PROFILE AND ASSOCIATED DETAILS*

☐ ☐ ☑ *EXISTING GROUND AND PROPOSED GRADE*

☐ ☐ ☐ Embankment or excavation side slopes labeled (3H:1V maximum).

☐ ☐ ☐ Minimum top width labeled (per VESCH or VSMH requirements).

☐ ☐ ☐ Removal of unsuitable material under proposed facility (per Geotechnical Report requirements).

Yes No N/A

☐ ☐ ☑ *CORE TRENCH*

- ☐ ☐ ☐ Material (per plan or Geotechnical Report).
- ☐ ☐ ☐ Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations).
- ☐ ☐ ☐ Side slopes (1:1 maximum steepness)
- ☐ ☐ ☐ Depth (4' minimum or greater as dictated by Geotechnical Report).

☐ ☐ ☑ *PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)*

- ☐ ☐ ☐ Durable, watertight, resistant material (concrete preferred).
- ☐ ☐ ☐ Riser diameter is at least 1.25 times larger than barrel diameter.
- ☐ ☐ ☐ All pertinent dimensions and elevations shown.
- ☐ ☐ ☐ Control orifice or weir dimensions and elevations shown.
- ☐ ☐ ☐ Trash rack - removable - for each release.
- ☐ ☐ ☐ Anti-vortex device, baffle or plate.
- ☐ ☐ ☐ Riser base structure with dimensions and embedment specifications (concrete preferred).
- ☐ ☐ ☐ Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion.
- ☐ ☐ ☐ Low flow orifice with trash rack device.

☐ ☐ ☑ *PRINCIPAL CONTROL STRUCTURE OUTLET BARREL*

- ☐ ☐ ☐ Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.).
- ☐ ☐ ☐ Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report.
- ☐ ☐ ☐ Pipe inverts, length, size, class and slope shown.
- ☐ ☐ ☐ Flared end section or endwall provided on barrel outlet.

☐ ☐ ☑ *SEEPAGE CONTROL*

- ☐ ☐ ☐ Phreatic line shown (4:1 slope measured from the intersection of the embankment and the principal spillway design high water).

- ☐ ☐ ☐ *ANTI-SEEP COLLARS*
  - ☐ ☐ ☐ Anti-seep collar, concrete preferred.
  - ☐ ☐ ☐ Size - 15 percent increase in length of saturation using outside pipe diameter.
  - ☐ ☐ ☐ Spacing and location on barrel (located at least 2 feet from a pipe joint).
  - ☐ ☐ ☐ *FILTER DIAPHRAGMS*
  - ☐ ☐ ☐ Design based on latest NRCS design methods and certified by a professional engineer.

Yes No N/A

☐ ☐ ☑ *ELEVATION AND DIMENSIONAL DESIGN DATA*

- ☐ ☐ ☐ Top of facility - construction height and settled height (10 percent settlement).
- ☐ ☐ ☐ Crest of principal control structure spillway at least one (1) foot below crest of emergency spillway, if provided.
- ☐ ☐ ☐ Minimum freeboard of one (1) foot above the 100-year design high water elevation for facilities <u>with</u> an emergency spillway.
- ☐ ☐ ☐ Minimum freeboard of two (2) feet above the 100-year design high water elevation for facilities <u>without</u> an emergency spillway or in accordance with the SCS National Engineering Handbook (prior approval required).
- ☐ ☐ ☐ Basin Sediment Clean-Out elevation (permanent mode). Typically 10 to 25 percent of water quality volume.

☐ ☐ ☑ *CROSS SECTION THROUGH FACILITY*

- ☐ ☐ ☐ Existing Ground.
- ☐ ☐ ☐ Proposed grade.
- ☐ ☐ ☐ Top of facility - constructed and settled.
- ☐ ☐ ☐ Location of emergency spillway with side slopes labeled (emergency spillway in cut).
- ☐ ☐ ☐ Bottom of core trench (4' minimum).
- ☐ ☐ ☐ Location of each soil boring.
- ☐ ☐ ☐ Barrel location.
- ☐ ☐ ☐ Existing and proposed utility location/protection.

☐ ☐ ☑ *EMERGENCY SPILLWAY PROFILE*

- ☐ ☐ ☐ Existing ground.
- ☐ ☐ ☐ Inlet, level (control) and outlet sections per SCS.
- ☐ ☐ ☐ Spillway and crest elevations.

☑ ☐ ☐ *PRETREATMENT DEVICES* of adequate depth and properly designed using required pretreatment volumes for the selected County BMP facility type. Including, but not limited to: sediment forebays, sediment basins, sumps, grass channels, gravel diaphragms, plunge pools, chamber separators, manufactured systems or other acceptable methods.

Yes No N/A

☐ ☐ ☑ *CONSTRUCTION SPECIFICATIONS and NOTES*

- ☐ ☐ ☐ Anticipated sequence of construction for BMP (consistent with erosion and sediment control plan).
- ☐ ☐ ☐ Provisions to control base stream or storm flow conditions encountered during construction.
- ☐ ☐ ☐ Site and subgrade preparation requirements.
- ☐ ☐ ☐ Embankment, fill and backfill material soil and placement (lift) thickness requirements.
- ☐ ☐ ☐ Compaction and soil moisture content requirements.
- ☐ ☐ ☐ Geosynthetics for drainage, filtration, moisture barrier, separation, and reinforcement purposes.
- ☐ ☐ ☐ Clay or synthetic (PVC or HDPE) pond liners.
- ☐ ☐ ☐ Storm drain, underdrain and pipe conduit requirements.
- ☐ ☐ ☐ Minimum depth of pipe cover for temporary (construction) and final cover conditions.
- ☐ ☐ ☐ Permanent shutoff valve and pond drain.
- ☐ ☐ ☐ Concrete requirements for structural components.
- ☐ ☐ ☐ Riprap and slope protection.
- ☐ ☐ ☐ Access or maintenance road surface, base, subbase.
- ☐ ☐ ☐ Temporary and permanent stabilization measures.
- ☐ ☐ ☐ Temporary or permanent safety fencing.
- ☐ ☐ ☐ BMP Landscaping (deep, shallow, fringe, perimeter,etc.)
- ☐ ☐ ☐ Dust and traffic control (if warranted).
- ☐ ☐ ☐ Construction monitoring and certification by professional.
- ☐ ☐ ☐ Other: _____
- ☐ ☐ ☐ Other: _____.

☑ ☐ ☐ *MAINTENANCE PROVISIONS*

- ☑ ☐ ☐ Entity responsible for maintenance identified..
- ☑ ☐ ☐ Maintenance Plan which outlines the long-term schedule for inspection/maintenance of the facility and forebays
- ☐ ☐ ☑ Maintenance access from public right-of-way or publicly traveled road.
- ☐ ☐ ☑ Maintenance easement provided encompassing high water pool and buffer, principal and emergency spillways, outlet structures, forebays, embankment area and possible sediment-removal stockpile areas.
- ☐ ☐ ☑ Minimum 6 foot wide public safety shelf (landing) or alternative fencing.

IV. *OUTLET PROTECTIONS:*

Yes	No	N/A	
☑	☐	☐	Sized for maximum design release (generally 10-year storm).
☑	☐	☐	Flared end section or endwall.
☑	☐	☐	Dimensions.
☑	☐	☐	Rock or riprap size, quantity and placement thickness.
☑	☐	☐	Slope at 0 percent (Level Grade).
☑	☐	☐	Geotextiles (nonwoven).
☑	☐	☐	Special energy dissipators are required for design discharge velocities that exceed eighteen (18) feet per second; or if use of standard outlet protection would result in velocities exceeding permissible channel velocities; or if space restricts or limits their use.

V. *ADDITIONAL COMMENTS OR INFORMATION SPECIFIC TO THE PLAN:*

Plan Preparer: PIOTR SWIETUCHOWSKI, P.E.

Date: 02/09/11

SWMProg/BMP/Checklist/ChkList

STEEP SLOPES WAIVER REQUEST

Transportation
Land Development
Environmental
Services

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February 09, 2011

VHB+LandMark • Legacy • Leadership • Results

Mr. Scott Thomas, P.E.
Director
Environmental Division
P.O. Box 8784
Williamsburg, VA 23187-8784

RE: **Steep Slope Waiver Request,**
Oktoberfest Attraction Expansion
SeaWorld Parks and Entertainment
7851 Pocahontas Trail, Williamsburg, VA 23185

Dear Mr. Thomas:

On behalf of our Client, owner of the above referenced property/project, the Vanasse Hangen Brustlin, Inc., requests a waiver of part of Section 23-5 of the James City County Chesapeake Bay Preservation Ordinance as the referenced project requires impacting 1.242 acres of slopes in excess of 25%. The impact areas are associated with the proposed site development and are shown on the Environmental Inventory sheet, C02.2[illegible].

We trust that this request is satisfactory for your approval. Please advise us if you need any additional information or would like to discuss this further.

Sincerely,

Vanasse Hangen Brustlin, Inc.

Piotr Swieluchowski, P.E.
Project Engineer

Vanasse Hangen Brustlin, Inc.
351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185-6316
757.220.0500 • FAX 757.220.8526
email: info@vhb.com
www.vhb.com

DRAINAGE AREA CALCULATIONS

VHB *Computations*

Project: OKTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: JAMES CITY COUNTY Sheet of
Calculated by: P.S. Date: 02/09/11
Checked by: Date:
Title DRAINAGE AREAS CALCULATIONS

DA-1 = 0.60 Ac T_c = 5 min
Imp = 0.39 Ac PERV = 0.21 Ac C = 0.71

DA-2 = 0.21 Ac T_c = 5 min
Imp = 0.03 Ac PERV = 0.18 Ac C = 0.43

DA-3B 0.53 Ac T_c = 5 min
Imp = 0.38 Ac PERV = 0.15 Ac C = 0.74

DA-3 = 0.26 Ac T_c = 5 min
Imp = 0.07 Ac PERV = 0.19 Ac C = 0.50

DA-3A = 1.34 Ac T_c = 8 min
Imp = 0.80 Ac PERV = 0.54 Ac C = 0.68

~~DA-4 = 0.18 Ac~~ ~~T_c = 5 min~~
Imp = 0.05 Ac PERV = 0.13 Ac C = 0.50

DA-5 = 0.23 Ac T_c = 5 min
Imp = 0.08 Ac PERV = 0.15 Ac C = 0.54

DA-6 = 0.24 Ac T_c = 5 min
Imp = 0.14 Ac PERV = 0.10 Ac C = 0.67

DA-7 = 0.76 Ac T_c = 5 min
Imp = 0.40 Ac PERV = 0.36 Ac C = 0.64

PA-200 = 0.05 Ac T_c = 5 min
Imp = 0.03 Ac PERV = 0.02 Ac C = 0.68

DA-201 = 0.04 Ac T_c = 5 min
Imp = 0.037 Ac PERV = 0.003 Ac C = 0.86

VHB Computations

Project: OKTOBERFEST ATTACTION EXPANSION Project # 33 299.00
Location: Sheet of
Calculated by: P.S Date: 03/22/11
Checked by: Date:
Title DRAINAGE AREAS CALCULATIONS

D-1.0 = 0.03Ac T_c = 5min
Imp = 0.0Ac PERV = 0.03Ac C=0.35

D-1.1 = 0.02Ac T_c = 5min
Imp = 0.0Ac PERV = 0.02Ac C=0.35

D-1.2 = 0.03Ac T_c = 5min
Imp = 0.0Ac PERV = 0.03Ac C=0.35

D-1.3 = 0.04Ac T_c = 5min
Imp = 0.0Ac PERV = 0.04Ac C=0.35

D-1.4 = 0.03Ac T_c = 5min
Imp = 0.0Ac PERV = 0.03Ac C=0.35

D-1.5 = 0.06Ac T_c = 5min
Imp = 0.0Ac PERV = 0.06Ac C=0.35

D-1.6 = 0.06Ac T_c = 5min
Imp = 0.0Ac PERV = 0.06Ac C=0.35

D-2.0 = 0.82Ac T_c = 5min
Imp = 0.19Ac PERV = 0.63Ac C=0.48

D-2.1 = 0.08Ac T_c = 5min
Imp = 0.02Ac PERV = 0.06Ac C= 0.49

D-2.2 = 0.05Ac T_c = 5min
Imp = 0.01Ac PERV = 0.04Ac C=0.46

D-2.3 = 0.03Ac T_c = 5min
Imp = 0.01Ac PERV = 0.02Ac C=0.53

VHB

Computations

Project: OKTOBERFEST IMPACT EXPANSION
Project # 33299.00
Location: JCC
Sheet of
Calculated by: P.S
Date: 03/22/11
Checked by:
Date:
Title

D-2.4 = 0.04 Ac T_c = 5min
Imp = 0.0 Ac Perv = 0.04 Ac C = 0.35

D-2.5 = 0.06 Ac T_c = 5min
Imp = 0.0 Ac Perv = 0.06 Ac C = 0.35

D-2.6 = 0.13 Ac T_c = 5min
Imp = 0.0 Ac Perv = 0.13 Ac C = 0.35

VHB *Computations*

Project: OCTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: JAMES CITY COUNTY Sheet of
Calculated by: P.S. Date:
Checked by: Date:
Title DRAINAGE AREAS CALCULATIONS

DA-TSD-1 = 0.31 Ac Tc = 5 min
Imp = 0.12 Ac PERV = 0.19 Ac C = 0.56

DA-TSD-2 = 1.34 Ac Tc = 8 min
Imp = 0.80 Ac PERV = 0.54 Ac C = 0.68

DA-TSD-3 = 0.53 Ac Tc = 5 min
Imp = 0.38 Ac PERV = 0.15 Ac C = 0.74

DA-TSD-4 = 0.47 Ac Tc = 5 min
Imp = 0.10 Ac PERV = 0.37 Ac C = 0.47

DA-ST = 2.99 Ac Tc = 5 min (SEDIMENT FOREBAY)
Imp = 1.01 Ac PERV = 1.98 Ac C = 0.54

DA-SF = 7.15 Ac (DRAINAGE AREA TO SEDIMENT FOREBAY)
Tc = 9.8 min
Imp = 2.83 Ac PERV = 4.32 Ac C = 0.57

RHINE RIVER BMP WATER QUALITY CALCULATIONS

VHB Computations

Project: OKTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: JAMES CITY COUNTY Sheet of
Calculated by: P.S. Date: 02/09/11
Checked by: Date:
Title RHINE RIVER BMP WQ CALCULATIONS

RHINE RIVER BMP

DRAINAGE AREA = 433 Ac
IMPERVIOUS TOTAL = 147 Ac

WATER QUALITY VOLUME

$$\frac{1}{2} \times (147\,Ac) \times \left(\frac{1}{12}\right) \times \left(\frac{43560\,ft^2}{Ac}\right) = 266{,}805\,ft^3$$

65% POLLUTANT REMOVAL RATE 4 WQV

TOTAL WATER QUALITY VOLUME REQUIRED

$4 \times 266{,}805\,ft^3 = 1{,}067{,}220\,ft^3 = 24.5\,Ac\text{-}ft$

FUTURE IMPERVIOUS AREA 50% = 216.5 Ac

WQV = 392,948 ft^3

TOTAL WQV REQUIRED = $4 \times 392{,}948\,ft^3 = 1{,}571{,}792\,ft^3 =$
$= 36.1\,Ac\text{-}ft$

PROVIDED STORAGE VOLUME FOR WATER QUALITY
@ ELEV=30.00

575 Ac-ft > 36.1 Ac-ft
> 24.3 Ac-ft
ok

Busch Gardens BMP - Rhine River Water Quality					
		Post - Existing Riser		Post - Mod. Riser*	
Storm Event	Pre	Existing	Future	Existing	Future
1	112.03	38.4	53.45	0.8	7.58
2	206.34	67.45	89.27	13.3	21.15
10	598.77	218.92	247.67	110.86	129.47
25	714.03	263.39	296.78	148.45	172.16
100	1031.49	375.65	437.5	250.19	303.55

* Modification to riser: Raise existing riser 1' to elevation 31 and add 6" diameter orifice at elevation 30.

Water Quality - 4WQV Retention Basin IV (65% Pollutant Removal)

Drainage Area to BMP	433	Ac
Impervious to date	147	Ac
Impervious future	216.5	Ac

Required WQV (to date)	24.5	Ac-ft
Required WQV (50% imp)	36.1	Ac-ft

Provided WQV		575	Ac-ft

Water Quality Volume Provided Exceeds Current Required By 23.5 times

Water Quality Volume Future Exceeds Current Required By 16 times

Stage-Area-Storage for Pond 1P: Busch Gardens BMP - Rhine River

Elevation (feet)	Surface (acres)	Storage (acre-feet)	Elevation (feet)	Surface (acres)	Storage (acre-feet)
10.00	11.000	0.000	13.12	17.240	44.054
10.06	11.120	0.664	13.18	17.360	45.092
10.12	11.240	1.334	13.24	17.480	46.138
10.18	11.360	2.012	13.30	17.600	47.190
10.24	11.480	2.698	13.36	17.720	48.250
10.30	11.600	3.390	13.42	17.840	49.316
10.36	11.720	4.090	13.48	17.960	50.390
10.42	11.840	4.796	13.54	18.080	51.472
10.48	11.960	5.510	13.60	18.200	52.560
10.54	12.080	6.232	13.66	18.320	53.656
10.60	12.200	6.960	13.72	18.440	54.758
10.66	12.320	7.696	13.78	18.560	55.868
10.72	12.440	8.438	13.84	18.680	56.986
10.78	12.560	9.188	13.90	18.800	58.110
10.84	12.680	9.946	13.96	18.920	59.242
10.90	12.800	10.710	14.02	19.040	60.380
10.96	12.920	11.482	14.08	19.160	61.526
11.02	13.040	12.260	14.14	19.280	62.680
11.08	13.160	13.046	14.20	19.400	63.840
11.14	13.280	13.840	14.26	19.520	65.008
11.20	13.400	14.640	14.32	19.640	66.182
11.26	13.520	15.448	14.38	19.760	67.364
11.32	13.640	16.262	14.44	19.880	68.554
11.38	13.760	17.084	14.50	20.000	69.750
11.44	13.880	17.914	14.56	20.120	70.954
11.50	14.000	18.750	14.62	20.240	72.164
11.56	14.120	19.594	14.68	20.360	73.382
11.62	14.240	20.444	14.74	20.480	74.608
11.68	14.360	21.302	14.80	20.600	75.840
11.74	14.480	22.168	14.86	20.720	77.080
11.80	14.600	23.040	14.92	20.840	78.326
11.86	14.720	23.920	14.98	20.960	79.580
11.92	14.840	24.806	15.04	21.080	80.842
11.98	14.960	25.700	15.10	21.200	82.110
12.04	15.080	26.602	15.16	21.320	83.386
12.10	15.200	27.510	15.22	21.440	84.668
12.16	15.320	28.426	15.28	21.560	85.958
12.22	15.440	29.348	15.34	21.680	87.256
12.28	15.560	30.278	15.40	21.800	88.560
12.34	15.680	31.216	15.46	21.920	89.872
12.40	15.800	32.160	15.52	22.040	91.190
12.46	15.920	33.112	15.58	22.160	92.516
12.52	16.040	34.070	15.64	22.280	93.850
12.58	16.160	35.036	15.70	22.400	95.190
12.64	16.280	36.010	15.76	22.520	96.538
12.70	16.400	36.990	15.82	22.640	97.892
12.76	16.520	37.978	15.88	22.760	99.254
12.82	16.640	38.972	15.94	22.880	100.624
12.88	16.760	39.974	16.00	23.000	102.000
12.94	16.880	40.984	16.06	23.120	103.384
13.00	17.000	42.000	16.12	23.240	104.774
13.06	17.120	43.024	16.18	23.360	106.172

EXIST. WQV REQUIRED 24.5 Ac-ft

FUTURE WQV REQUIRED = 36.1 Ac-ft

Stage-Area-Storage for Pond 1P: Busch Gardens BMP - Rhine River (continued)

Elevation (feet)	Surface (acres)	Storage (acre-feet)	Elevation (feet)	Surface (acres)	Storage (acre-feet)
16.24	23.480	107.578	19.36	29.720	190.570
16.30	23.600	108.990	19.42	29.840	192.356
16.36	23.720	110.410	19.48	29.960	194.150
16.42	23.840	111.836	19.54	30.080	195.952
16.48	23.960	113.270	19.60	30.200	197.760
16.54	24.080	114.712	19.66	30.320	199.576
16.60	24.200	116.160	19.72	30.440	201.398
16.66	24.320	117.616	19.78	30.560	203.228
16.72	24.440	119.078	19.84	30.680	205.066
16.78	24.560	120.548	19.90	30.800	206.910
16.84	24.680	122.026	19.96	30.920	208.762
16.90	24.800	123.510	20.02	31.022	210.620
16.96	24.920	125.002	20.08	31.088	212.484
17.02	25.040	126.500	20.14	31.154	214.351
17.08	25.160	128.006	20.20	31.220	216.222
17.14	25.280	129.520	20.26	31.286	218.097
17.20	25.400	131.040	20.32	31.352	219.976
17.26	25.520	132.568	20.38	31.418	221.859
17.32	25.640	134.102	20.44	31.484	223.746
17.38	25.760	135.644	20.50	31.550	225.638
17.44	25.880	137.194	20.56	31.616	227.532
17.50	26.000	138.750	20.62	31.682	229.431
17.56	26.120	140.314	20.68	31.748	231.334
17.62	26.240	141.884	20.74	31.814	233.241
17.68	26.360	143.462	20.80	31.880	235.152
17.74	26.480	145.048	20.86	31.946	237.067
17.80	26.600	146.640	20.92	32.012	238.986
17.86	26.720	148.240	20.98	32.078	240.908
17.92	26.840	149.846	21.04	32.144	242.835
17.98	26.960	151.460	21.10	32.210	244.766
18.04	27.080	153.082	21.16	32.276	246.700
18.10	27.200	154.710	21.22	32.342	248.639
18.16	27.320	156.346	21.28	32.408	250.581
18.22	27.440	157.988	21.34	32.474	252.528
18.28	27.560	159.638	21.40	32.540	254.478
18.34	27.680	161.296	21.46	32.606	256.432
18.40	27.800	162.960	21.52	32.672	258.391
18.46	27.920	164.632	21.58	32.738	260.353
18.52	28.040	166.310	21.64	32.804	262.319
18.58	28.160	167.996	21.70	32.870	264.289
18.64	28.280	169.690	21.76	32.936	266.264
18.70	28.400	171.390	21.82	33.002	268.242
18.76	28.520	173.098	21.88	33.068	270.224
18.82	28.640	174.812	21.94	33.134	272.210
18.88	28.760	176.534	22.00	33.200	274.200
18.94	28.880	178.264	22.06	33.266	276.194
19.00	29.000	180.000	22.12	33.332	278.192
19.06	29.120	181.744	22.18	33.398	280.194
19.12	29.240	183.494	22.24	33.464	282.200
19.18	29.360	185.252	22.30	33.530	284.209
19.24	29.480	187.018	22.36	33.596	286.223
19.30	29.600	188.790	22.42	33.662	288.241

Stage-Area-Storage for Pond 1P: Busch Gardens BMP - Rhine River (continued)

Elevation (feet)	Surface (acres)	Storage (acre-feet)	Elevation (feet)	Surface (acres)	Storage (acre-feet)
22.48	33.728	290.263	25.60	37.160	400.848
22.54	33.794	292.288	25.66	37.226	403.080
22.60	33.860	294.318	25.72	37.292	405.315
22.66	33.926	296.352	25.78	37.358	407.555
22.72	33.992	298.389	25.84	37.424	409.798
22.78	34.058	300.431	25.90	37.490	412.045
22.84	34.124	302.476	25.96	37.556	414.297
22.90	34.190	304.525	26.02	37.622	416.552
22.96	34.256	306.579	26.08	37.688	418.812
23.02	34.322	308.636	26.14	37.754	421.075
23.08	34.388	310.698	26.20	37.820	423.342
23.14	34.454	312.763	26.26	37.886	425.613
23.20	34.520	314.832	26.32	37.952	427.888
23.26	34.586	316.905	26.38	38.018	430.167
23.32	34.652	318.982	26.44	38.084	432.450
23.38	34.718	321.063	26.50	38.150	434.737
23.44	34.784	323.148	26.56	38.216	437.028
23.50	34.850	325.238	26.62	38.282	439.323
23.56	34.916	327.330	26.68	38.348	441.622
23.62	34.982	329.427	26.74	38.414	443.925
23.68	35.048	331.528	26.80	38.480	446.232
23.74	35.114	333.633	26.86	38.546	448.543
23.80	35.180	335.742	26.92	38.612	450.858
23.86	35.246	337.855	26.98	38.678	453.176
23.92	35.312	339.972	27.04	38.744	455.499
23.98	35.378	342.092	27.10	38.810	457.825
24.04	35.444	344.217	27.16	38.876	460.156
24.10	35.510	346.346	27.22	38.942	462.491
24.16	35.576	348.478	27.28	39.008	464.829
24.22	35.642	350.615	27.34	39.074	467.172
24.28	35.708	352.755	27.40	39.140	469.518
24.34	35.774	354.900	27.46	39.206	471.868
24.40	35.840	357.048	27.52	39.272	474.223
24.46	35.906	359.200	27.58	39.338	476.581
24.52	35.972	361.357	27.64	39.404	478.943
24.58	36.038	363.517	27.70	39.470	481.310
24.64	36.104	365.681	27.76	39.536	483.680
24.70	36.170	367.850	27.82	39.602	486.054
24.76	36.236	370.022	27.88	39.668	488.432
24.82	36.302	372.198	27.94	39.734	490.814
24.88	36.368	374.378	28.00	39.800	493.200
24.94	36.434	376.562	28.06	39.866	495.590
25.00	36.500	378.750	28.12	39.932	497.984
25.06	36.566	380.942	28.18	39.998	500.382
25.12	36.632	383.138	28.24	40.064	502.784
25.18	36.698	385.338	28.30	40.130	505.190
25.24	36.764	387.542	28.36	40.196	507.599
25.30	36.830	389.749	28.42	40.262	510.013
25.36	36.896	391.961	28.48	40.328	512.431
25.42	36.962	394.177	28.54	40.394	514.852
25.48	37.028	396.397	28.60	40.460	517.278
25.54	37.094	398.620	28.66	40.526	519.708

Stage-Area-Storage for Pond 1P: Busch Gardens BMP - Rhine River (continued)

Elevation (feet)	Surface (acres)	Storage (acre-feet)	Elevation (feet)	Surface (acres)	Storage (acre-feet)
28.72	40.592	522.141	31.84	43.472	653.634
28.78	40.658	524.579	31.90	43.520	656.244
28.84	40.724	527.020	31.96	43.568	658.857
28.90	40.790	529.466	32.02	43.616	661.472
28.96	40.856	531.915	32.08	43.664	664.091
29.02	40.922	534.368	32.14	43.712	666.712
29.08	40.988	536.826	32.20	43.760	669.336
29.14	41.054	539.287	32.26	43.808	671.963
29.20	41.120	541.752	32.32	43.856	674.593
29.26	41.186	544.221	32.38	43.904	677.226
29.32	41.252	546.694	32.44	43.952	679.861
29.38	41.318	549.171	32.50	44.000	682.500
29.44	41.384	551.652	32.56	44.048	685.141
29.50	41.450	554.137	32.62	44.096	687.786
29.56	41.516	556.626	32.68	44.144	690.433
29.62	41.582	559.119	32.74	44.192	693.083
29.68	41.648	561.616	32.80	44.240	695.736
29.74	41.714	564.117	32.86	44.288	698.392
29.80	41.780	566.622	32.92	44.336	701.051
29.86	41.846	569.131	32.98	44.384	703.712
29.92	41.912	571.644	33.04	44.432	706.377
29.98	41.978	574.160	33.10	44.480	709.044
30.04	42.032	576.681	33.16	44.528	711.714
30.10	42.080	579.204	33.22	44.576	714.387
30.16	42.128	581.730	33.28	44.624	717.063
30.22	42.176	584.259	33.34	44.672	719.742
30.28	42.224	586.791	33.40	44.720	722.424
30.34	42.272	589.326	33.46	44.768	725.109
30.40	42.320	591.864	33.52	44.816	727.796
30.46	42.368	594.405	33.58	44.864	730.487
30.52	42.416	596.948	33.64	44.912	733.180
30.58	42.464	599.495	33.70	44.960	735.876
30.64	42.512	602.044	33.76	45.008	738.575
30.70	42.560	604.596	33.82	45.056	741.277
30.76	42.608	607.151	33.88	45.104	743.982
30.82	42.656	609.709	33.94	45.152	746.689
30.88	42.704	612.270	34.00	45.200	749.400
30.94	42.752	614.833	34.06	45.248	752.113
31.00	42.800	617.400	34.12	45.296	754.830
31.06	42.848	619.969	34.18	45.344	757.549
31.12	42.896	622.542	34.24	45.392	760.271
31.18	42.944	625.117	34.30	45.440	762.996
31.24	42.992	627.695	34.36	45.488	765.724
31.30	43.040	630.276	34.42	45.536	768.455
31.36	43.088	632.860	34.48	45.584	771.188
31.42	43.136	635.447	34.54	45.632	773.925
31.48	43.184	638.036	34.60	45.680	776.664
31.54	43.232	640.629	34.66	45.728	779.406
31.60	43.280	643.224	34.72	45.776	782.151
31.66	43.328	645.822	34.78	45.824	784.899
31.72	43.376	648.423	34.84	45.872	787.650
31.78	43.424	651.027	34.90	45.920	790.404

PROVIDED WQ V @ ELEV 30.00 = 575 AF

Stage-Area-Storage for Pond 1P: Busch Gardens BMP - Rhine River (continued)

Elevation (feet)	Surface (acres)	Storage (acre-feet)
34.96	45.968	793.161
35.02	46.016	795.920
35.08	46.064	798.683
35.14	46.112	801.448
35.20	46.160	804.216
35.26	46.208	806.987
35.32	46.256	809.761
35.38	46.304	812.538
35.44	46.352	815.317
35.50	46.400	818.100
35.56	46.448	820.885
35.62	46.496	823.674
35.68	46.544	826.465
35.74	46.592	829.259
35.80	46.640	832.056
35.86	46.688	834.856
35.92	46.736	837.659
35.98	46.784	840.464
36.04	46.832	843.273
36.10	46.880	846.084
36.16	46.928	848.898
36.22	46.976	851.715
36.28	47.024	854.535
36.34	47.072	857.358
36.40	47.120	860.184
36.46	47.168	863.013
36.52	47.216	865.844
36.58	47.264	868.679
36.64	47.312	871.516
36.70	47.360	874.356
36.76	47.408	877.199
36.82	47.456	880.045
36.88	47.504	882.894
36.94	47.552	885.745
37.00	47.600	888.600
37.06	47.648	891.457
37.12	47.696	894.318
37.18	47.744	897.181
37.24	47.792	900.047
37.30	47.840	902.916
37.36	47.888	905.788
37.42	47.936	908.663
37.48	47.984	911.540
37.54	48.032	914.421
37.60	48.080	917.304
37.66	48.128	920.190
37.72	48.176	923.079
37.78	48.224	925.971
37.84	48.272	928.866
37.90	48.320	931.764
37.96	48.368	934.665
38.02	48.416	937.568
38.08	48.464	940.475
38.14	48.512	943.384
38.20	48.560	946.296
38.26	48.608	949.211
38.32	48.656	952.129
38.38	48.704	955.050
38.44	48.752	957.973
38.50	48.800	960.900
38.56	48.848	963.829
38.62	48.896	966.762
38.68	48.944	969.697
38.74	48.992	972.635
38.80	49.040	975.576
38.86	49.088	978.520
38.92	49.136	981.467
38.98	49.184	984.416
39.04	49.232	987.369
39.10	49.280	990.324
39.16	49.328	993.282
39.22	49.376	996.243
39.28	49.424	999.207
39.34	49.472	1,002.174
39.40	49.520	1,005.144
39.46	49.568	1,008.117
39.52	49.616	1,011.092
39.58	49.664	1,014.071
39.64	49.712	1,017.052
39.70	49.760	1,020.036
39.76	49.808	1,023.023
39.82	49.856	1,026.013
39.88	49.904	1,029.006
39.94	49.952	1,032.001
40.00	50.000	1,035.000

SEDIMENT TRAP #1 SIZING CALCULATIONS

VHB Computations

Project: OCTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: JAMES CITY COUNTY Sheet of
Calculated by: P.S. Date: 02/09/11
Checked by: Date:
Title SEDIMENT TRAP SIZING CALCULATIONS

SEDIMENT TRAP SIZING CALCULATIONS

DRAINAGE AREA TO SEDIMENT FOREBAY = 2.98 Ac

134 cy/Ac

WET STORAGE REQUIRED

67 cy/Ac × 2.99 Ac × 27 ft³/cy = 5,409 ft³

PROVIDED WET STORAGE 5,667 ft³ @ ELEV = 32.80

DRY STORAGE REQUIRED

67 cy/Ac × 2.99 Ac × 27 ft³/cy = 5,409 ft³

PROVIDED DRY STORAGE 5,574 ft³ @ ELEV = 35.00

CLEANOUT ELEVATION PROVIDED AT ELEV = 31.00

5,667 ft³ / 2 = 2,834 ft³

mkgr forms humanres computations pm65

Vanasse Hangen Brustlin, Inc.

Stage-Area-Storage for Pond ST: Sediment Trap

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
27.00	307	0	28.14	502	467
27.02	310	8	28.16	506	478
27.04	314	15	28.18	510	490
27.06	317	23	28.20	514	501
27.08	320	31	28.22	518	513
27.10	324	39	28.24	523	524
27.12	327	46	28.26	527	536
27.14	330	54	28.28	531	547
27.16	333	62	28.30	535	559
27.18	337	70	28.32	540	570
27.20	340	77	28.34	544	582
27.22	343	85	28.36	548	593
27.24	347	93	28.38	552	605
27.26	350	101	28.40	556	616
27.28	353	108	28.42	561	628
27.30	357	116	28.44	565	639
27.32	360	124	28.46	569	651
27.34	363	131	28.48	573	662
27.36	366	139	28.50	578	674
27.38	370	147	28.52	582	685
27.40	373	155	28.54	586	697
27.42	376	162	28.56	590	708
27.44	380	170	28.58	594	720
27.46	383	178	28.60	599	731
27.48	386	186	28.62	603	743
27.50	390	193	28.64	607	754
27.52	393	201	28.66	611	766
27.54	396	209	28.68	615	777
27.56	399	216	28.70	620	789
27.58	403	224	28.72	624	800
27.60	406	232	28.74	628	812
27.62	409	240	28.76	632	823
27.64	413	247	28.78	637	834
27.66	416	255	28.80	641	846
27.68	419	263	28.82	645	857
27.70	422	271	28.84	649	869
27.72	426	278	28.86	653	880
27.74	429	286	28.88	658	892
27.76	432	294	28.90	662	903
27.78	436	302	28.92	666	915
27.80	439	309	28.94	670	926
27.82	442	317	28.96	675	938
27.84	446	325	28.98	679	949
27.86	449	332	29.00	683	961
27.88	452	340	29.02	688	977
27.90	455	348	29.04	692	993
27.92	459	356	29.06	697	1,008
27.94	462	363	29.08	701	1,024
27.96	465	371	29.10	706	1,040
27.98	469	379	29.12	710	1,056
28.00	472	387	29.14	715	1,072
28.02	476	398	29.16	720	1,088
28.04	480	410	29.18	724	1,104
28.06	485	421	29.20	729	1,120
28.08	489	432	29.22	733	1,136
28.10	493	444	29.24	738	1,152
28.12	497	455	29.26	743	1,167

Stage-Area-Storage for Pond ST: Sediment Trap (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
29.28	747	1,183	30.42	1,047	2,204
29.30	752	1,199	30.44	1,053	2,226
29.32	756	1,215	30.46	1,060	2,247
29.34	761	1,231	30.48	1,066	2,268
29.36	765	1,247	30.50	1,073	2,290
29.38	770	1,263	30.52	1,079	2,311
29.40	775	1,279	30.54	1,085	2,333
29.42	779	1,295	30.56	1,092	2,354
29.44	784	1,311	30.58	1,098	2,375
29.46	788	1,326	30.60	1,105	2,397
29.48	793	1,342	30.62	1,111	2,418
29.50	798	1,358	30.64	1,117	2,439
29.52	802	1,374	30.66	1,124	2,461
29.54	807	1,390	30.68	1,130	2,482
29.56	811	1,406	30.70	1,137	2,503
29.58	816	1,422	30.72	1,143	2,525
29.60	820	1,438	30.74	1,150	2,546
29.62	825	1,454	30.76	1,156	2,568
29.64	830	1,469	30.78	1,162	2,589
29.66	834	1,485	30.80	1,169	2,610
29.68	839	1,501	30.82	1,175	2,632
29.70	843	1,517	30.84	1,182	2,653
29.72	848	1,533	30.86	1,188	2,674
29.74	852	1,549	30.88	1,194	2,696
29.76	857	1,565	30.90	1,201	2,717
29.78	862	1,581	30.92	1,207	2,739
29.80	866	1,597	30.94	1,214	2,760
29.82	871	1,613	30.96	1,220	2,781
29.84	875	1,628	30.98	1,227	2,803
29.86	880	1,644	31.00	1,233	2,824
29.88	885	1,660	31.02	1,241	2,852
29.90	889	1,676	31.04	1,249	2,881
29.92	894	1,692	31.06	1,256	2,909
29.94	898	1,708	31.08	1,264	2,938
29.96	903	1,724	31.10	1,272	2,966
29.98	907	1,740	31.12	1,280	2,995
30.00	912	1,756	31.14	1,287	3,023
30.02	918	1,777	31.16	1,295	3,052
30.04	925	1,798	31.18	1,303	3,080
30.06	931	1,820	31.20	1,311	3,109
30.08	938	1,841	31.22	1,319	3,137
30.10	944	1,862	31.24	1,326	3,166
30.12	951	1,884	31.26	1,334	3,194
30.14	957	1,905	31.28	1,342	3,222
30.16	963	1,927	31.30	1,350	3,251
30.18	970	1,948	31.32	1,357	3,279
30.20	976	1,969	31.34	1,365	3,308
30.22	983	1,991	31.36	1,373	3,336
30.24	989	2,012	31.38	1,381	3,365
30.26	995	2,033	31.40	1,389	3,393
30.28	1,002	2,055	31.42	1,396	3,422
30.30	1,008	2,076	31.44	1,404	3,450
30.32	1,015	2,097	31.46	1,412	3,479
30.34	1,021	2,119	31.48	1,420	3,507
30.36	1,028	2,140	31.50	1,428	3,536
30.38	1,034	2,162	31.52	1,435	3,564
30.40	1,040	2,183	31.54	1,443	3,592

Stage-Area-Storage for Pond ST: Sediment Trap (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
31.56	1,451	3,621
31.58	1,459	3,649
31.60	1,466	3,678
31.62	1,474	3,706
31.64	1,482	3,735
31.66	1,490	3,763
31.68	1,498	3,792
31.70	1,505	3,820
31.72	1,513	3,849
31.74	1,521	3,877
31.76	1,529	3,906
31.78	1,536	3,934
31.80	1,544	3,962
31.82	1,552	3,991
31.84	1,560	4,019
31.86	1,568	4,048
31.88	1,575	4,076
31.90	1,583	4,105
31.92	1,591	4,133
31.94	1,599	4,162
31.96	1,606	4,190
31.98	1,614	4,219
32.00	1,622	4,247
32.02	1,628	4,281
32.04	1,633	4,315
32.06	1,639	4,349
32.08	1,645	4,382
32.10	1,650	4,416
32.12	1,656	4,450
32.14	1,661	4,484
32.16	1,667	4,518
32.18	1,673	4,552
32.20	1,678	4,585
32.22	1,684	4,619
32.24	1,690	4,653
32.26	1,695	4,687
32.28	1,701	4,721
32.30	1,707	4,755
32.32	1,712	4,789
32.34	1,718	4,822
32.36	1,724	4,856
32.38	1,729	4,890
32.40	1,735	4,924
32.42	1,740	4,958
32.44	1,746	4,992
32.46	1,752	5,025
32.48	1,757	5,059
32.50	1,763	5,093
32.52	1,775	5,131
32.54	1,787	5,170
32.56	1,800	5,208
32.58	1,812	5,246
32.60	1,824	5,284
32.62	1,836	5,323
32.64	1,849	5,361
32.66	1,861	5,399
32.68	1,873	5,438
32.70	1,885	5,476
32.72	1,898	5,514
32.74	1,910	5,552
32.76	1,922	5,591
32.78	1,934	5,629
32.80	1,947	5,667
32.82	1,959	5,706
32.84	1,971	5,744
32.86	1,983	5,782
32.88	1,996	5,820
32.90	2,008	5,859
32.92	2,020	5,897
32.94	2,032	5,935
32.96	2,045	5,974
32.98	2,057	6,012
33.00	2,069	6,050
33.02	2,080	6,097
33.04	2,090	6,143
33.06	2,101	6,190
33.08	2,111	6,236
33.10	2,122	6,283
33.12	2,132	6,329
33.14	2,143	6,376
33.16	2,153	6,423
33.18	2,164	6,469
33.20	2,175	6,516
33.22	2,185	6,562
33.24	2,196	6,609
33.26	2,206	6,655
33.28	2,217	6,702
33.30	2,227	6,748
33.32	2,238	6,795
33.34	2,249	6,842
33.36	2,259	6,888
33.38	2,270	6,935
33.40	2,280	6,981
33.42	2,291	7,028
33.44	2,301	7,074
33.46	2,312	7,121
33.48	2,322	7,168
33.50	2,333	7,214
33.52	2,344	7,261
33.54	2,354	7,307
33.56	2,365	7,354
33.58	2,375	7,400
33.60	2,386	7,447
33.62	2,396	7,493
33.64	2,407	7,540
33.66	2,417	7,587
33.68	2,428	7,633
33.70	2,439	7,680
33.72	2,449	7,726
33.74	2,460	7,773
33.76	2,470	7,819
33.78	2,481	7,866
33.80	2,491	7,912
33.82	2,502	7,959

WET STORAGE PROVIDED 5,667 ft³ @ ELEV = 32.80

Stage-Area-Storage for Pond ST: Sediment Trap (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
33.84	2,513	8,006
33.86	2,523	8,052
33.88	2,534	8,099
33.90	2,544	8,145
33.92	2,555	8,192
33.94	2,565	8,238
33.96	2,576	8,285
33.98	2,586	8,332
34.00	2,597	8,378
34.02	2,608	8,435
34.04	2,619	8,493
34.06	2,629	8,550
34.08	2,640	8,607
34.10	2,651	8,664
34.12	2,662	8,722
34.14	2,673	8,779
34.16	2,684	8,836
34.18	2,694	8,893
34.20	2,705	8,951
34.22	2,716	9,008
34.24	2,727	9,065
34.26	2,738	9,123
34.28	2,748	9,180
34.30	2,759	9,237
34.32	2,770	9,294
34.34	2,781	9,352
34.36	2,792	9,409
34.38	2,803	9,466
34.40	2,813	9,523
34.42	2,824	9,581
34.44	2,835	9,638
34.46	2,846	9,695
34.48	2,857	9,752
34.50	2,868	9,810
34.52	2,878	9,867
34.54	2,889	9,924
34.56	2,900	9,982
34.58	2,911	10,039
34.60	2,922	10,096
34.62	2,932	10,153
34.64	2,943	10,211
34.66	2,954	10,268
34.68	2,965	10,325
34.70	2,976	10,382
34.72	2,987	10,440
34.74	2,997	10,497
34.76	3,008	10,554
34.78	3,019	10,611
34.80	3,030	10,669
34.82	3,041	10,726
34.84	3,051	10,783
34.86	3,062	10,840
34.88	3,073	10,898
34.90	3,084	10,955
34.92	3,095	11,012
34.94	3,106	11,070
34.96	3,116	11,127
34.98	3,127	11,184
35.00	**3,138**	**11,241**

DRY STORAGE PROVIDED 5,574 ft3 @ ELEV = 35.00

SEDIMENT TRAP #2 SIZING CALCULATIONS

VHB Computations

Project: OKTOBERFEST ATTACTION EXPANSION | Project # 33.299.00
Location: JAMES CITY COUNTY | Sheet of
Calculated by: P.S. | Date: 03/14/11
Checked by: | Date:
Title SEDIMENT TRAP SIZING CALCULATIONS

SEDIMENT TRAP #2

DA TO ST #2 = 0.68Ac

Imp AREA = 0.18Ac

PERVIOUS AREA = 0.50 Ac

$C = (0.50Ac \times 0.35 + 0.18 Ac \times 0.90) / 0.68Ac = 0.50$

WEST STORAGE REQUIRED:

$67 \text{ cy/Ac} \times 0.68Ac \times 27 \text{ ft}^3/\text{cy} = 1{,}230 \text{ ft}^3$

PROVIDED WET STORAGE $1{,}248 \text{ ft}^3$ @ ELEV = 81.50

DRY STORAGE REQUIRED:

$67 \text{ cy/Ac} \times 0.68Ac \times 27 \text{ ft}^3/\text{cy} = 1{,}230 \text{ ft}^3$

PROVIDED DRY STORAGE $1{,}372 \text{ ft}^3$ @ ELEV = 83.00

Stage-Area-Storage for Pond ST 2: Sediment Trap 2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
79.00	282	0	79.57	372	186
79.01	283	3	79.58	374	190
79.02	285	6	79.59	375	193
79.03	286	9	79.60	377	197
79.04	288	11	79.61	379	201
79.05	289	14	79.62	380	205
79.06	291	17	79.63	382	208
79.07	292	20	79.64	384	212
79.08	294	23	79.65	386	216
79.09	295	26	79.66	387	220
79.10	297	29	79.67	389	224
79.11	298	32	79.68	391	228
79.12	300	35	79.69	392	232
79.13	301	38	79.70	394	236
79.14	303	41	79.71	396	240
79.15	304	44	79.72	398	243
79.16	306	47	79.73	399	247
79.17	308	50	79.74	401	251
79.18	309	53	79.75	403	255
79.19	311	56	79.76	405	260
79.20	312	59	79.77	406	264
79.21	314	63	79.78	408	268
79.22	315	66	79.79	410	272
79.23	317	69	79.80	412	276
79.24	318	72	79.81	414	280
79.25	320	75	79.82	415	284
79.26	321	78	79.83	417	288
79.27	323	82	79.84	419	292
79.28	325	85	79.85	421	297
79.29	326	88	79.86	422	301
79.30	328	91	79.87	424	305
79.31	329	95	79.88	426	309
79.32	331	98	79.89	428	314
79.33	333	101	79.90	430	318
79.34	334	105	79.91	431	322
79.35	336	108	79.92	433	327
79.36	337	111	79.93	435	331
79.37	339	115	79.94	437	335
79.38	341	118	79.95	439	340
79.39	342	122	79.96	441	344
79.40	344	125	79.97	442	348
79.41	345	128	79.98	444	353
79.42	347	132	79.99	446	357
79.43	349	135	80.00	448	362
79.44	350	139	80.01	450	366
79.45	352	142	80.02	451	371
79.46	354	146	80.03	453	375
79.47	355	149	80.04	455	380
79.48	357	153	80.05	457	384
79.49	359	157	80.06	459	389
79.50	360	160	80.07	460	394
79.51	362	164	80.08	462	398
79.52	364	167	80.09	464	403
79.53	365	171	80.10	466	407
79.54	367	175	80.11	467	412
79.55	369	178	80.12	469	417
79.56	370	182	80.13	471	422

Stage-Area-Storage for Pond ST 2: Sediment Trap 2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
80.14	473	426	80.71	580	726
80.15	474	431	80.72	582	732
80.16	476	436	80.73	584	737
80.17	478	441	80.74	586	743
80.18	480	445	80.75	588	749
80.19	482	450	80.76	590	755
80.20	483	455	80.77	592	761
80.21	485	460	80.78	594	767
80.22	487	465	80.79	596	773
80.23	489	470	80.80	598	779
80.24	491	474	80.81	600	785
80.25	493	479	80.82	602	791
80.26	494	484	80.83	604	797
80.27	496	489	80.84	606	803
80.28	498	494	80.85	608	809
80.29	500	499	80.86	610	815
80.30	502	504	80.87	612	821
80.31	504	509	80.88	614	827
80.32	505	514	80.89	616	833
80.33	507	519	80.90	618	840
80.34	509	524	80.91	620	846
80.35	511	530	80.92	622	852
80.36	513	535	80.93	625	858
80.37	515	540	80.94	627	865
80.38	517	545	80.95	629	871
80.39	518	550	80.96	631	877
80.40	520	555	80.97	633	883
80.41	522	561	80.98	635	890
80.42	524	566	80.99	637	896
80.43	526	571	81.00	639	902
80.44	528	576	81.01	641	909
80.45	530	582	81.02	643	915
80.46	532	587	81.03	645	922
80.47	534	592	81.04	647	928
80.48	535	598	81.05	649	935
80.49	537	603	81.06	651	941
80.50	539	608	81.07	653	948
80.51	541	614	81.08	655	954
80.52	543	619	81.09	657	961
80.53	545	625	81.10	659	967
80.54	547	630	81.11	661	974
80.55	549	635	81.12	663	981
80.56	551	641	81.13	665	987
80.57	553	646	81.14	667	994
80.58	555	652	81.15	669	1,001
80.59	557	658	81.16	671	1,007
80.60	559	663	81.17	674	1,014
80.61	560	669	81.18	676	1,021
80.62	562	674	81.19	678	1,028
80.63	564	680	81.20	680	1,034
80.64	566	686	81.21	682	1,041
80.65	568	691	81.22	684	1,048
80.66	570	697	81.23	686	1,055
80.67	572	703	81.24	688	1,062
80.68	574	708	81.25	690	1,069
80.69	576	714	81.26	692	1,075
80.70	578	720	81.27	694	1,082

Stage-Area-Storage for Pond ST 2: Sediment Trap 2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
81.28	696	1,089	81.85	821	1,521
81.29	698	1,096	81.86	823	1,529
81.30	701	1,103	81.87	825	1,538
81.31	703	1,110	81.88	827	1,546
81.32	705	1,117	81.89	830	1,554
81.33	707	1,124	81.90	832	1,563
81.34	709	1,132	81.91	834	1,571
81.35	711	1,139	81.92	837	1,579
81.36	713	1,146	81.93	839	1,588
81.37	715	1,153	81.94	841	1,596
81.38	717	1,160	81.95	843	1,604
81.39	720	1,167	81.96	846	1,613
81.40	722	1,174	81.97	848	1,621
81.41	724	1,182	81.98	850	1,630
81.42	726	1,189	81.99	853	1,638
81.43	728	1,196	82.00	855	1,647
81.44	730	1,203	82.01	857	1,655
81.45	732	1,211	82.02	860	1,664
81.46	734	1,218	82.03	862	1,673
81.47	737	1,225	82.04	864	1,681
81.48	739	1,233	82.05	866	1,690
81.49	741	1,240	82.06	869	1,699
81.50	743	1,248	82.07	871	1,707
81.51	745	1,255	82.08	873	1,716
81.52	747	1,263	82.09	875	1,725
81.53	750	1,270	82.10	878	1,734
81.54	752	1,278	82.11	880	1,742
81.55	754	1,285	82.12	882	1,751
81.56	756	1,293	82.13	885	1,760
81.57	758	1,300	82.14	887	1,769
81.58	760	1,308	82.15	889	1,778
81.59	763	1,315	82.16	892	1,787
81.60	765	1,323	82.17	894	1,796
81.61	767	1,331	82.18	896	1,804
81.62	769	1,338	82.19	898	1,813
81.63	771	1,346	82.20	901	1,822
81.64	774	1,354	82.21	903	1,831
81.65	776	1,362	82.22	905	1,841
81.66	778	1,369	82.23	908	1,850
81.67	780	1,377	82.24	910	1,859
81.68	782	1,385	82.25	912	1,868
81.69	785	1,393	82.26	915	1,877
81.70	787	1,401	82.27	917	1,886
81.71	789	1,409	82.28	919	1,895
81.72	791	1,416	82.29	922	1,904
81.73	794	1,424	82.30	924	1,914
81.74	796	1,432	82.31	927	1,923
81.75	798	1,440	82.32	929	1,932
81.76	800	1,448	82.33	931	1,942
81.77	803	1,456	82.34	934	1,951
81.78	805	1,464	82.35	936	1,960
81.79	807	1,472	82.36	938	1,970
81.80	809	1,480	82.37	941	1,979
81.81	812	1,489	82.38	943	1,988
81.82	814	1,497	82.39	945	1,998
81.83	816	1,505	82.40	948	2,007
81.84	818	1,513	82.41	950	2,017

WET STORAGE REQUIRED 1,230 ft³ @ ELEV=81.49

WET STORAGE PROVIDED 1,248 ft³ @ ELEV=81.50

@81.5 1248

@83 2,620

1230
1230
2460

Stage-Area-Storage for Pond ST 2: Sediment Trap 2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
82.42	953	2,026
82.43	955	2,036
82.44	957	2,045
82.45	960	2,055
82.46	962	2,065
82.47	965	2,074
82.48	967	2,084
82.49	969	2,094
82.50	972	2,103
82.51	974	2,113
82.52	977	2,123
82.53	979	2,133
82.54	981	2,142
82.55	984	2,152
82.56	986	2,162
82.57	989	2,172
82.58	991	2,182
82.59	994	2,192
82.60	996	2,202
82.61	998	2,212
82.62	1,001	2,222
82.63	1,003	2,232
82.64	1,006	2,242
82.65	1,008	2,252
82.66	1,011	2,262
82.67	1,013	2,272
82.68	1,016	2,282
82.69	1,018	2,292
82.70	1,021	2,302
82.71	1,023	2,313
82.72	1,026	2,323
82.73	1,028	2,333
82.74	1,030	2,343
82.75	1,033	2,354
82.76	1,035	2,364
82.77	1,038	2,375
82.78	1,040	2,385
82.79	1,043	2,395
82.80	1,045	2,406
82.81	1,048	2,416
82.82	1,050	2,427
82.83	1,053	2,437
82.84	1,055	2,448
82.85	1,058	2,458
82.86	1,060	2,469
82.87	1,063	2,480
82.88	1,066	2,490
82.89	1,068	2,501
82.90	1,071	2,512
82.91	1,073	2,522
82.92	1,076	2,533
82.93	1,078	2,544
82.94	1,081	2,555
82.95	1,083	2,565
82.96	1,086	2,576
82.97	1,088	2,587
82.98	1,091	2,598
82.99	1,093	2,609
83.00	1,096	2,620
83.01	1,099	2,631
83.02	1,101	2,642
83.03	1,104	2,653
83.04	1,106	2,664
83.05	1,109	2,675
83.06	1,111	2,686
83.07	1,114	2,697
83.08	1,116	2,708
83.09	1,119	2,720
83.10	1,121	2,731
83.11	1,124	2,742
83.12	1,127	2,753
83.13	1,129	2,765
83.14	1,132	2,776
83.15	1,134	2,787
83.16	1,137	2,798
83.17	1,139	2,810
83.18	1,142	2,821
83.19	1,144	2,833
83.20	1,147	2,844
83.21	1,150	2,856
83.22	1,152	2,867
83.23	1,155	2,879
83.24	1,157	2,890
83.25	1,160	2,902
83.26	1,163	2,913
83.27	1,165	2,925
83.28	1,168	2,937
83.29	1,170	2,948
83.30	1,173	2,960
83.31	1,176	2,972
83.32	1,178	2,984
83.33	1,181	2,995
83.34	1,184	3,007
83.35	1,186	3,019
83.36	1,189	3,031
83.37	1,191	3,043
83.38	1,194	3,055
83.39	1,197	3,067
83.40	1,199	3,079
83.41	1,202	3,091
83.42	1,205	3,103
83.43	1,207	3,115
83.44	1,210	3,127
83.45	1,213	3,139
83.46	1,215	3,151
83.47	1,218	3,163
83.48	1,221	3,176
83.49	1,223	3,188
83.50	1,226	3,200
83.51	1,229	3,212
83.52	1,231	3,225
83.53	1,234	3,237
83.54	1,237	3,249
83.55	1,239	3,262

DRY STORAGE REQUIRED 1,230 ft³
DRY STORAGE PROVIDED 1,372 ft³ @ ELEV = 83.00

Stage-Area-Storage for Pond ST 2: Sediment Trap 2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
83.56	1,242	3,274
83.57	1,245	3,287
83.58	1,247	3,299
83.59	1,250	3,311
83.60	1,253	3,324
83.61	1,255	3,337
83.62	1,258	3,349
83.63	1,261	3,362
83.64	1,264	3,374
83.65	1,266	3,387
83.66	1,269	3,400
83.67	1,272	3,412
83.68	1,274	3,425
83.69	1,277	3,438
83.70	1,280	3,451
83.71	1,283	3,463
83.72	1,285	3,476
83.73	1,288	3,489
83.74	1,291	3,502
83.75	1,294	3,515
83.76	1,296	3,528
83.77	1,299	3,541
83.78	1,302	3,554
83.79	1,305	3,567
83.80	1,307	3,580
83.81	1,310	3,593
83.82	1,313	3,606
83.83	1,316	3,619
83.84	1,318	3,632
83.85	1,321	3,646
83.86	1,324	3,659
83.87	1,327	3,672
83.88	1,329	3,685
83.89	1,332	3,699
83.90	1,335	3,712
83.91	1,338	3,725
83.92	1,341	3,739
83.93	1,343	3,752
83.94	1,346	3,766
83.95	1,349	3,779
83.96	1,352	3,793
83.97	1,355	3,806
83.98	1,357	3,820
83.99	1,360	3,833
84.00	1,363	3,847

TEMPORARY SLOPE DRAIN SIZING CALCULATIONS

VHB *Computations*

Project: OKTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: JAMES CITY COUNTY Sheet of
Calculated by: P.J Date:
Checked by: Date:
Title TEMPORARY SLOPE DRAIN

TOTAL DRAINAGE AREA TO TSD-1 ; TSD-2 ; TSD-3

0.30Ac + 1.34Ac + 0.53Ac = 2.17Ac

24" TEMPORARY SLOPE DRAIN HAS BEEN SPECIFIED

TOTAL DRAINAGE AREA TSD-4 = 0.47Ac

12" TEMPORARY SLOPE DRAIN HAS BEEN SPECIFIED

TABLE 3.15-A

SIZE OF SLOPE DRAIN

Maximum Drainage Area (acres)	Pipe Diameter (inches)
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

DRAINAGE AREA
TSD-4 = 0.47Ac

DRAINAGE AREAS
TSD-1 ; TSD-2
TSD-3 = 2.17Ac

Source: Va. DSWC

Dike Design

An earthen dike shall be used to direct stormwater runoff into the temporary slope drain and shall be constructed as set forth in DIVERSION, Std. & Spec. 3.12. See Plate 3.15-1 for placement of dike in relation to the slope drain.

The height of the dike at the centerline of the inlet shall be equal to the diameter of the pipe plus 6 inches. Where the dike height is greater than 18 inches at the inlet, it shall be sloped at the rate of 3:1 or flatter to connect with the remainder of the dike (see Plate 3.15-1).

Outlet Protection

The outlet of the slope drain must be protected from erosion as set forth in OUTLET PROTECTION, Std. & Spec. 3.18.

Construction Specifications

1. The measure shall be placed on undisturbed soil or well-compacted fill.

2. The entrance section shall slope toward the slope drain at the minimum rate of 1/2-inch per foot.

3. The soil around and under the entrance section shall be hand-tamped in 8-inch lifts to the top of the dike to prevent piping failure around the inlet.

SEDIMENT FOREBAY WATER QUALITY CALCULATIONS

VHB Computations

Project: OKTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: GCC Sheet of
Calculated by: P.S. Date: 03/22/11
Checked by: Date:
Title SEDIMENT FOREBAY WATER QUALITY CALCULATIONS

DRAINAGE AREA TO SEDIMENT FOREBAY = 7.15 Ac

IMP AREA TO SEDIMENT FOREBAY = 2.83 Ac

SEDIMENT FOREBAY SIZED FOR 25% OF REQUIRED WATER QUALITY VOLUME

$$0.25 \times 4 \times \frac{0.5 \text{ inch}}{12 \frac{\text{inch}}{\text{ft}}} \times 2.83 \text{ Ac} \times 43560 \text{ ft}^2/\text{Ac} = 5{,}137 \text{ ft}^3$$

REQUIRED STORAGE VOLUME FOR WATER QUALITY

5,137 ft³

WET STORAGE PROVIDED IN SEDIMENT FOREBAY

5,667 ft³ @ ELEV = 32.80

BOTTOM ELEV = 27.00

WET STORAGE ELEV = 35.00

DRY STORAGE ELEV = 35.00

CLEANOUT ELEV = 31.00

Stage-Area-Storage for Pond SF: Sediment Forebay

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
27.00	307	0	28.14	502	467
27.02	310	8	28.16	506	478
27.04	314	15	28.18	510	490
27.06	317	23	28.20	514	501
27.08	320	31	28.22	518	513
27.10	324	39	28.24	523	524
27.12	327	46	28.26	527	536
27.14	330	54	28.28	531	547
27.16	333	62	28.30	535	559
27.18	337	70	28.32	540	570
27.20	340	77	28.34	544	582
27.22	343	85	28.36	548	593
27.24	347	93	28.38	552	605
27.26	350	101	28.40	556	616
27.28	353	108	28.42	561	628
27.30	357	116	28.44	565	639
27.32	360	124	28.46	569	651
27.34	363	131	28.48	573	662
27.36	366	139	28.50	578	674
27.38	370	147	28.52	582	685
27.40	373	155	28.54	586	697
27.42	376	162	28.56	590	708
27.44	380	170	28.58	594	720
27.46	383	178	28.60	599	731
27.48	386	186	28.62	603	743
27.50	390	193	28.64	607	754
27.52	393	201	28.66	611	766
27.54	396	209	28.68	615	777
27.56	399	216	28.70	620	789
27.58	403	224	28.72	624	800
27.60	406	232	28.74	628	812
27.62	409	240	28.76	632	823
27.64	413	247	28.78	637	834
27.66	416	255	28.80	641	846
27.68	419	263	28.82	645	857
27.70	422	271	28.84	649	869
27.72	426	278	28.86	653	880
27.74	429	286	28.88	658	892
27.76	432	294	28.90	662	903
27.78	436	302	28.92	666	915
27.80	439	309	28.94	670	926
27.82	442	317	28.96	675	938
27.84	446	325	28.98	679	949
27.86	449	332	29.00	683	961
27.88	452	340	29.02	688	977
27.90	455	348	29.04	692	993
27.92	459	356	29.06	697	1,008
27.94	462	363	29.08	701	1,024
27.96	465	371	29.10	706	1,040
27.98	469	379	29.12	710	1,056
28.00	472	387	29.14	715	1,072
28.02	476	398	29.16	720	1,088
28.04	480	410	29.18	724	1,104
28.06	485	421	29.20	729	1,120
28.08	489	432	29.22	733	1,136
28.10	493	444	29.24	738	1,152
28.12	497	455	29.26	743	1,167

Stage-Area-Storage for Pond SF: Sediment Forebay (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
29.28	747	1,183	30.42	1,047	2,204
29.30	752	1,199	30.44	1,053	2,226
29.32	756	1,215	30.46	1,060	2,247
29.34	761	1,231	30.48	1,066	2,268
29.36	765	1,247	30.50	1,073	2,290
29.38	770	1,263	30.52	1,079	2,311
29.40	775	1,279	30.54	1,085	2,333
29.42	779	1,295	30.56	1,092	2,354
29.44	784	1,311	30.58	1,098	2,375
29.46	788	1,326	30.60	1,105	2,397
29.48	793	1,342	30.62	1,111	2,418
29.50	798	1,358	30.64	1,117	2,439
29.52	802	1,374	30.66	1,124	2,461
29.54	807	1,390	30.68	1,130	2,482
29.56	811	1,406	30.70	1,137	2,503
29.58	816	1,422	30.72	1,143	2,525
29.60	820	1,438	30.74	1,150	2,546
29.62	825	1,454	30.76	1,156	2,568
29.64	830	1,469	30.78	1,162	2,589
29.66	834	1,485	30.80	1,169	2,610
29.68	839	1,501	30.82	1,175	2,632
29.70	843	1,517	30.84	1,182	2,653
29.72	848	1,533	30.86	1,188	2,674
29.74	852	1,549	30.88	1,194	2,696
29.76	857	1,565	30.90	1,201	2,717
29.78	862	1,581	30.92	1,207	2,739
29.80	866	1,597	30.94	1,214	2,760
29.82	871	1,613	30.96	1,220	2,781
29.84	875	1,628	30.98	1,227	2,803
29.86	880	1,644	31.00	1,233	2,824
29.88	885	1,660	31.02	1,241	2,852
29.90	889	1,676	31.04	1,249	2,881
29.92	894	1,692	31.06	1,256	2,909
29.94	898	1,708	31.08	1,264	2,938
29.96	903	1,724	31.10	1,272	2,966
29.98	907	1,740	31.12	1,280	2,995
30.00	912	1,756	31.14	1,287	3,023
30.02	918	1,777	31.16	1,295	3,052
30.04	925	1,798	31.18	1,303	3,080
30.06	931	1,820	31.20	1,311	3,109
30.08	938	1,841	31.22	1,319	3,137
30.10	944	1,862	31.24	1,326	3,166
30.12	951	1,884	31.26	1,334	3,194
30.14	957	1,905	31.28	1,342	3,222
30.16	963	1,927	31.30	1,350	3,251
30.18	970	1,948	31.32	1,357	3,279
30.20	976	1,969	31.34	1,365	3,308
30.22	983	1,991	31.36	1,373	3,336
30.24	989	2,012	31.38	1,381	3,365
30.26	995	2,033	31.40	1,389	3,393
30.28	1,002	2,055	31.42	1,396	3,422
30.30	1,008	2,076	31.44	1,404	3,450
30.32	1,015	2,097	31.46	1,412	3,479
30.34	1,021	2,119	31.48	1,420	3,507
30.36	1,028	2,140	31.50	1,428	3,536
30.38	1,034	2,162	31.52	1,435	3,564
30.40	1,040	2,183	31.54	1,443	3,592

Stage-Area-Storage for Pond SF: Sediment Forebay (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
31.56	1,451	3,621
31.58	1,459	3,649
31.60	1,466	3,678
31.62	1,474	3,706
31.64	1,482	3,735
31.66	1,490	3,763
31.68	1,498	3,792
31.70	1,505	3,820
31.72	1,513	3,849
31.74	1,521	3,877
31.76	1,529	3,906
31.78	1,536	3,934
31.80	1,544	3,962
31.82	1,552	3,991
31.84	1,560	4,019
31.86	1,568	4,048
31.88	1,575	4,076
31.90	1,583	4,105
31.92	1,591	4,133
31.94	1,599	4,162
31.96	1,606	4,190
31.98	1,614	4,219
32.00	1,622	4,247
32.02	1,628	4,281
32.04	1,633	4,315
32.06	1,639	4,349
32.08	1,645	4,382
32.10	1,650	4,416
32.12	1,656	4,450
32.14	1,661	4,484
32.16	1,667	4,518
32.18	1,673	4,552
32.20	1,678	4,585
32.22	1,684	4,619
32.24	1,690	4,653
32.26	1,695	4,687
32.28	1,701	4,721
32.30	1,707	4,755
32.32	1,712	4,789
32.34	1,718	4,822
32.36	1,724	4,856
32.38	1,729	4,890
32.40	1,735	4,924
32.42	1,740	4,958
32.44	1,746	4,992
32.46	1,752	5,025
32.48	1,757	5,059
32.50	1,763	5,093
32.52	1,775	5,131
32.54	1,787	5,170
32.56	1,800	5,208
32.58	1,812	5,246
32.60	1,824	5,284
32.62	1,836	5,323
32.64	1,849	5,361
32.66	1,861	5,399
32.68	1,873	5,438
32.70	1,885	5,476
32.72	1,898	5,514
32.74	1,910	5,552
32.76	1,922	5,591
32.78	1,934	5,629
32.80	1,947	5,667
32.82	1,959	5,706
32.84	1,971	5,744
32.86	1,983	5,782
32.88	1,996	5,820
32.90	2,008	5,859
32.92	2,020	5,897
32.94	2,032	5,935
32.96	2,045	5,974
32.98	2,057	6,012
33.00	2,069	6,050
33.02	2,080	6,097
33.04	2,090	6,143
33.06	2,101	6,190
33.08	2,111	6,236
33.10	2,122	6,283
33.12	2,132	6,329
33.14	2,143	6,376
33.16	2,153	6,423
33.18	2,164	6,469
33.20	2,175	6,516
33.22	2,185	6,562
33.24	2,196	6,609
33.26	2,206	6,655
33.28	2,217	6,702
33.30	2,227	6,748
33.32	2,238	6,795
33.34	2,249	6,842
33.36	2,259	6,888
33.38	2,270	6,935
33.40	2,280	6,981
33.42	2,291	7,028
33.44	2,301	7,074
33.46	2,312	7,121
33.48	2,322	7,168
33.50	2,333	7,214
33.52	2,344	7,261
33.54	2,354	7,307
33.56	2,365	7,354
33.58	2,375	7,400
33.60	2,386	7,447
33.62	2,396	7,493
33.64	2,407	7,540
33.66	2,417	7,587
33.68	2,428	7,633
33.70	2,439	7,680
33.72	2,449	7,726
33.74	2,460	7,773
33.76	2,470	7,819
33.78	2,481	7,866
33.80	2,491	7,912
33.82	2,502	7,959

PROVIDED STORAGE VOLUME FOR WATER QUALITY @ ELEV=32.80

Stage-Area-Storage for Pond SF: Sediment Forebay (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
33.84	2,513	8,006
33.86	2,523	8,052
33.88	2,534	8,099
33.90	2,544	8,145
33.92	2,555	8,192
33.94	2,565	8,238
33.96	2,576	8,285
33.98	2,586	8,332
34.00	2,597	8,378
34.02	2,608	8,435
34.04	2,619	8,493
34.06	2,629	8,550
34.08	2,640	8,607
34.10	2,651	8,664
34.12	2,662	8,722
34.14	2,673	8,779
34.16	2,684	8,836
34.18	2,694	8,893
34.20	2,705	8,951
34.22	2,716	9,008
34.24	2,727	9,065
34.26	2,738	9,123
34.28	2,748	9,180
34.30	2,759	9,237
34.32	2,770	9,294
34.34	2,781	9,352
34.36	2,792	9,409
34.38	2,803	9,466
34.40	2,813	9,523
34.42	2,824	9,581
34.44	2,835	9,638
34.46	2,846	9,695
34.48	2,857	9,752
34.50	2,868	9,810
34.52	2,878	9,867
34.54	2,889	9,924
34.56	2,900	9,982
34.58	2,911	10,039
34.60	2,922	10,096
34.62	2,932	10,153
34.64	2,943	10,211
34.66	2,954	10,268
34.68	2,965	10,325
34.70	2,976	10,382
34.72	2,987	10,440
34.74	2,997	10,497
34.76	3,008	10,554
34.78	3,019	10,611
34.80	3,030	10,669
34.82	3,041	10,726
34.84	3,051	10,783
34.86	3,062	10,840
34.88	3,073	10,898
34.90	3,084	10,955
34.92	3,095	11,012
34.94	3,106	11,070
34.96	3,116	11,127
34.98	3,127	11,184
35.00	**3,138**	**11,241**

SEDIMENT FOREBAY OUTFALL CALCULATIONS

VHB Computations

Project: OCTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: JCC Sheet of
Calculated by: P.S Date: 03/22/11
Checked by: Date:
Title SEDIMENT FOREBAY OUTFALL CALCULATIONS

DRAINAGE AREA TO SEDIMENT FOREBAY = 7.15 AC

$T_c = 9.0$ MIN

IMP = 2.83 AC PERV = 4.32 AC C = 0.57

2-YEAR STORM EVENT

$B_2 = 70.63$ $D_2 = 12.75$ $E_2 = 0.87$

$$I_2 = \frac{B_2}{(T_c + D_2)^{E_2}} = 4.85$$

$$Q_2 = CI_2A = 0.57 \times 7.15 \times 4.85 = 19.77 \text{ cfs}$$

10-year storm EVENT

$B_{10} = 55.61$ $D_{10} = 10.00$ $E_{10} = 0.74$

$$I_{10} = \frac{B_{10}}{(T_c + D_{10})^{E_{10}}} = 6.29$$

$$Q_{10} = CI_{10}A = 0.57 \times 6.29 \times 7.15 = 25.64 \text{ cfs}$$

25-year STORM EVENT

$B_{25} = 48.54$ $D_{25} = 8.50$ $E_{25} = 0.67$

$$I_{25} = \frac{B_{25}}{(T_c + D_{25})^{E_{25}}} = 7.13$$

$$Q_{25} = CI_{25}A = 0.57 \times 7.13 \times 7.15 = 29.06 \text{ cfs}$$

Label	Solve For	Discharge (ft^3/s)	Headwater Elevation (ft)	Crest Elevation (ft)	Tailwater Elevation (ft)	Crest Surface Type	Crest Breadth (ft)	Crest Length (ft)	Headwater Height Above Crest (ft)	Tailwater Height Above Crest (ft)	Weir Coefficient (US)	Submergence Factor	Adjusted Weir Coefficient (US)	Flow Area (ft^2)	Velocity (ft/s)	Wetted Perimeter (ft)	Top Width (ft)
Sediment Forebay Outfall 2-year	Discharge	19.77	35.62	35	30	Gravel	10	15	0.62	-5	2.73	1	2.73	9.23	2.14	16.23	15
Sediment Forebay Outfall 10-year	Discharge	25.64	35.73	35	30	Gravel	10	15	0.73	-5	2.76	1	2.76	10.9	2.35	16.45	15
Sediment Forebay Outfall 25-year	Discharge	29.06	35.79	35	30	Gravel	10	15	0.79	-5	2.78	1	2.78	11.8	2.46	16.57	15

Worksheet for Sediment Forebay Outfall 2-year

Project Description

Solve For	Headwater Elevation

Input Data

Discharge		19.77	ft^3/s
Crest Elevation		35.00	ft
Tailwater Elevation		30.00	ft
Crest Surface Type	Gravel		
Crest Breadth		10.00	ft
Crest Length		15.00	ft

Results

Headwater Elevation	35.62	ft
Headwater Height Above Crest	0.62	ft
Tailwater Height Above Crest	-5.00	ft
Weir Coefficient	2.73	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	2.73	US
Flow Area	9.23	ft^2
Velocity	2.14	ft/s
Wetted Perimeter	16.23	ft
Top Width	15.00	ft

Worksheet for Sediment Forebay Outfall 10-year

Project Description

Solve For	Headwater Elevation

Input Data

Discharge		25.64	ft^3/s
Crest Elevation		35.00	ft
Tailwater Elevation		30.00	ft
Crest Surface Type	Gravel		
Crest Breadth		10.00	ft
Crest Length		15.00	ft

Results

Headwater Elevation	35.73	ft
Headwater Height Above Crest	0.73	ft
Tailwater Height Above Crest	-5.00	ft
Weir Coefficient	2.76	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	2.76	US
Flow Area	10.90	ft^2
Velocity	2.35	ft/s
Wetted Perimeter	16.45	ft
Top Width	15.00	ft

Worksheet for Sediment Forebay Outfall 25-year

Project Description

Solve For	Headwater Elevation

Input Data

Discharge		29.06	ft³/s
Crest Elevation		35.00	ft
Tailwater Elevation		30.00	ft
Crest Surface Type	Gravel		
Crest Breadth		10.00	ft
Crest Length		15.00	ft

Results

Headwater Elevation	35.79	ft
Headwater Height Above Crest	0.79	ft
Tailwater Height Above Crest	-5.00	ft
Weir Coefficient	2.78	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	2.78	US
Flow Area	11.80	ft²
Velocity	2.46	ft/s
Wetted Perimeter	16.57	ft
Top Width	15.00	ft

STORM SEWER CALCULATIONS 10-YEAR STORM EVENT

VHB Inc.
Storm Sewer Design Computations
Oktoberfest Attraction Expansion

DATE: March-11 PROJECT NO. 33299.00

55.61 = B (10-YR) 10.00 = D 0.74 = E		AREA DRAIN. "A"	RUNOFF COEF.	CA		INLET TIME	RAIN FALL	RUNOFF "Q"		INVERT ELEVATIONS		PIPE LNGTH	SLOPE	DIA	CAPA-CITY	VEL.	FLOW TIME	REMARKS		
FROM POINT	TO POINT	ACRES	C	INCRE-MENT	ACCUM-ULATED	MIN-UTES	IN.\HR	INCRE-MENT	ACCUM-ULATED	UPPER END	LOWER END	FT.	FT./FT.	IN.	C.F.S.	F.P.S.	MIN.		RIM	MANN. N
1	2	0.60	0.71	0.43	0.43	5.00	7.50	3.19	3.19	54.08	53.82	26	0.010	15	6.46	5.25	0.08	PR-DI-3B	59.03	0.013
2	3	0.21	0.43	0.09	0.52	5.08	7.47	0.67	3.85	53.72	53.16	56	0.010	15	6.46	5.49	0.17	PR-DI-3B	57.85	0.013
3B	3A	0.53	0.74	0.39	0.39	5.00	7.50	2.94	2.94	76.00	73.30	121	0.022	15	9.64	6.87	0.29	PR-DI-7	80.50 80.00	0.013
3A	3	1.34	0.68	0.91	0.91	8.00	6.55	5.97	5.97	56.25	53.55	54	0.050	15	14.44	11.05	0.08	PR-DI-7	77.00	0.013
3	4	0.26	0.50	0.13	1.56	8.08	6.53	0.85	10.17	53.06	52.50	56	0.010	24	22.61	7.01	0.13	PR-DI-3B	57.35	0.013
4	5	0.18	0.50	0.09	1.65	8.21	6.49	0.58	10.70	52.40	51.93	47	0.010	24	22.61	7.10	0.11	PR-DI-3B	56.85	0.013
5	6	0.22	0.53	0.12	1.76	8.32	6.46	0.75	11.40	51.83	51.08	75	0.010	24	22.61	7.21	0.17	PR-DI-3B	56.40	0.013
6	7	0.24	0.67	0.16	1.92	8.50	6.42	1.03	12.36	50.98	50.00	98	0.010	24	22.61	7.36	0.22	PR-DI-3B	55.90	0.013
303	302	1.48	0.43	0.64	0.64	9.15	6.26	3.98	3.98	78.48	73.28	130	0.040	15	12.91	9.27	0.23	FES	79.79	0.013
302	301	0.00	0.00	0.00	0.64	9.38	6.26	0.00	3.98	62.00	60.80	30	0.040	15	12.91	9.27	0.05	PR-MH	80.50	0.013
301	7	0.00	0.00	0.00	0.64	9.44	6.26	0.00	3.98	51.65	50.93	18	0.040	15	12.91	9.27	0.03	PR-MH	65.50	0.013
7	8	0.69	0.62	0.43	2.99	8.72	6.36	2.72	19.02	40.54	38.38	144	0.015	30	50.21	9.53	0.25	PR-DI-3C	54.75	0.013
8	9	0.00	0.00	0.00	2.99	8.97	6.36	0.00	19.02	27.95	27.01	52	0.018	30	55.00	10.18	0.09	PR-MH	45.00	0.013

VHB Inc.
Hydraulic Gradeline Computations 10 Yr Storm
Oktoberfest Attraction Expansion

DATE: March-11

PROJECT NO : 33299.00

RCP PIPE n= 0.013

INLET STATIO	OUTLET SURFAC	D(O)	Q(O)	L(O)	SF(O)	H(F)	JUNCTION LOSS														FINAL H	INLET SURFAC	RIM ELEV
							V(O)	H(O)	Q(I)	D(I)	V(I)	Q*V	$V^2/2G$	H(I)	ANGLE	E K	H(>)	H(T)	1*3 H(T)	0.5*			
	Sediment Forebay 10-year storm WSEL																						
8	35.73	30	19.02	52	0.0038	0.20	10.18	0.4023	19.02	30	9.53	181	1.41	0.49	0	0.00	0.00	0.90	1.16	0.58	0.78	36.51	45.00
7	40.38	30	19.02	144	0.0038	0.54	9.53	0.3526	12.36	30	7.36	91	0.84	0.29	46	0.43	0.36	1.01	1.31	0.66	1.20	41.58	54.75
									3.98	15	9.27	37											
6	52.00	30	12.36	98	0.0016	0.16	7.36	0.2103	11.40	24	7.21	82	0.81	0.28	15	0.10	0.08	0.57	0.75	0.37	0.53	52.53	55.90
5	52.68	24	11.40	75	0.0025	0.19	7.21	0.2018	10.70	24	7.10	76	0.78	0.27	28	0.22	0.17	0.65	0.84	0.42	0.61	53.29	56.40
4	53.53	24	10.70	47	0.0022	0.11	7.10	0.1957	10.17	24	7.01	71	0.76	0.27	62	0.47	0.36	0.82	1.07	0.53	0.64	54.17	56.85
3	54.17	24	10.17	56	0.0020	0.11	7.01	0.1908	5.97	15	11.05	66	1.90	0.66	75	0.64	1.21	2.07	2.69	1.34	1.46	55.63	57.35
									3.85	15	5.49	21											
3A	55.63	15	5.97	54	0.0085	0.46	11.05	0.4740	2.94	15	6.87	20	0.73	0.26	80	0.66	0.48	1.21	1.58	0.79	1.25	56.88	77.00
3B	74.30	15	2.94	121	0.0021	0.25	6.87	0.1832										0.18	0.24	0.12	0.37	74.67	80.00
2	55.63	15	3.85	56	0.0036	0.20	5.49	0.1170	3.19	15	5.25	17	0.43	0.15	62	0.47	0.20	0.47	0.61	0.30	0.50	56.13	57.85
1	56.13	15	3.19	26	0.0024	0.06	5.25	0.1070										0.11	0.14	0.07	0.13	56.26	59.03

Worksheet for 1 to 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.25	ft
Discharge	3.19	ft^3/s

Results

Normal Depth	0.62	ft
Flow Area	0.61	ft^2
Wetted Perimeter	1.95	ft
Hydraulic Radius	0.31	ft
Top Width	1.25	ft
Critical Depth	0.72	ft
Percent Full	49.6	%
Critical Slope	0.00615	ft/ft
Velocity	5.25	ft/s
Velocity Head	0.43	ft
Specific Energy	1.05	ft
Froude Number	1.33	
Maximum Discharge	6.95	ft^3/s
Discharge Full	6.46	ft^3/s
Slope Full	0.00244	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.62	%
Downstream Velocity	Infinity	ft/s

Worksheet for 1 to 2

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.72	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00615	ft/ft

Worksheet for 2 to 3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.25	ft
Discharge	3.85	ft^3/s

Results

Normal Depth	0.69	ft
Flow Area	0.70	ft^2
Wetted Perimeter	2.10	ft
Hydraulic Radius	0.33	ft
Top Width	1.24	ft
Critical Depth	0.79	ft
Percent Full	55.6	%
Critical Slope	0.00665	ft/ft
Velocity	5.49	ft/s
Velocity Head	0.47	ft
Specific Energy	1.16	ft
Froude Number	1.29	
Maximum Discharge	6.95	ft^3/s
Discharge Full	6.46	ft^3/s
Slope Full	0.00355	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	55.60	%
Downstream Velocity	Infinity	ft/s

Worksheet for 2 to 3

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.69	ft
Critical Depth	0.79	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00665	ft/ft

Worksheet for 3B to 3A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02200	ft/ft
Diameter	1.25	ft
Discharge	2.94	ft^3/s

Results

Normal Depth	0.48	ft
Flow Area	0.43	ft^2
Wetted Perimeter	1.66	ft
Hydraulic Radius	0.26	ft
Top Width	1.21	ft
Critical Depth	0.69	ft
Percent Full	38.0	%
Critical Slope	0.00598	ft/ft
Velocity	6.87	ft/s
Velocity Head	0.73	ft
Specific Energy	1.21	ft
Froude Number	2.04	
Maximum Discharge	10.31	ft^3/s
Discharge Full	9.58	ft^3/s
Slope Full	0.00207	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	38.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for 3B to 3A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.69	ft
Channel Slope	0.02200	ft/ft
Critical Slope	0.00598	ft/ft

Worksheet for 3A to 3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.05000	ft/ft
Diameter	1.25	ft
Discharge	5.67	ft^3/s

Results

Normal Depth	0.54	ft
Flow Area	0.51	ft^2
Wetted Perimeter	1.80	ft
Hydraulic Radius	0.28	ft
Top Width	1.24	ft
Critical Depth	0.96	ft
Percent Full	43.5	%
Critical Slope	0.00870	ft/ft
Velocity	11.05	ft/s
Velocity Head	1.90	ft
Specific Energy	2.44	ft
Froude Number	3.03	
Maximum Discharge	15.54	ft^3/s
Discharge Full	14.44	ft^3/s
Slope Full	0.00771	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	43.54	%
Downstream Velocity	Infinity	ft/s

Worksheet for 3A to 3

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	0.96	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.00870	ft/ft

Worksheet for 3 to 4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	10.17	ft^3/s

Results

Normal Depth	0.94	ft
Flow Area	1.45	ft^2
Wetted Perimeter	3.02	ft
Hydraulic Radius	0.48	ft
Top Width	2.00	ft
Critical Depth	1.14	ft
Percent Full	47.0	%
Critical Slope	0.00523	ft/ft
Velocity	7.01	ft/s
Velocity Head	0.76	ft
Specific Energy	1.70	ft
Froude Number	1.45	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00202	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	47.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for 3 to 4

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.94	ft
Critical Depth	1.14	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00523	ft/ft

Worksheet for 4 to 5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	10.70	ft^3/s

Results

Normal Depth	0.97	ft
Flow Area	1.51	ft^2
Wetted Perimeter	3.08	ft
Hydraulic Radius	0.49	ft
Top Width	2.00	ft
Critical Depth	1.17	ft
Percent Full	48.4	%
Critical Slope	0.00533	ft/ft
Velocity	7.10	ft/s
Velocity Head	0.78	ft
Specific Energy	1.75	ft
Froude Number	1.44	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00224	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	48.41	%
Downstream Velocity	Infinity	ft/s

Worksheet for 4 to 5

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.97	ft
Critical Depth	1.17	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00533	ft/ft

Worksheet for 5 to 6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	11.40	ft^3/s

Results

Normal Depth	1.00	ft
Flow Area	1.58	ft^2
Wetted Perimeter	3.15	ft
Hydraulic Radius	0.50	ft
Top Width	2.00	ft
Critical Depth	1.21	ft
Percent Full	50.2	%
Critical Slope	0.00546	ft/ft
Velocity	7.21	ft/s
Velocity Head	0.81	ft
Specific Energy	1.81	ft
Froude Number	1.43	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00254	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.24	%
Downstream Velocity	Infinity	ft/s

Worksheet for 5 to 6

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	1.21	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00546	ft/ft

Worksheet for 6 to 7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	12.36	ft^3/s

Results

Normal Depth	1.05	ft
Flow Area	1.68	ft^2
Wetted Perimeter	3.25	ft
Hydraulic Radius	0.52	ft
Top Width	2.00	ft
Critical Depth	1.26	ft
Percent Full	52.7	%
Critical Slope	0.00566	ft/ft
Velocity	7.36	ft/s
Velocity Head	0.84	ft
Specific Energy	1.90	ft
Froude Number	1.42	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00299	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	52.71	%
Downstream Velocity	Infinity	ft/s

Worksheet for 6 to 7

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.05	ft
Critical Depth	1.26	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00566	ft/ft

Worksheet for 7 to 8

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01500	ft/ft
Diameter	2.50	ft
Discharge	19.02	ft^3/s

Results

Normal Depth	1.07	ft
Flow Area	2.00	ft^2
Wetted Perimeter	3.56	ft
Hydraulic Radius	0.56	ft
Top Width	2.47	ft
Critical Depth	1.48	ft
Percent Full	42.6	%
Critical Slope	0.00497	ft/ft
Velocity	9.53	ft/s
Velocity Head	1.41	ft
Specific Energy	2.48	ft
Froude Number	1.87	
Maximum Discharge	54.04	ft^3/s
Discharge Full	50.23	ft^3/s
Slope Full	0.00215	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	42.65	%
Downstream Velocity	Infinity	ft/s

Worksheet for 7 to 8

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.07	ft
Critical Depth	1.48	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00497	ft/ft

Worksheet for 8 to 9

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01800	ft/ft
Diameter	2.50	ft
Discharge	19.02	ft^3/s

Results

Normal Depth	1.01	ft
Flow Area	1.87	ft^2
Wetted Perimeter	3.45	ft
Hydraulic Radius	0.54	ft
Top Width	2.46	ft
Critical Depth	1.48	ft
Percent Full	40.6	%
Critical Slope	0.00498	ft/ft
Velocity	10.18	ft/s
Velocity Head	1.61	ft
Specific Energy	2.63	ft
Froude Number	2.06	
Maximum Discharge	59.19	ft^3/s
Discharge Full	55.03	ft^3/s
Slope Full	0.00215	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	40.56	%
Downstream Velocity	Infinity	ft/s

Worksheet for 8 to 9

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.01	ft
Critical Depth	1.48	ft
Channel Slope	0.01800	ft/ft
Critical Slope	0.00498	ft/ft

Worksheet for 303 to 302

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.04000	ft/ft
Diameter	1.25	ft
Discharge	3.98	ft^3/s

Results

Normal Depth	0.48	ft
Flow Area	0.43	ft^2
Wetted Perimeter	1.66	ft
Hydraulic Radius	0.26	ft
Top Width	1.21	ft
Critical Depth	0.81	ft
Percent Full	38.1	%
Critical Slope	0.00676	ft/ft
Velocity	9.27	ft/s
Velocity Head	1.34	ft
Specific Energy	1.81	ft
Froude Number	2.75	
Maximum Discharge	13.90	ft^3/s
Discharge Full	12.92	ft^3/s
Slope Full	0.00380	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	38.08	%
Downstream Velocity	Infinity	ft/s

Worksheet for 303 to 302

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.81	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.00676	ft/ft

Worksheet for 302 to 301

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.04000	ft/ft
Diameter	1.25	ft
Discharge	3.98	ft^3/s

Results

Normal Depth	0.48	ft
Flow Area	0.43	ft^2
Wetted Perimeter	1.66	ft
Hydraulic Radius	0.26	ft
Top Width	1.21	ft
Critical Depth	0.81	ft
Percent Full	38.1	%
Critical Slope	0.00676	ft/ft
Velocity	9.27	ft/s
Velocity Head	1.34	ft
Specific Energy	1.81	ft
Froude Number	2.75	
Maximum Discharge	13.90	ft^3/s
Discharge Full	12.92	ft^3/s
Slope Full	0.00380	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	38.08	%
Downstream Velocity	Infinity	ft/s

Worksheet for 302 to 301

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.81	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.00676	ft/ft

Worksheet for 301 to 7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.04000	ft/ft
Diameter	1.25	ft
Discharge	3.98	ft^3/s

Results

Normal Depth	0.48	ft
Flow Area	0.43	ft^2
Wetted Perimeter	1.66	ft
Hydraulic Radius	0.26	ft
Top Width	1.21	ft
Critical Depth	0.81	ft
Percent Full	38.1	%
Critical Slope	0.00676	ft/ft
Velocity	9.27	ft/s
Velocity Head	1.34	ft
Specific Energy	1.81	ft
Froude Number	2.75	
Maximum Discharge	13.90	ft^3/s
Discharge Full	12.92	ft^3/s
Slope Full	0.00380	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	38.08	%
Downstream Velocity	Infinity	ft/s

Worksheet for 301 to 7

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.81	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.00676	ft/ft

Worksheet for 200 to 201

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.05000	ft/ft
Diameter	0.50	ft
Discharge	0.25	ft^3/s

Results

Normal Depth	0.15	ft
Flow Area	0.05	ft^2
Wetted Perimeter	0.58	ft
Hydraulic Radius	0.09	ft
Top Width	0.46	ft
Critical Depth	0.25	ft
Percent Full	30.3	%
Critical Slope	0.00774	ft/ft
Velocity	4.98	ft/s
Velocity Head	0.38	ft
Specific Energy	0.54	ft
Froude Number	2.65	
Maximum Discharge	1.35	ft^3/s
Discharge Full	1.25	ft^3/s
Slope Full	0.00199	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	30.30	%
Downstream Velocity	Infinity	ft/s

Worksheet for 200 to 201

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.15	ft
Critical Depth	0.25	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.00774	ft/ft

Worksheet for 201 to 202

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.10900	ft/ft
Diameter	0.50	ft
Discharge	0.51	ft^3/s

Results

Normal Depth	0.18	ft
Flow Area	0.06	ft^2
Wetted Perimeter	0.64	ft
Hydraulic Radius	0.10	ft
Top Width	0.48	ft
Critical Depth	0.36	ft
Percent Full	35.8	%
Critical Slope	0.01065	ft/ft
Velocity	8.07	ft/s
Velocity Head	1.01	ft
Specific Energy	1.19	ft
Froude Number	3.92	
Maximum Discharge	1.99	ft^3/s
Discharge Full	1.85	ft^3/s
Slope Full	0.00826	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	35.82	%
Downstream Velocity	Infinity	ft/s

Worksheet for 201 to 202

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.18	ft
Critical Depth	0.36	ft
Channel Slope	0.10900	ft/ft
Critical Slope	0.01065	ft/ft

Worksheet for 202 to 203

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.06500	ft/ft
Diameter	0.50	ft
Discharge	0.51	ft^3/s

Results

Normal Depth	0.21	ft
Flow Area	0.08	ft^2
Wetted Perimeter	0.70	ft
Hydraulic Radius	0.11	ft
Top Width	0.49	ft
Critical Depth	0.36	ft
Percent Full	41.2	%
Critical Slope	0.01064	ft/ft
Velocity	6.68	ft/s
Velocity Head	0.69	ft
Specific Energy	0.90	ft
Froude Number	2.99	
Maximum Discharge	1.54	ft^3/s
Discharge Full	1.43	ft^3/s
Slope Full	0.00826	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	41.23	%
Downstream Velocity	Infinity	ft/s

Worksheet for 202 to 203

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.36	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.01064	ft/ft

Worksheet for 203 to 204

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.06500	ft/ft
Diameter	0.50	ft
Discharge	0.51	ft^3/s

Results

Normal Depth	0.21	ft
Flow Area	0.08	ft^2
Wetted Perimeter	0.70	ft
Hydraulic Radius	0.11	ft
Top Width	0.49	ft
Critical Depth	0.36	ft
Percent Full	41.2	%
Critical Slope	0.01064	ft/ft
Velocity	6.68	ft/s
Velocity Head	0.69	ft
Specific Energy	0.90	ft
Froude Number	2.99	
Maximum Discharge	1.54	ft^3/s
Discharge Full	1.43	ft^3/s
Slope Full	0.00826	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	41.23	%
Downstream Velocity	Infinity	ft/s

Worksheet for 203 to 204

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.36	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.01064	ft/ft

Worksheet for 204 to 205

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.03600	ft/ft
Diameter	0.50	ft
Discharge	0.51	ft^3/s

Results

Normal Depth	0.24	ft
Flow Area	0.10	ft^2
Wetted Perimeter	0.77	ft
Hydraulic Radius	0.12	ft
Top Width	0.50	ft
Critical Depth	0.36	ft
Percent Full	48.7	%
Critical Slope	0.01066	ft/ft
Velocity	5.37	ft/s
Velocity Head	0.45	ft
Specific Energy	0.69	ft
Froude Number	2.17	
Maximum Discharge	1.15	ft^3/s
Discharge Full	1.06	ft^3/s
Slope Full	0.00826	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	48.75	%
Downstream Velocity	Infinity	ft/s

Worksheet for 204 to 205

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.24	ft
Critical Depth	0.36	ft
Channel Slope	0.03600	ft/ft
Critical Slope	0.01066	ft/ft

STORM SEWER CALCULATIONS 100-YEAR STORM EVENT

VHB Inc.
Storm Sewer Design Computations
Oktoberfest Attraction Expansion

DATE: March-11

PROJECT NO. 33299.00

36.77 = B (100-YR) 5.25 0.56		AREA DRAIN. "A"	RUNOFF COEF.	CA		INLET TIME	RAIN FALL	RUNOFF "Q"		INVERT ELEVATIONS		PIPE LNGTH	SLOPE	DIA	CAPA-CITY	VEL.	FLOW TIME	REMARKS		
FROM POINT	TO POINT	ACRES	C	INCRE-MENT	ACCUM-ULATED	MIN-UTES	IN.\HR	INCRE-MENT	ACCUM-ULATED	UPPER END	LOWER END	FT.	FT./FT.	IN.	C.F.S.	F.P.S.	MIN.		RIM	MANN. N
1	2	0.60	0.71	0.43	0.43	5:00	9.99	4.25	4.25	54.08	53.82	26	0.010	15	6.46	5.62	0.08	PR-DI-3B	59.03	0.013
2	3	0.21	0.43	0.09	0.52	5.08	9.95	0.90	5.14	53.72	53.16	56	0.010	15	6.46	5.84	0.16	PR-DI-3B	57.85	0.013
3B	3A	0.53	0.74	0.39	0.39	5.00	9.99	3.92	3.92	76.00	73.30	121	0.022	15	9.64	7.41	0.27	PR-DI-7	80.00	0.013
3A	3	1.34	0.68	0.91	0.91	8.00	8.65	7.88	7.88	56.25	53.55	54	0.050	15	14.44	12.03	0.07	PR-DI-7	77.00	0.013
3	4	0.26	0.50	0.13	1.56	8.07	8.62	1.12	13.43	53.06	52.50	56	0.010	24	22.61	7.51	0.12	PR-DI-3B	57.35	0.013
4	5	0.18	0.50	0.09	1.65	8.20	8.58	0.77	14.13	52.40	51.93	47	0.010	24	22.61	7.60	0.10	PR-DI-3B	56.85	0.013
5	6	0.22	0.53	0.12	1.76	8.30	8.54	1.00	15.07	51.83	51.08	75	0.010	24	22.61	7.71	0.16	PR-DI-3B	56.40	0.013
6	7	0.24	0.67	0.16	1.92	8.46	8.49	1.36	16.33	50.98	50.00	98	0.010	24	22.61	7.84	0.21	PR-DI-3B	55.90	0.013
303	302	1.48	0.43	0.64	0.64	9.15	8.26	5.25	5.25	78.48	73.28	130	0.040	15	12.91	9.98	0.22	FES	79.79	0.013
302	301	0.00	0.00	0.00	0.64	9.37	8.26	0.00	5.25	62.00	60.80	30	0.040	15	12.91	9.98	0.05	PR-MH	80.50	0.013
301	7	0.00	0.00	0.00	0.64	9.42	8.26	0.00	5.25	51.65	50.93	18	0.040	15	12.91	9.98	0.03	PR-MH	65.50	0.013
7	8	0.69	0.62	0.43	2.99	8.67	8.41	3.60	25.15	40.54	38.38	144	0.015	30	50.21	10.24	0.23	PR-DI-3C	54.75	0.013
8	9	0.00	0.00	0.00	2.99	8.91	8.41	0.00	25.15	27.95	27.01	52	0.018	30	55.00	10.96	0.08	PR-MH	45.00	0.013

VHB Inc.
Hydraulic Gradeline Computations 100 Yr Storm
Oktoberfest Attraction Expansion

DATE: March-11

PROJECT NO : 33299.00

RCP PIPE n= 0.013

INLET STATIO	OUTLET SURFAC	D(O)	Q(O)	L(O)	SF(O)	H(F)	JUNCTION LOSS															FINAL H	INLET SURFAC	RIM ELEV
							V(O)	H(O)	Q(I)	D(I)	V(I)	Q*V	$V^2/2G$	H(I)	ANGLE	E K	H(>)	H(T)	1*3 H(T)	0.5*				
	Sediment Forebay 100-year storm WSEL																							
8	35.85	30	25.15	52	0.0066	0.34	10.96	0.4663	25.15	30	10.24	258	1.63	0.57	0	0.00	0.00	1.04	1.35	0.67	1.02	36.87	45.00
7	40.38	30	25.15	144	0.0066	0.95	10.24	0.4071	16.33	30	7.84	128	0.95	0.33	46	0.43	0.41	1.15	1.50	0.75	1.70	42.08	54.75
									5.25	15	9.98	52											
6	52.00	30	16.33	98	0.0028	0.27	7.84	0.2386	15.07	24	7.71	116	0.92	0.32	15	0.10	0.09	0.65	0.85	0.43	0.70	52.70	55.90
5	52.70	24	15.07	75	0.0044	0.33	7.71	0.2308	14.13	24	7.60	107	0.90	0.31	28	0.22	0.20	0.74	0.96	0.48	0.82	53.51	56.40
4	53.53	24	14.13	47	0.0039	0.18	7.60	0.2242	13.43	24	7.51	101	0.88	0.31	62	0.47	0.41	0.94	1.23	0.61	0.80	54.33	56.85
3	54.33	24	13.43	56	0.0035	0.20	7.51	0.2189	7.88	15	12.03	95	2.25	0.79	75	0.64	1.44	2.44	3.18	1.59	1.79	56.11	57.35
									5.14	15	5.84	30											
3A	56.11	15	7.88	54	0.0149	0.80	12.03	0.5618	3.92	15	7.41	29	0.85	0.30	80	0.66	0.56	1.42	1.85	0.92	1.73	57.84	77.00
3B	74.30	15	3.92	121	0.0037	0.45	7.41	0.2132										0.21	0.28	0.14	0.58	74.89	80.00
2	56.11	15	5.14	56	0.0063	0.35	5.84	0.1324	4.25	15	5.62	24	0.49	0.17	62	0.47	0.23	0.53	0.69	0.35	0.70	56.81	57.85
1	56.81	15	4.25	26	0.0043	0.11	5.62	0.1226										0.12	0.16	0.08	0.19	57.01	59.03

Worksheet for 1 to 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.25	ft
Discharge	4.25	ft^3/s

Results

Normal Depth	0.74	ft
Flow Area	0.76	ft^2
Wetted Perimeter	2.19	ft
Hydraulic Radius	0.34	ft
Top Width	1.23	ft
Critical Depth	0.84	ft
Percent Full	59.2	%
Critical Slope	0.00701	ft/ft
Velocity	5.62	ft/s
Velocity Head	0.49	ft
Specific Energy	1.23	ft
Froude Number	1.26	
Maximum Discharge	6.95	ft^3/s
Discharge Full	6.46	ft^3/s
Slope Full	0.00433	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	59.20	%
Downstream Velocity	Infinity	ft/s

Worksheet for 1 to 2

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.74	ft
Critical Depth	0.84	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00701	ft/ft

Worksheet for 2 to 3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.25	ft
Discharge	5.14	ft^3/s

Results

Normal Depth	0.84	ft
Flow Area	0.88	ft^2
Wetted Perimeter	2.41	ft
Hydraulic Radius	0.37	ft
Top Width	1.17	ft
Critical Depth	0.92	ft
Percent Full	67.4	%
Critical Slope	0.00798	ft/ft
Velocity	5.84	ft/s
Velocity Head	0.53	ft
Specific Energy	1.37	ft
Froude Number	1.19	
Maximum Discharge	6.95	ft^3/s
Discharge Full	6.46	ft^3/s
Slope Full	0.00633	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	67.39	%
Downstream Velocity	Infinity	ft/s

Worksheet for 2 to 3

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.84	ft
Critical Depth	0.92	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00798	ft/ft

Worksheet for 3B to 3A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02200	ft/ft
Diameter	1.25	ft
Discharge	3.92	ft^3/s

Results

Normal Depth	0.56	ft
Flow Area	0.53	ft^2
Wetted Perimeter	1.83	ft
Hydraulic Radius	0.29	ft
Top Width	1.24	ft
Critical Depth	0.80	ft
Percent Full	44.6	%
Critical Slope	0.00671	ft/ft
Velocity	7.41	ft/s
Velocity Head	0.85	ft
Specific Energy	1.41	ft
Froude Number	2.00	
Maximum Discharge	10.31	ft^3/s
Discharge Full	9.58	ft^3/s
Slope Full	0.00368	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	44.56	%
Downstream Velocity	Infinity	ft/s

Worksheet for 3B to 3A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.56	ft
Critical Depth	0.80	ft
Channel Slope	0.02200	ft/ft
Critical Slope	0.00671	ft/ft

Worksheet for 3A to 3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.05000	ft/ft
Diameter	1.25	ft
Discharge	7.88	ft^3/s

Results

Normal Depth	0.66	ft
Flow Area	0.66	ft^2
Wetted Perimeter	2.03	ft
Hydraulic Radius	0.32	ft
Top Width	1.25	ft
Critical Depth	1.11	ft
Percent Full	52.7	%
Critical Slope	0.01327	ft/ft
Velocity	12.03	ft/s
Velocity Head	2.25	ft
Specific Energy	2.91	ft
Froude Number	2.93	
Maximum Discharge	15.54	ft^3/s
Discharge Full	14.44	ft^3/s
Slope Full	0.01488	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	52.66	%
Downstream Velocity	Infinity	ft/s

Worksheet for 3A to 3

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	1.11	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.01327	ft/ft

Worksheet for 3 to 4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	13.43	ft^3/s

Results

Normal Depth	1.11	ft
Flow Area	1.79	ft^2
Wetted Perimeter	3.36	ft
Hydraulic Radius	0.53	ft
Top Width	1.99	ft
Critical Depth	1.32	ft
Percent Full	55.5	%
Critical Slope	0.00591	ft/ft
Velocity	7.51	ft/s
Velocity Head	0.88	ft
Specific Energy	1.99	ft
Froude Number	1.40	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00352	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	55.46	%
Downstream Velocity	Infinity	ft/s

Worksheet for 3 to 4

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.11	ft
Critical Depth	1.32	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00591	ft/ft

Worksheet for 4 to 5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	14.13	ft^3/s

Results

Normal Depth	1.15	ft
Flow Area	1.86	ft^2
Wetted Perimeter	3.43	ft
Hydraulic Radius	0.54	ft
Top Width	1.98	ft
Critical Depth	1.35	ft
Percent Full	57.3	%
Critical Slope	0.00608	ft/ft
Velocity	7.60	ft/s
Velocity Head	0.90	ft
Specific Energy	2.04	ft
Froude Number	1.38	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00390	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	57.26	%
Downstream Velocity	Infinity	ft/s

Worksheet for 4 to 5

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.15	ft
Critical Depth	1.35	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00608	ft/ft

Worksheet for 5 to 6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	15.07	ft^3/s

Results

Normal Depth	1.19	ft
Flow Area	1.96	ft^2
Wetted Perimeter	3.53	ft
Hydraulic Radius	0.55	ft
Top Width	1.96	ft
Critical Depth	1.40	ft
Percent Full	59.7	%
Critical Slope	0.00634	ft/ft
Velocity	7.71	ft/s
Velocity Head	0.92	ft
Specific Energy	2.12	ft
Froude Number	1.36	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00444	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	59.68	%
Downstream Velocity	Infinity	ft/s

Worksheet for 5 to 6

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.19	ft
Critical Depth	1.40	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00634	ft/ft

Worksheet for 6 to 7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.00	ft
Discharge	16.33	ft^3/s

Results

Normal Depth	1.26	ft
Flow Area	2.08	ft^2
Wetted Perimeter	3.66	ft
Hydraulic Radius	0.57	ft
Top Width	1.93	ft
Critical Depth	1.46	ft
Percent Full	62.9	%
Critical Slope	0.00672	ft/ft
Velocity	7.84	ft/s
Velocity Head	0.96	ft
Specific Energy	2.21	ft
Froude Number	1.33	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00521	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	62.93	%
Downstream Velocity	Infinity	ft/s

Worksheet for 6 to 7

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.26	ft
Critical Depth	1.46	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00672	ft/ft

Worksheet for 7 to 8

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01500	ft/ft
Diameter	2.50	ft
Discharge	25.15	ft^3/s

Results

Normal Depth	1.25	ft
Flow Area	2.46	ft^2
Wetted Perimeter	3.93	ft
Hydraulic Radius	0.63	ft
Top Width	2.50	ft
Critical Depth	1.71	ft
Percent Full	50.0	%
Critical Slope	0.00571	ft/ft
Velocity	10.24	ft/s
Velocity Head	1.63	ft
Specific Energy	2.88	ft
Froude Number	1.82	
Maximum Discharge	54.04	ft^3/s
Discharge Full	50.23	ft^3/s
Slope Full	0.00376	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.05	%
Downstream Velocity	Infinity	ft/s

Worksheet for 7 to 8

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.25	ft
Critical Depth	1.71	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00571	ft/ft

Worksheet for 8 to 9

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01800	ft/ft
Diameter	2.50	ft
Discharge	25.15	ft^3/s

Results

Normal Depth	1.19	ft
Flow Area	2.29	ft^2
Wetted Perimeter	3.80	ft
Hydraulic Radius	0.60	ft
Top Width	2.50	ft
Critical Depth	1.71	ft
Percent Full	47.4	%
Critical Slope	0.00571	ft/ft
Velocity	10.96	ft/s
Velocity Head	1.87	ft
Specific Energy	3.05	ft
Froude Number	2.02	
Maximum Discharge	59.19	ft^3/s
Discharge Full	55.03	ft^3/s
Slope Full	0.00376	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	47.44	%
Downstream Velocity	Infinity	ft/s

Worksheet for 8 to 9

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.19	ft
Critical Depth	1.71	ft
Channel Slope	0.01800	ft/ft
Critical Slope	0.00571	ft/ft

Worksheet for 303 to 302

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.04000	ft/ft
Diameter	1.25	ft
Discharge	5.25	ft^3/s

Results

Normal Depth	0.55	ft
Flow Area	0.53	ft^2
Wetted Perimeter	1.82	ft
Hydraulic Radius	0.29	ft
Top Width	1.24	ft
Critical Depth	0.93	ft
Percent Full	44.4	%
Critical Slope	0.00811	ft/ft
Velocity	9.98	ft/s
Velocity Head	1.55	ft
Specific Energy	2.10	ft
Froude Number	2.70	
Maximum Discharge	13.90	ft^3/s
Discharge Full	12.92	ft^3/s
Slope Full	0.00661	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	44.39	%
Downstream Velocity	Infinity	ft/s

Worksheet for 303 to 302

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.93	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.00811	ft/ft

Worksheet for 302 to 301

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.04000	ft/ft
Diameter	1.25	ft
Discharge	5.25	ft^3/s

Results

Normal Depth	0.55	ft
Flow Area	0.53	ft^2
Wetted Perimeter	1.82	ft
Hydraulic Radius	0.29	ft
Top Width	1.24	ft
Critical Depth	0.93	ft
Percent Full	44.4	%
Critical Slope	0.00811	ft/ft
Velocity	9.98	ft/s
Velocity Head	1.55	ft
Specific Energy	2.10	ft
Froude Number	2.70	
Maximum Discharge	13.90	ft^3/s
Discharge Full	12.92	ft^3/s
Slope Full	0.00661	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	44.39	%
Downstream Velocity	Infinity	ft/s

Worksheet for 302 to 301

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.93	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.00811	ft/ft

Worksheet for 301 to 7

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.04000	ft/ft
Diameter	1.25	ft
Discharge	5.25	ft^3/s

Results

Normal Depth	0.55	ft
Flow Area	0.53	ft^2
Wetted Perimeter	1.82	ft
Hydraulic Radius	0.29	ft
Top Width	1.24	ft
Critical Depth	0.93	ft
Percent Full	44.4	%
Critical Slope	0.00811	ft/ft
Velocity	9.98	ft/s
Velocity Head	1.55	ft
Specific Energy	2.10	ft
Froude Number	2.70	
Maximum Discharge	13.90	ft^3/s
Discharge Full	12.92	ft^3/s
Slope Full	0.00661	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	44.39	%
Downstream Velocity	Infinity	ft/s

Worksheet for 301 to 7

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.93	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.00811	ft/ft

Worksheet for 200 to 201

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.05000	ft/ft
Diameter	0.50	ft
Discharge	0.34	ft^3/s

Results

Normal Depth	0.18	ft
Flow Area	0.06	ft^2
Wetted Perimeter	0.64	ft
Hydraulic Radius	0.10	ft
Top Width	0.48	ft
Critical Depth	0.30	ft
Percent Full	35.6	%
Critical Slope	0.00849	ft/ft
Velocity	5.42	ft/s
Velocity Head	0.46	ft
Specific Energy	0.63	ft
Froude Number	2.64	
Maximum Discharge	1.35	ft^3/s
Discharge Full	1.25	ft^3/s
Slope Full	0.00367	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	35.61	%
Downstream Velocity	Infinity	ft/s

Worksheet for 200 to 201

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.18	ft
Critical Depth	0.30	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.00849	ft/ft

Worksheet for 201 to 202

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.10900	ft/ft
Diameter	0.50	ft
Discharge	0.68	ft^3/s

Results

Normal Depth	0.21	ft
Flow Area	0.08	ft^2
Wetted Perimeter	0.70	ft
Hydraulic Radius	0.11	ft
Top Width	0.49	ft
Critical Depth	0.42	ft
Percent Full	41.9	%
Critical Slope	0.01426	ft/ft
Velocity	8.71	ft/s
Velocity Head	1.18	ft
Specific Energy	1.39	ft
Froude Number	3.86	
Maximum Discharge	1.99	ft^3/s
Discharge Full	1.85	ft^3/s
Slope Full	0.01469	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	41.92	%
Downstream Velocity	Infinity	ft/s

Worksheet for 201 to 202

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.42	ft
Channel Slope	0.10900	ft/ft
Critical Slope	0.01426	ft/ft

Worksheet for 202 to 203

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.06500	ft/ft
Diameter	0.50	ft
Discharge	0.68	ft^3/s

Results

Normal Depth	0.24	ft
Flow Area	0.09	ft^2
Wetted Perimeter	0.77	ft
Hydraulic Radius	0.12	ft
Top Width	0.50	ft
Critical Depth	0.42	ft
Percent Full	48.5	%
Critical Slope	0.01425	ft/ft
Velocity	7.20	ft/s
Velocity Head	0.80	ft
Specific Energy	1.05	ft
Froude Number	2.92	
Maximum Discharge	1.54	ft^3/s
Discharge Full	1.43	ft^3/s
Slope Full	0.01469	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	48.53	%
Downstream Velocity	Infinity	ft/s

Worksheet for 202 to 203

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.24	ft
Critical Depth	0.42	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.01425	ft/ft

Worksheet for 203 to 204

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.06500	ft/ft
Diameter	0.50	ft
Discharge	0.68	ft^3/s

Results

Normal Depth	0.24	ft
Flow Area	0.09	ft^2
Wetted Perimeter	0.77	ft
Hydraulic Radius	0.12	ft
Top Width	0.50	ft
Critical Depth	0.42	ft
Percent Full	48.5	%
Critical Slope	0.01425	ft/ft
Velocity	7.20	ft/s
Velocity Head	0.80	ft
Specific Energy	1.05	ft
Froude Number	2.92	
Maximum Discharge	1.54	ft^3/s
Discharge Full	1.43	ft^3/s
Slope Full	0.01469	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	48.53	%
Downstream Velocity	Infinity	ft/s

Worksheet for 203 to 204

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.24	ft
Critical Depth	0.42	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.01425	ft/ft

Worksheet for 204 to 205

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.03600	ft/ft
Diameter	0.50	ft
Discharge	0.68	ft^3/s

Results

Normal Depth	0.29	ft
Flow Area	0.12	ft^2
Wetted Perimeter	0.87	ft
Hydraulic Radius	0.14	ft
Top Width	0.49	ft
Critical Depth	0.42	ft
Percent Full	58.1	%
Critical Slope	0.01426	ft/ft
Velocity	5.75	ft/s
Velocity Head	0.51	ft
Specific Energy	0.80	ft
Froude Number	2.07	
Maximum Discharge	1.15	ft^3/s
Discharge Full	1.06	ft^3/s
Slope Full	0.01469	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	58.08	%
Downstream Velocity	Infinity	ft/s

Worksheet for 204 to 205

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.42	ft
Channel Slope	0.03600	ft/ft
Critical Slope	0.01426	ft/ft

INLET SPREAD CALCULATIONS

VHB Computations

Project: OKTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: JCC Sheet of
Calculated by: P.S. Date: 03/23/11
Checked by: Date:
Title INLET SPREAD CALCULATIONS

INLET #1 T_c=5min DA = 0.60Ac C = 0.71 I_{10} = 7.50 I_{100} = 9.99

$Q_{10} = CI_{10}A = 3.20$ cfs $Q_{100} = CI_{100}A = 4.26$ cfs

INLET #2 T_c=5min DA = 0.21Ac C = 0.43 I_{10} = 7.50 I_{100} = 9.99

Q_{10} = 0.68 cfs Q_{100} = 0.91 cfs

OVERFLOW FROM Inlet #1 (100-year storm) = 2.13 cfs

Total flow to Inlet #2 = 2.13 cfs + 0.91 cfs = 3.04 cfs

INLET #3 T_c=5min DA = 0.26Ac C = 0.50 I_{10} = 7.50 I_{100} = 9.99

Q_{10} = 0.98 cfs Q_{100} = 1.30 cfs

BYPASS FLOW FROM INLET #2 = 1.07 cfs

TOTAL FLOW = 1.30 cfs + 1.07 cfs = 2.37 cfs

INLET #4 T_c = 5min DA = 0.18 Ac C = 0.50 I_{10} = 7.50 I_{100} = 9.99

Q_{10} = 0.68 cfs Q_{100} = 0.90 cfs

BYPASS FLOW FROM INLET #3 = 0.12 cfs

TOTAL FLOW = 0.90 cfs + 0.12 cfs = 1.02 cfs

INLET #5 T_c = 5min DA = 0.23Ac C = 0.54 I_{10} = 7.50 I_{100} = 9.99

Q_{10} = 0.93 cfs Q_{100} = 1.15 cfs

VHB Computations

Project: OKTOBERFEST ATTRACTION EXPANSION Project # 33299.00
Location: JCC Sheet of
Calculated by: P.S. Date: 03/23/11
Checked by: Date:
Title INLET SPREAD CALCULATIONS

INLET # 6 DA = 0.24 Ac C = 0.65 T_c = 5min I_{10} = 7.50 I_{100} = 9.99

Q_{10} = 1.17 cfs Q_{100} = 1.56 cfs

INLET # 7 DA = 0.76 C = 0.64 T_c = 5min I_{10} = 7.50 I_{100} = 9.99

Q_{10} = 3.65 cfs Q_{100} = 4.86 cfs

Worksheet for 1

Project Description

Solve For	Efficiency

Input Data

Discharge	4.26	ft^3/s
Slope	0.06600	ft/ft
Gutter Width	1.00	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	8.00	ft
Local Depression	2.00	in
Local Depression Width	0.50	ft

Results

Efficiency	49.96	%
Intercepted Flow	2.13	ft^3/s
Bypass Flow	2.13	ft^3/s
Spread	7.73	ft
Depth	0.22	ft
Flow Area	0.63	ft^2
Gutter Depression	0.06	ft
Total Depression	0.23	ft
Velocity	6.77	ft/s
Equivalent Cross Slope	0.10845	ft/ft
Length Factor	0.32	
Total Interception Length	25.05	ft

Worksheet for 2

Project Description

Solve For	Efficiency

Input Data

Discharge	3.04	ft^3/s
Slope	0.06600	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	8.00	ft
Local Depression	2.00	in
Local Depression Width	0.50	ft

Results

Efficiency	64.89	%
Intercepted Flow	1.97	ft^3/s
Bypass Flow	1.07	ft^3/s
Spread	5.35	ft
Depth	0.23	ft
Flow Area	0.41	ft^2
Gutter Depression	0.13	ft
Total Depression	0.29	ft
Velocity	7.37	ft/s
Equivalent Cross Slope	0.14664	ft/ft
Length Factor	0.44	
Total Interception Length	18.14	ft

Worksheet for 3

Project Description

Solve For	Efficiency

Input Data

Discharge	2.37	ft^3/s
Slope	0.00800	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	8.00	ft
Local Depression	2.00	in
Local Depression Width	0.50	ft

Results

Efficiency	94.76	%
Intercepted Flow	2.25	ft^3/s
Bypass Flow	0.12	ft^3/s
Spread	8.40	ft
Depth	0.29	ft
Flow Area	0.83	ft^2
Gutter Depression	0.13	ft
Total Depression	0.29	ft
Velocity	2.85	ft/s
Equivalent Cross Slope	0.11712	ft/ft
Length Factor	0.81	
Total Interception Length	9.93	ft

Worksheet for 4

Project Description

Solve For	Efficiency

Input Data

Discharge	1.02	ft^3/s
Slope	0.00800	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	8.00	ft
Local Depression	2.00	in
Local Depression Width	0.50	ft

Results

Efficiency	100.00	%
Intercepted Flow	1.02	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	5.23	ft
Depth	0.23	ft
Flow Area	0.40	ft^2
Gutter Depression	0.13	ft
Total Depression	0.29	ft
Velocity	2.56	ft/s
Equivalent Cross Slope	0.14792	ft/ft
Length Factor	1.32	
Total Interception Length	6.06	ft

Worksheet for 5

Project Description

Solve For	Efficiency

Input Data

Discharge	1.15	ft^3/s
Slope	0.00800	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	8.00	ft
Local Depression	2.00	in
Local Depression Width	0.50	ft

Results

Efficiency	100.00	%
Intercepted Flow	1.15	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	5.65	ft
Depth	0.24	ft
Flow Area	0.44	ft^2
Gutter Depression	0.13	ft
Total Depression	0.29	ft
Velocity	2.59	ft/s
Equivalent Cross Slope	0.14370	ft/ft
Length Factor	1.23	
Total Interception Length	6.48	ft

Worksheet for 6

Project Description

Solve For	Efficiency

Input Data

Discharge	1.56	ft^3/s
Slope	0.00800	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	8.00	ft
Local Depression	2.00	in
Local Depression Width	0.50	ft

Results

Efficiency	100.00	%
Intercepted Flow	1.56	ft^3/s
Bypass Flow	0.00	ft^3/s
Spread	6.75	ft
Depth	0.26	ft
Flow Area	0.58	ft^2
Gutter Depression	0.13	ft
Total Depression	0.29	ft
Velocity	2.68	ft/s
Equivalent Cross Slope	0.13247	ft/ft
Length Factor	1.03	
Total Interception Length	7.74	ft

Worksheet for 7

Project Description

Solve For	Spread

Input Data

Discharge	3.26	ft³/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Curb Opening Length	8.00	ft
Opening Height	0.46	ft
Curb Throat Type	Horizontal	
Local Depression	2.00	in
Local Depression Width	8.00	ft
Throat Incline Angle	90.00	degrees

Results

Spread	4.33	ft
Depth	0.28	ft
Gutter Depression	0.12	ft
Total Depression	0.29	ft

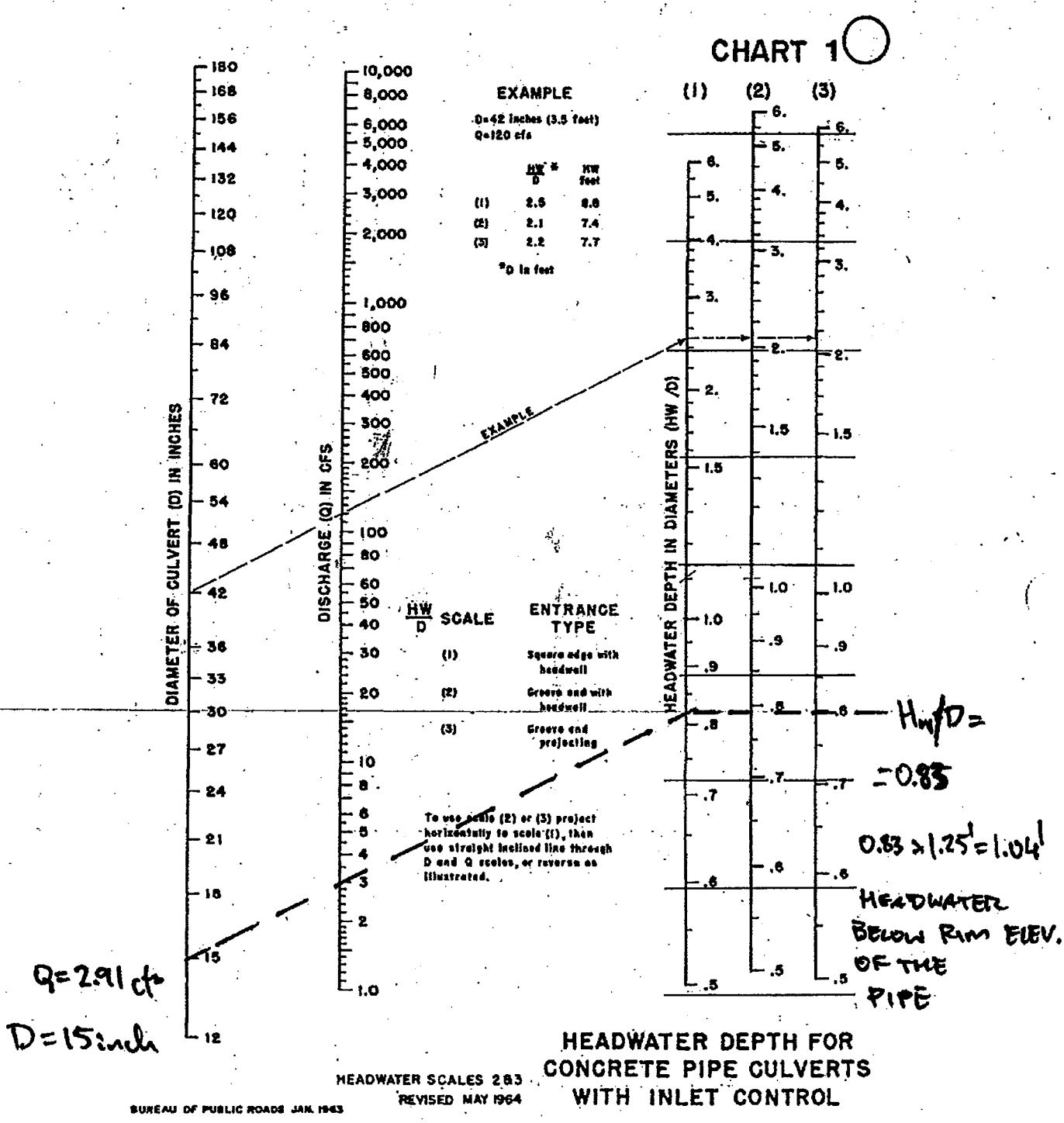
CULVERT CALCULATIONS

VHB Computations

Project: OKTOBERFEST ATTRACTION EXPANSION | Project # 33299.00
Location: JAMES CITY COUNTY | Sheet of
Calculated by: P.S. | Date: 02/09/11
Checked by: | Date:
Title

FLOW Q_{10} TO THE CULVERT $Q_{10} = 2.91$ cfs
(SEE DITCH CALCULATIONS STA 1+00 TO 1+28.00

Appendix 8C-1 Inlet Control, Circular Concrete



Source: HDS -5

GRASS SWALES CALCULATIONS

VDOT DITCH DESIGN FORM

Appendix 7B-1 LD-268 Roadside and Median Ditch Design Form

LD-268

LANE

R SIDE

SLOPE: 2 TO 1

PROJECT: Octoberfest Attraction Expansion

BY: PS

DATE: March-11

SHEET: 1 OF 1

	STA.	TO STA.	FLOW	0.9 WS	0.9 CA	0.5 WS	0.5 CA	0.35 WS	0.35 CA	C A INCR.	C A ACC.	Tc	I_2	Q_2	C or F	Slope Pt/Pt	Allow VEL.	EARTH n=0.03 VEL	PROTECTIVE LINING n=0.05 Qn	n=0.05 VEL	n=0.05 DEP	n=0.015 Qn	n=0.015 DEP	I_{10}	Q_{10}	DEP	REMARKS
D-1.0	00+00.00	00+50.00	↓	0.000	0.000	0.000	0.000	0.030	0.011	0.011	0.011	5.00	5.78	0.06						0.82	0.14			7.50	0.08	0.21	OK
D-1.1	00+50.00	01+00.00	↓	0.000	0.000	0.000	0.000	0.020	0.007	0.007	0.018	6.02	5.51	0.10						1.10	0.21			7.14	0.23	0.25	OK
D-1.2	01+00.00	01+50.00	↓	0.000	0.000	0.000	0.000	0.030	0.011	0.011	0.028	6.77	5.32	0.15						1.05	0.27			6.90	0.19	0.29	OK
D-1.3	01+50.00	02+00.00	↓	0.000	0.000	0.000	0.000	0.040	0.014	0.014	0.042	7.57	5.14	0.22						1.47	0.27			6.67	0.28	0.30	OK
D-1.4	02+00.00	02+50.00	↓	0.000	0.000	0.000	0.000	0.030	0.011	0.011	0.053	8.13	5.02	0.26						1.53	0.29			6.51	0.34	0.32	OK
D-1.5	02+50.00	03+00.00	↓	0.000	0.000	0.000	0.000	0.060	0.021	0.021	0.074	8.68	4.91	0.36						1.78	0.32			6.37	0.47	0.35	OK
D-1.6	03+00.00	03+25.00	↓	0.000	0.000	0.000	0.000	0.060	0.021	0.021	0.095	9.15	4.82	0.46						1.89	0.35			6.26	0.59	0.38	OK
		FES																									
D-2.0	00+00.00	00+50.00	↓	0.190	0.171	0.000	0.000	0.630	0.221	0.392	0.392	7.00	5.27	2.06						1.09	0.79			6.83	2.68	0.87	OK
D-2.1	00+50.00	01+00.00	↓	0.020	0.018	0.000	0.000	0.060	0.021	0.039	0.431	7.76	5.10	2.20						1.11	0.81			6.61	2.85	0.89	OK
D-2.2	01+00.00	01+28.00	↓	0.010	0.009	0.000	0.000	0.040	0.014	0.023	0.454	8.52	4.94	2.24						1.12	0.82			6.41	2.93	0.90	OK
D-2.3	01+28.00	01+50.00	↓	0.010	0.009	0.000	0.000	0.020	0.007	0.016	0.470	8.93	4.86	2.28						1.56	0.85			6.31	2.96	0.94	OK
D-2.4	01+50.00	02+00.00	↓	0.000	0.000	0.000	0.000	0.040	0.014	0.014	0.484	9.17	4.81	2.33						2.52	0.68			6.25	3.02	0.75	OK
D-2.5	02+00.00	02+50.00	↓	0.000	0.000	0.000	0.000	0.060	0.021	0.021	0.505	9.50	4.75	2.40						2.66	0.67			6.17	3.11	0.74	OK
D-2.6	02+50.00	03+35.00	↓	0.000	0.000	0.000	0.000	0.130	0.046	0.046	0.550	9.81	4.69	2.58						1.41	0.96			6.10	3.36	1.06	OK

Worksheet for 00+00 to 00+50 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.06	ft^3/s

Results

Normal Depth	0.19	ft
Flow Area	0.07	ft^2
Wetted Perimeter	0.86	ft
Hydraulic Radius	0.09	ft
Top Width	0.77	ft
Critical Depth	0.14	ft
Critical Slope	0.10232	ft/ft
Velocity	0.82	ft/s
Velocity Head	0.01	ft
Specific Energy	0.20	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	0.19	ft
Critical Depth	0.14	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.10232	ft/ft

Worksheet for 00+50 to 01+00 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.03130	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.10	ft^3/s

Results

Normal Depth	0.21	ft
Flow Area	0.09	ft^2
Wetted Perimeter	0.95	ft
Hydraulic Radius	0.10	ft
Top Width	0.85	ft
Critical Depth	0.17	ft
Critical Slope	0.09554	ft/ft
Velocity	1.10	ft/s
Velocity Head	0.02	ft
Specific Energy	0.23	ft
Froude Number	0.59	
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	0.21	ft
Critical Depth	0.17	ft
Channel Slope	0.03130	ft/ft
Critical Slope	0.09554	ft/ft

Worksheet for 01+00 to 01+50 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02130	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.15	ft^3/s

Results

Normal Depth	0.27	ft
Flow Area	0.14	ft^2
Wetted Perimeter	1.19	ft
Hydraulic Radius	0.12	ft
Top Width	1.07	ft
Critical Depth	0.20	ft
Critical Slope	0.09052	ft/ft
Velocity	1.05	ft/s
Velocity Head	0.02	ft
Specific Energy	0.28	ft
Froude Number	0.51	
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	0.27	ft
Critical Depth	0.20	ft
Channel Slope	0.02130	ft/ft
Critical Slope	0.09052	ft/ft

VHB

Worksheet for 01+50 to 02+00 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.22	ft^3/s

Results

Normal Depth	0.27	ft
Flow Area	0.15	ft^2
Wetted Perimeter	1.23	ft
Hydraulic Radius	0.12	ft
Top Width	1.10	ft
Critical Depth	0.24	ft
Critical Slope	0.08604	ft/ft
Velocity	1.47	ft/s
Velocity Head	0.03	ft
Specific Energy	0.31	ft
Froude Number	0.70	
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	0.27	ft
Critical Depth	0.24	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.08604	ft/ft

Worksheet for 02+00 to 02+50 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.26	ft^3/s

Results

Normal Depth	0.29	ft
Flow Area	0.17	ft^2
Wetted Perimeter	1.30	ft
Hydraulic Radius	0.13	ft
Top Width	1.17	ft
Critical Depth	0.25	ft
Critical Slope	0.08414	ft/ft
Velocity	1.53	ft/s
Velocity Head	0.04	ft
Specific Energy	0.33	ft
Froude Number	0.71	
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	0.29	ft
Critical Depth	0.25	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.08414	ft/ft

Worksheet for 02+50 to 03+00 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04800	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.36	ft^3/s

Results

Normal Depth	0.32	ft
Flow Area	0.20	ft^2
Wetted Perimeter	1.42	ft
Hydraulic Radius	0.14	ft
Top Width	1.27	ft
Critical Depth	0.29	ft
Critical Slope	0.08054	ft/ft
Velocity	1.78	ft/s
Velocity Head	0.05	ft
Specific Energy	0.37	ft
Froude Number	0.78	
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	0.29	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.08054	ft/ft

Worksheet for 03+00 to 03+25 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04800	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.46	ft^3/s

Results

Normal Depth	0.35	ft
Flow Area	0.24	ft^2
Wetted Perimeter	1.56	ft
Hydraulic Radius	0.16	ft
Top Width	1.40	ft
Critical Depth	0.32	ft
Critical Slope	0.07798	ft/ft
Velocity	1.89	ft/s
Velocity Head	0.06	ft
Specific Energy	0.40	ft
Froude Number	0.80	
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	0.35	ft
Critical Depth	0.32	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.07798	ft/ft

Worksheet for 00+00 to 00+50 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.08	ft^3/s

Results

Normal Depth	0.21	ft
Flow Area	0.09	ft^2
Wetted Perimeter	0.95	ft
Hydraulic Radius	0.10	ft
Top Width	0.85	ft
Critical Depth	0.16	ft
Critical Slope	0.09846	ft/ft
Velocity	0.88	ft/s
Velocity Head	0.01	ft
Specific Energy	0.23	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	0.21	ft
Critical Depth	0.16	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.09846	ft/ft

Worksheet for 00+50 to 01+00 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.03130	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.12	ft^3/s

Results

Normal Depth	0.23	ft
Flow Area	0.10	ft^2
Wetted Perimeter	1.02	ft
Hydraulic Radius	0.10	ft
Top Width	0.91	ft
Critical Depth	0.19	ft
Critical Slope	0.09331	ft/ft
Velocity	1.15	ft/s
Velocity Head	0.02	ft
Specific Energy	0.25	ft
Froude Number	0.60	
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	0.23	ft
Critical Depth	0.19	ft
Channel Slope	0.03130	ft/ft
Critical Slope	0.09331	ft/ft

Worksheet for 01+00 to 01+50 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02130	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.19	ft^3/s

Results

Normal Depth	0.29	ft
Flow Area	0.17	ft^2
Wetted Perimeter	1.30	ft
Hydraulic Radius	0.13	ft
Top Width	1.17	ft
Critical Depth	0.22	ft
Critical Slope	0.08775	ft/ft
Velocity	1.12	ft/s
Velocity Head	0.02	ft
Specific Energy	0.31	ft
Froude Number	0.52	
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	0.29	ft
Critical Depth	0.22	ft
Channel Slope	0.02130	ft/ft
Critical Slope	0.08775	ft/ft

VHB

Worksheet for 01+50 to 02+00 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.28	ft^3/s

Results

Normal Depth	0.30	ft
Flow Area	0.18	ft^2
Wetted Perimeter	1.34	ft
Hydraulic Radius	0.13	ft
Top Width	1.20	ft
Critical Depth	0.26	ft
Critical Slope	0.08331	ft/ft
Velocity	1.56	ft/s
Velocity Head	0.04	ft
Specific Energy	0.34	ft
Froude Number	0.71	
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	0.30	ft
Critical Depth	0.26	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.08331	ft/ft

VHB

Worksheet for 02+00 to 02+50 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.34	ft^3/s

Results

Normal Depth	0.32	ft
Flow Area	0.21	ft^2
Wetted Perimeter	1.44	ft
Hydraulic Radius	0.14	ft
Top Width	1.29	ft
Critical Depth	0.28	ft
Critical Slope	0.08117	ft/ft
Velocity	1.63	ft/s
Velocity Head	0.04	ft
Specific Energy	0.36	ft
Froude Number	0.72	
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	0.28	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.08117	ft/ft

Worksheet for 02+50 to 03+00 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04800	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.47	ft^3/s

Results

Normal Depth	0.35	ft
Flow Area	0.25	ft^2
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.16	ft
Top Width	1.41	ft
Critical Depth	0.32	ft
Critical Slope	0.07775	ft/ft
Velocity	1.90	ft/s
Velocity Head	0.06	ft
Specific Energy	0.41	ft
Froude Number	0.80	
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	0.35	ft
Critical Depth	0.32	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.07775	ft/ft

Worksheet for 03+00 to 03+25 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04800	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	0.59	ft^3/s

Results

Normal Depth	0.38	ft
Flow Area	0.29	ft^2
Wetted Perimeter	1.71	ft
Hydraulic Radius	0.17	ft
Top Width	1.53	ft
Critical Depth	0.35	ft
Critical Slope	0.07542	ft/ft
Velocity	2.01	ft/s
Velocity Head	0.06	ft
Specific Energy	0.45	ft
Froude Number	0.81	
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	0.38	ft
Critical Depth	0.35	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.07542	ft/ft

VHB

Worksheet for 00+00 to 00+50 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	2.06	ft^3/s

Results

Normal Depth	0.79	ft
Flow Area	1.88	ft^2
Wetted Perimeter	5.01	ft
Hydraulic Radius	0.38	ft
Top Width	4.75	ft
Critical Depth	0.49	ft
Critical Slope	0.06230	ft/ft
Velocity	1.09	ft/s
Velocity Head	0.02	ft
Specific Energy	0.81	ft
Froude Number	0.31	
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	0.79	ft
Critical Depth	0.49	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.06230	ft/ft

VHB

Worksheet for 00+50 to 01+00 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	2.20	ft^3/s

Results

Normal Depth	0.81	ft
Flow Area	1.98	ft^2
Wetted Perimeter	5.14	ft
Hydraulic Radius	0.39	ft
Top Width	4.87	ft
Critical Depth	0.51	ft
Critical Slope	0.06176	ft/ft
Velocity	1.11	ft/s
Velocity Head	0.02	ft
Specific Energy	0.83	ft
Froude Number	0.31	
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	0.81	ft
Critical Depth	0.51	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.06176	ft/ft

Worksheet for 01+00 to 01+28 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	2.24	ft^3/s

Results

Normal Depth	0.82	ft
Flow Area	2.00	ft^2
Wetted Perimeter	5.17	ft
Hydraulic Radius	0.39	ft
Top Width	4.90	ft
Critical Depth	0.51	ft
Critical Slope	0.06161	ft/ft
Velocity	1.12	ft/s
Velocity Head	0.02	ft
Specific Energy	0.84	ft
Froude Number	0.31	
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	0.82	ft
Critical Depth	0.51	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.06161	ft/ft

Worksheet for 01+28 to 01+50 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	2.28	ft^3/s

Results

Normal Depth	0.85	ft
Flow Area	1.46	ft^2
Wetted Perimeter	3.82	ft
Hydraulic Radius	0.38	ft
Top Width	3.41	ft
Critical Depth	0.60	ft
Critical Slope	0.06299	ft/ft
Velocity	1.56	ft/s
Velocity Head	0.04	ft
Specific Energy	0.89	ft
Froude Number	0.42	
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	0.85	ft
Critical Depth	0.60	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.06299	ft/ft

VHB

Worksheet for 01+50 to 02+00 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.03500	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	2.33	ft^3/s

Results

Normal Depth	0.68	ft
Flow Area	0.93	ft^2
Wetted Perimeter	3.04	ft
Hydraulic Radius	0.30	ft
Top Width	2.72	ft
Critical Depth	0.61	ft
Critical Slope	0.06280	ft/ft
Velocity	2.52	ft/s
Velocity Head	0.10	ft
Specific Energy	0.78	ft
Froude Number	0.76	
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	0.68	ft
Critical Depth	0.61	ft
Channel Slope	0.03500	ft/ft
Critical Slope	0.06280	ft/ft

VHB

Worksheet for 02+00 to 02+50 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	0.025
Channel Slope	0.04000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	2.40	ft^3/s

Results

Normal Depth	0.67	ft
Flow Area	0.90	ft^2
Wetted Perimeter	3.00	ft
Hydraulic Radius	0.30	ft
Top Width	2.68	ft
Critical Depth	0.62	ft
Critical Slope	0.06256	ft/ft
Velocity	2.66	ft/s
Velocity Head	0.11	ft
Specific Energy	0.78	ft
Froude Number	0.81	
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	0.67	ft
Critical Depth	0.62	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.06256	ft/ft

VHB

Worksheet for 02+50 to 03+35 2-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00700	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	2.58	ft^3/s

Results

Normal Depth	0.96	ft
Flow Area	1.83	ft^2
Wetted Perimeter	4.27	ft
Hydraulic Radius	0.43	ft
Top Width	3.82	ft
Critical Depth	0.64	ft
Critical Slope	0.06196	ft/ft
Velocity	1.41	ft/s
Velocity Head	0.03	ft
Specific Energy	0.99	ft
Froude Number	0.36	
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	0.96	ft
Critical Depth	0.64	ft
Channel Slope	0.00700	ft/ft
Critical Slope	0.06196	ft/ft

Worksheet for 00+00 to 00+50 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	2.68	ft^3/s

Results

Normal Depth	0.87	ft
Flow Area	2.29	ft^2
Wetted Perimeter	5.53	ft
Hydraulic Radius	0.41	ft
Top Width	5.25	ft
Critical Depth	0.55	ft
Critical Slope	0.06015	ft/ft
Velocity	1.17	ft/s
Velocity Head	0.02	ft
Specific Energy	0.90	ft
Froude Number	0.31	
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	0.87	ft
Critical Depth	0.55	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.06015	ft/ft

Worksheet for 00+50 to 01+00 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	2.85	ft^3/s

Results

Normal Depth	0.89	ft
Flow Area	2.40	ft^2
Wetted Perimeter	5.66	ft
Hydraulic Radius	0.42	ft
Top Width	5.37	ft
Critical Depth	0.56	ft
Critical Slope	0.05966	ft/ft
Velocity	1.19	ft/s
Velocity Head	0.02	ft
Specific Energy	0.92	ft
Froude Number	0.31	
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	0.89	ft
Critical Depth	0.56	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.05966	ft/ft

Worksheet for 01+00 to 01+28 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00500	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	2.91	ft^3/s

Results

Normal Depth	0.90	ft
Flow Area	2.44	ft^2
Wetted Perimeter	5.70	ft
Hydraulic Radius	0.43	ft
Top Width	5.41	ft
Critical Depth	0.57	ft
Critical Slope	0.05949	ft/ft
Velocity	1.19	ft/s
Velocity Head	0.02	ft
Specific Energy	0.92	ft
Froude Number	0.31	
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	0.90	ft
Critical Depth	0.57	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.05949	ft/ft

VHB

Worksheet for 01+28 to 01+50 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.01000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	2.96	ft^3/s

Results

Normal Depth	0.94	ft
Flow Area	1.77	ft^2
Wetted Perimeter	4.21	ft
Hydraulic Radius	0.42	ft
Top Width	3.77	ft
Critical Depth	0.67	ft
Critical Slope	0.06084	ft/ft
Velocity	1.67	ft/s
Velocity Head	0.04	ft
Specific Energy	0.98	ft
Froude Number	0.43	
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	0.94	ft
Critical Depth	0.67	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.06084	ft/ft

VHB

Worksheet for 01+50 to 02+00 10-year

0.025-0.03
NOT 0.05

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.03500	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	3.02	ft^3/s

Results

Normal Depth	0.75	ft
Flow Area	1.13	ft^2
Wetted Perimeter	3.35	ft
Hydraulic Radius	0.34	ft
Top Width	3.00	ft
Critical Depth	0.68	ft
Critical Slope	0.06067	ft/ft
Velocity	2.68	ft/s
Velocity Head	0.11	ft
Specific Energy	0.86	ft
Froude Number	0.77	
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	0.75	ft
Critical Depth	0.68	ft
Channel Slope	0.03500	ft/ft
Critical Slope	0.06067	ft/ft

VHB

Worksheet for 02+00 to 02+50 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.04000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	3.11	ft^3/s

Results

Normal Depth	0.74	ft
Flow Area	1.09	ft^2
Wetted Perimeter	3.31	ft
Hydraulic Radius	0.33	ft
Top Width	2.96	ft
Critical Depth	0.68	ft
Critical Slope	0.06043	ft/ft
Velocity	2.84	ft/s
Velocity Head	0.13	ft
Specific Energy	0.87	ft
Froude Number	0.82	
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	0.74	ft
Critical Depth	0.68	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.06043	ft/ft

Worksheet for 02+50 to 03+35 10-year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.00700	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	3.36	ft^3/s

Results

Normal Depth	1.06	ft
Flow Area	2.23	ft^2
Wetted Perimeter	4.72	ft
Hydraulic Radius	0.47	ft
Top Width	4.22	ft
Critical Depth	0.71	ft
Critical Slope	0.05981	ft/ft
Velocity	1.51	ft/s
Velocity Head	0.04	ft
Specific Energy	1.09	ft
Froude Number	0.37	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

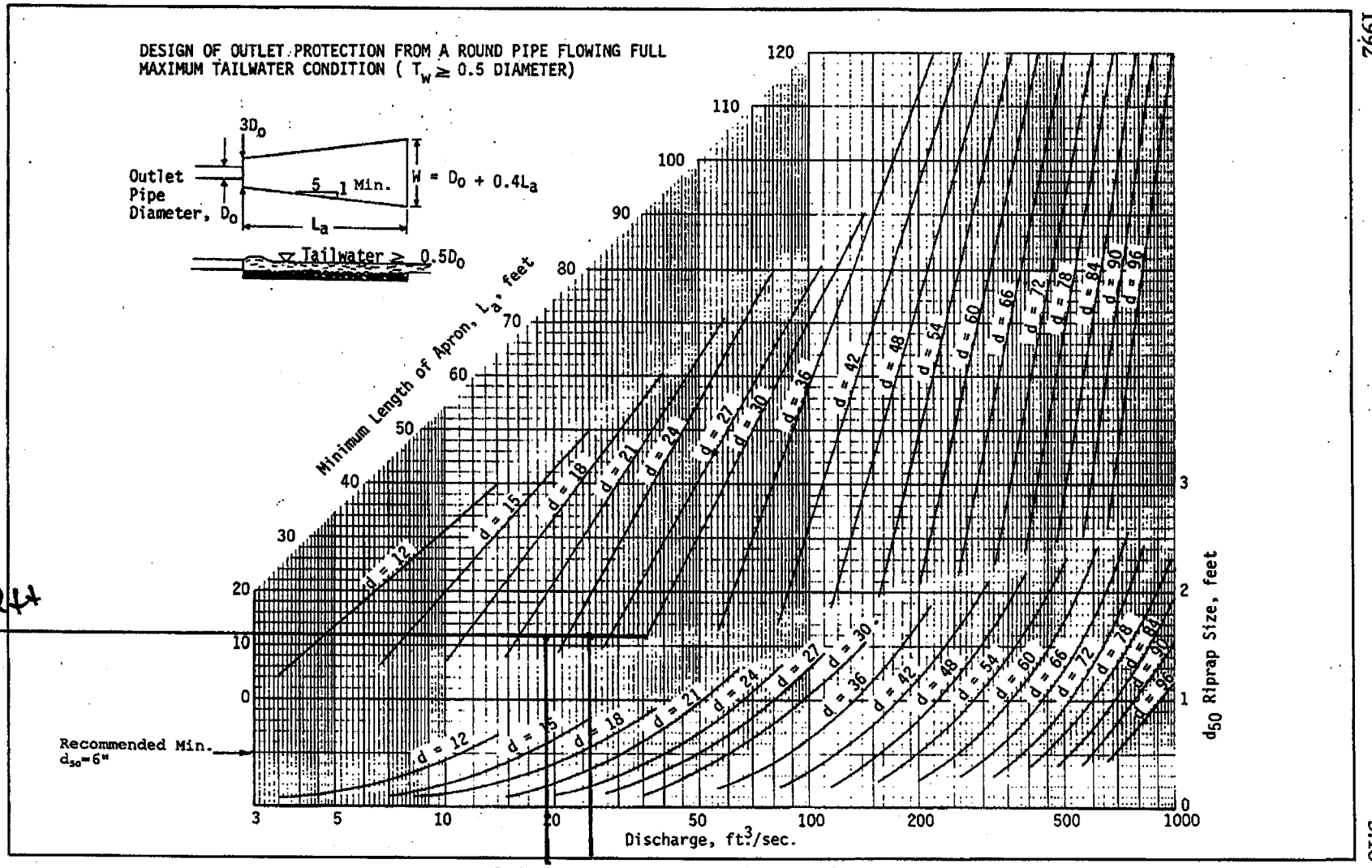
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.06	ft
Critical Depth	0.71	ft
Channel Slope	0.00700	ft/ft
Critical Slope	0.05981	ft/ft

OUTLET PROTECTION CALCULATIONS

$Q_{10} = 19.02$ cfs
$Q_{100} = 25.15$ cfs

$D_o = 2.5' = 30$ inch
$3D_o = 7.5$ ft
$L_a = 12$ ft
$W = 2.5' + 0.4 \cdot 12\text{ft} = 7.3\text{ft} \approx 7.5\text{ft}$



$L_a = 12$ ft

$Q_{10} = 19.02$ cfs

$Q_{100} = 25.15$ cfs

Source: USDA-SCS

Plate 3.18-4

HYDRANT FLOW TEST REPORT

Oktoberfest Attraction Expansion
Project No.: 33299.00
Date: 02/09/11
Prepared By: Piotr Swietuchowski

Hydrant Flow Test Report

Test performed by: VHB, Inc. Witness: VHB, Inc.

Date of Test: January 6, 2011 Time: 2:00 PM

Test Location: Former Drachen Fire Station Building

Flow Location: On the back of the Festhaus Building

Static Pressure (psi) = 104 Residual Pressure (psi) = 65

		1	2	3	4
Pitot Pressure (psi)	=	48			
Pitot Nozzle Size (in)	=	2.5			
Discharge Coefficient	=	0.904			

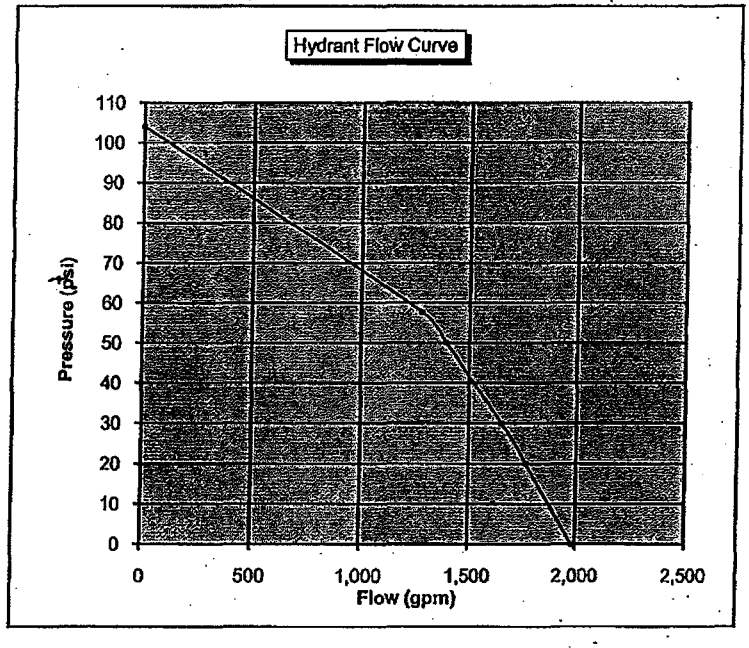
Flow based on nozzle diameter and pitot pressure: $Q_F = 29.83\ cd^2\ p^{1/2}$

Q_F	=	Observed Flow	Q_{F1}	=	1,168
c	=	coefficient	Q_{F2}	=	0
d	=	outlet diameter	Q_{F3}	=	0
p	=	pitot pressure	Q_{F4}	=	0
		Sum of Q_{Fx} =	Q_F	=	1,168 gpm

Calculate available flow based on flow test readings: $Q_R = Q_F \times (hr^{0.54}) / (hf^{0.54})$

Q_R = Available Flow Results
h_r = drop in pressure from static to *desired* residual
h_f = drop in pressure from static to *actual* residual

Q_R	@	104	psi
Q_R	=	0	gpm
Q_R	@	57.76	psi
Q_R	=	1,280	gpm
Q_R	@	50.00	psi
Q_R	=	1,392	gpm
Q_R	@	30	psi
Q_R	=	1,650	gpm
Q_R	@	20	psi
Q_R	=	1,767	gpm
Q_R	@	0	psi
Q_R	=	1,983	gpm



DRAINAGE AREA MAPS

P:\33299.00 PGAV BGW 2012 EXP\CAD\LD\PLANSET\3329900-DRAINAGE MAP-STORM

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Consultant

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Busch GARDENS. WILLIAMSBURG, VA

Oktoberfest Attraction Expansion

Williamsburg, VA

Storm Sewer and Grass Swales Drainage Area Map

Revision No.	Revision Date

Dr BSG	Ck CRO
PGAV 62047-00	Client
Date February 9, 2011	
Sheet Number DA-MAP-1	

P:\33299.00 PGAV BGW 2012 EXP\CAD\LD\PLANSET\3329900-DRAINAGE MAP-STORM - LAYOUT:DA-MAP-1 - 3/23/2011 1:15 PM - PLOTTED BY:PSWIETUCHOWSKI

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Busch GARDENS. WILLIAMSBURG, VA

Oktoberfest Attraction Expansion

Williamsburg, VA

Erosion and Sediment Control Drainage Area Map

Revision No.	Revision Date

Dr. BSG	Ck. CRO
PGAV 62047-00	Client
Date February 9, 2011	
Sheet Number DA-MAP-2	

P:\33299.00 PGAV BGW 2012 EXP\CAD\LD\PLANSET\3329900-DRAINAGE MAP-SEDIMENT FOREBAY

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P:\33299.00 PGAV BGW 2012 EXP\CAD\LD\PLANSET\3329900-DRAINAGE MAP-SEDIMENT FOREBAY – LAYOUT:DA-MAP-3 – 3/23/2011 11:26 PM – PLOTTED BY:PSWIETUCHOWSKI

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Busch GARDENS. WILLIAMSBURG, VA

Oktoberfest Attraction Expansion

Williamsburg, VA

Sediment Forebay Drainage Area Map

Revision No.	Revision Date

Dr BSG	Ck CRO
PGAV 62047-00	Client
Date February 9, 2011	
Sheet Number DA-MAP-3	

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DRAINAGE AS BUILTS

BUSCH GARDENS
WILLIAMSBURG

ATTRACTION 2012
WILLIAMSBURG, VA

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DATE

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JCC-SP-0014-2011

DRAINAGE AS-BUILTS
FOR
BUSCH GARDENS
ATTRACTION 2012

JAMES CITY COUNTY VIRGINIA

NO.	DATE	REVISION / COMMENT / NOTE
1	08/02/12	CORRECTED INVERT ELEVATION @8A
2	11/28/12	REVISED POND CONTOURS
3	01/10/13	REVISED PER CONTRACTOR MARKUP
4	10/03/13	ADDED RIPRAP

COMMONWEALTH OF VIRGINIA
Will S Felts
WILLIAM S. FELTS
Lic. No. 3149
10/03/13
LAND SURVEYOR

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web: landtechresources.com

AS SHOWN
DATE: 06/06/12
JOB: 11-137
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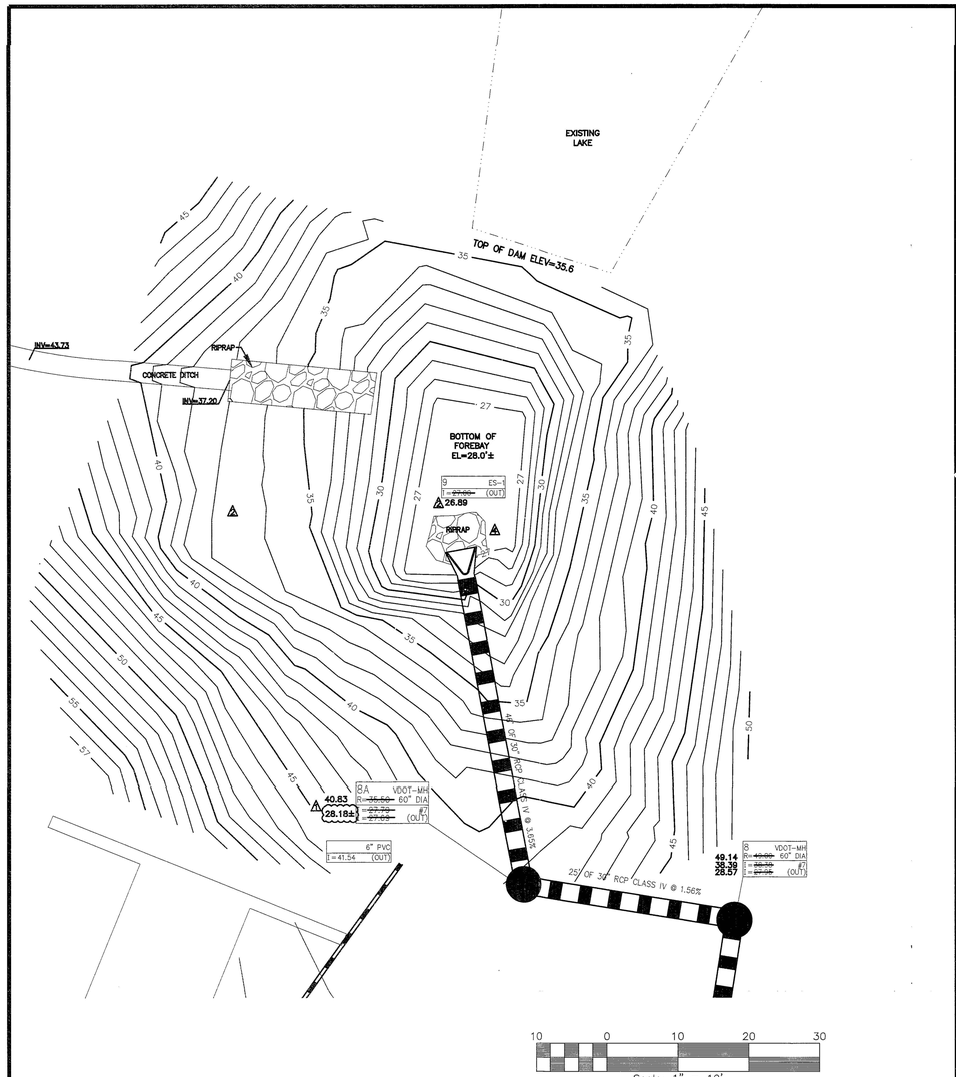
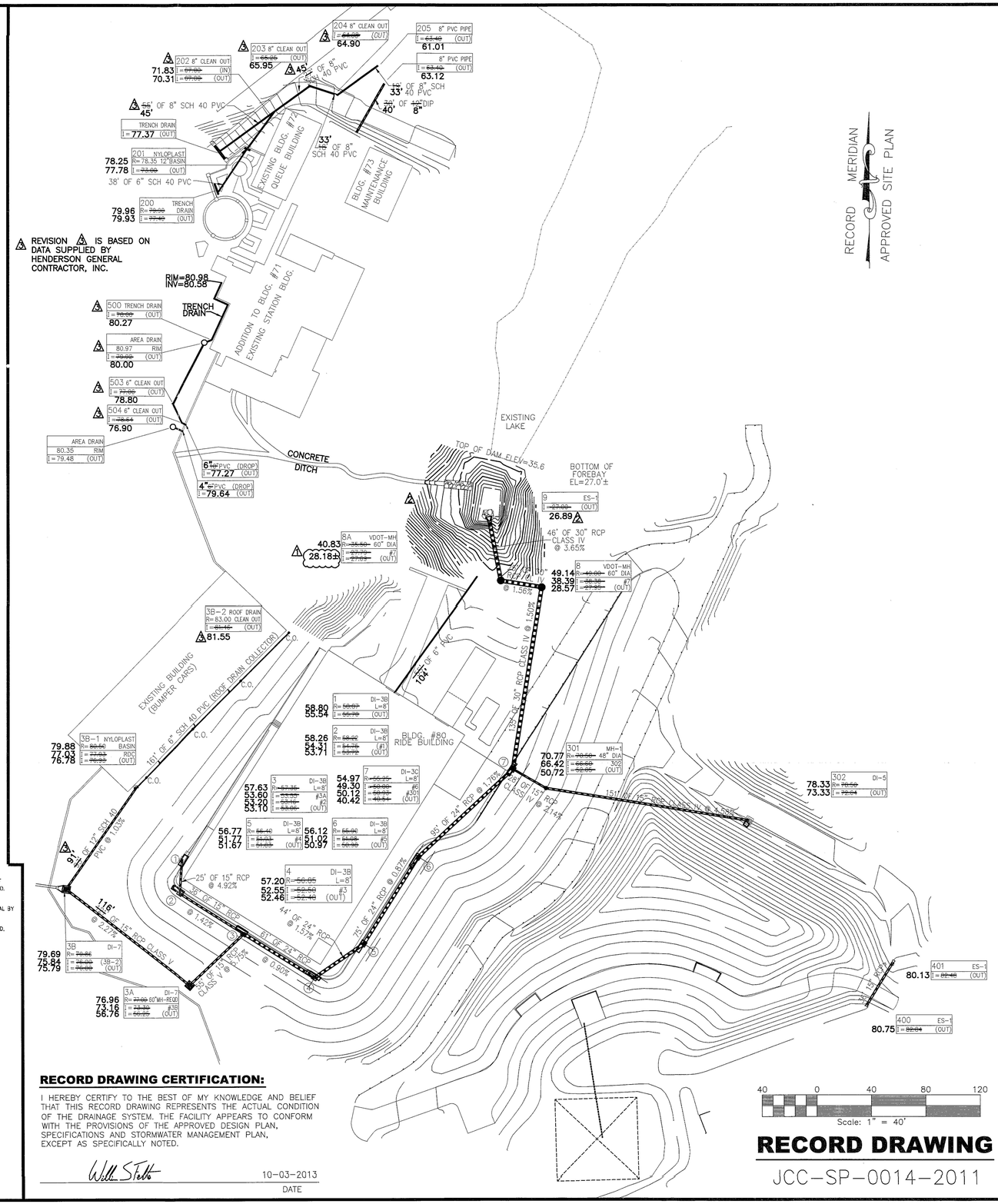
JR071





RECORD MERIDIAN
APPROVED SITE PLAN

NOTES:

1. PROPOSED GRADING IS SHOWN PER APPROVED SITE PLAN. THIS FIRM HAS ONLY VERIFIED THAT INFORMATION SHOWN IN BOLD FONT.

SEDIMENT FOREBAY MAINTENANCE PLAN

MAINTENANCE PLAN

A MAINTENANCE PROGRAM IS REQUIRED TO ENSURE THE STORMWATER MANAGEMENT (SWM) / BEST MANAGEMENT PRACTICE (BMP) FACILITY FUNCTIONS AS DESIGNED AND TO PROVIDE FOR REASONABLE AESTHETIC CONDITIONS. PROPER MAINTENANCE IS ENCOURAGED TO PREVENT THE INTRODUCTION OF DEBRIS AND SEDIMENT AT INFLOW LOCATIONS, PRETREATMENT AREAS, THE BMP ITSELF, ITS PRINCIPAL CONTROL STRUCTURES AND DOWNSTREAM WATERWAYS. FOLLOWING INSTALLATION AND ESTABLISHMENT OF VEGETATION IN DISTURBED SITE AREAS, INSPECTIONS FOR SEDIMENT BUILDUPS SHALL BE PERFORMED AT LEAST QUARTERLY. IT IS ANTICIPATED THAT UNDER NORMAL CONDITIONS, SEDIMENT REMOVAL SHALL BE REQUIRED ONCE EVERY 5 TO 10 YEARS. IF OTHER CONSTRUCTION OR RELATED LAND-DISTURBING ACTIVITIES ARE PERFORMED UPSLOPE OF THE BMP, ADEQUATE PROTECTION MEASURES SHALL BE IMPLEMENTED WITH INSPECTIONS PERFORMED AT LEAST ONCE WEEKLY.

THE OWNER OR ITS DESIGNATED REPRESENTATIVE SHALL INSPECT THE SWM/BMP STRUCTURE AFTER EACH SIGNIFICANT RAINFALL EVENT OR THE FOLLOWING WORKING DAY IF A WEEKEND OR HOLIDAY OCCURS. A SIGNIFICANT RAINFALL FOR THIS STRUCTURE IS DEFINED AS ONE (1) INCH OR MORE OF GAUGED RAINFALL WITHIN A 24 HOUR PERIOD. ONCE PER YEAR (MORE OR LESS) A REPRESENTATIVE OF THE JAMES CITY COUNTY MAY JOINTLY INSPECT THE STRUCTURE. APPROPRIATE ACTION, PERFORMED AT THE COST OF THE OWNER, SHALL BE TAKEN TO ENSURE APPROPRIATE MAINTENANCE. KEYS TO LOCKED ACCESS POINTS OR STRUCTURES SHALL BE MADE AVAILABLE TO THE JAMES CITY COUNTY REPRESENTATIVE UPON REQUEST.

INSPECTION AND MAINTENANCE MEASURES:

1. INSPECT FOR SEDIMENT BUILDUP BY VISUAL OBSERVATION AND A PHYSICAL DETERMINATION OF SEDIMENT DEPTH WITHIN POND STORAGE AREAS. IF THE DEPTH OF SEDIMENT REACHES THE DEPTH OF 4 FEET ABOVE THE BOTTOM OF POND , REMOVAL IS REQUIRED. DISPOSE OF SEDIMENTS REMOVED FROM THE FACILITY AT AN ACCEPTABLE DISPOSAL AREA.

2. TREES, SHRUBS AND WOODY VEGETATION ARE NOT PERMITTED TO GROW ALONG OR ON ANY PART OF THE EMBANKMENT THAT WAS CONSTRUCTED USING ENGINEERED (COMPACTED) FILLS.

3. PERFORM SOIL SAMPLING ON STABILIZED POND SOIL AREAS AT LEAST ONCE EVERY 5 YEARS. APPLY ADDITIONAL LIME AND FERTILIZER IN ACCORDANCE WITH TEST RECOMMENDATIONS.

4. PERFORM QUARTERLY INSPECTIONS OF THE SPILLWAY FOR THE OBSERVANCE OF COLLECTED TRASH AND DEBRIS. IMMEDIATELY REMOVE ANY TRASH OR DEBRIS THAT PREVENTS THE MOVEMENT OF WATER. REMOVE ANY TRASH AND LITTER DOWNSTREAM AND AT STORM CHANNEL INFLOW LOCATIONS TO MAINTAIN THE INTEGRITY OF THE STRUCTURE AND PROVIDE AN ATTRACTIVE APPEARANCE.

5. PERFORM YEARLY STRUCTURAL INSPECTIONS OF THE FACILITY FOR DAMAGE. STRUCTURAL INSPECTION SHALL BE PERFORMED PRIMARY SPILLWAY AND SEDIMENT FOREBAY EMBANKMENT. IF DAMAGE IS EVIDENT, FURTHER INVESTIGATION BY A PROFESSIONAL ENGINEER MAY BE REQUIRED TO ASSESS THE INTEGRITY OF THE STRUCTURE.

6. PERFORM QUARTERLY INSPECTIONS OF THE GRADED SIDE SLOPES OF THE FACILITY FOR SIGNS OF ANIMAL/RODENT BORROWS OR SLOPE EROSION. IMMEDIATELY PERFORM NECESSARY REPAIRS, REFILLING OR REPLANTING. REPLACE DEAD OR DISEASED PLANTS ON THE SIDE SLOPES.

7. PERFORM YEARLY OBSERVATIONS OF PERIMETER AREAS SURROUNDING THE FACILITY TO ENSURE CHANGES IN LAND USE, TOPOGRAPHY OR ACCESS HAVE NOT OCCURRED AND DO NOT AFFECT THE OPERATION, MAINTENANCE, ACCESS OR SAFETY FEATURES AS PROVIDED.

8. RECORD KEEPING. THE OWNER OR DESIGNATED REPRESENTATIVE SHALL KEEP REASONABLE, ACCURATE WRITTEN RECORDS OF INSPECTIONS PERFORMED FOR THE STRUCTURE. RECORDS SHALL DOCUMENT ROUTINE MAINTENANCE AND/OR REPAIRS PERFORMED. COPIES SHALL BE PROVIDED TO THE JAMES CITY COUNTY UPON REQUEST.

9. THE FACILITY SHALL NOT ACCEPT ADDITIONAL DRAINAGE OR BE MODIFIED IN ANY WAY WITHOUT PRIOR CONSENT OR APPROVAL BY THE JAMES CITY COUNTY ENVIRONMENTAL DIVISION.

10. IN GENERAL SEDIMENT SHALL BE REMOVED FROM FOREBAY EVERY 3 TO 5 YEAR OR WHEN 3 TO 4 FEET HAVE ACCUMULATED, WHICHEVER COMES FIRST.

11. THE OWNER IS RESPONSIBLE FOR LONG TERM MAINTENANCE OF SEDIMENT FOREBAY AND ALL INCOMING PIPE SYSTEMS AND APPURTENANCES.

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Wm. S. Felts 10-03-2013
DATE

DRAINAGE AS-BUILTS FOR BUSCH GARDENS ATTRACTION 2012

JAMES CITY COUNTY VIRGINIA

NO.	DATE	REVISION / COMMENT / NOTE
1	08/02/12	CORRECTED INVERT ELEVATION @8A
2	11/28/12	REVISED POND CONTOURS
3	01/10/13	REVISED PER CONTRACTOR MARKUP
4	10/03/13	ADDED RIPRAP

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Wm. S. Felts
WILLIAM S. FELTS
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10/03/13
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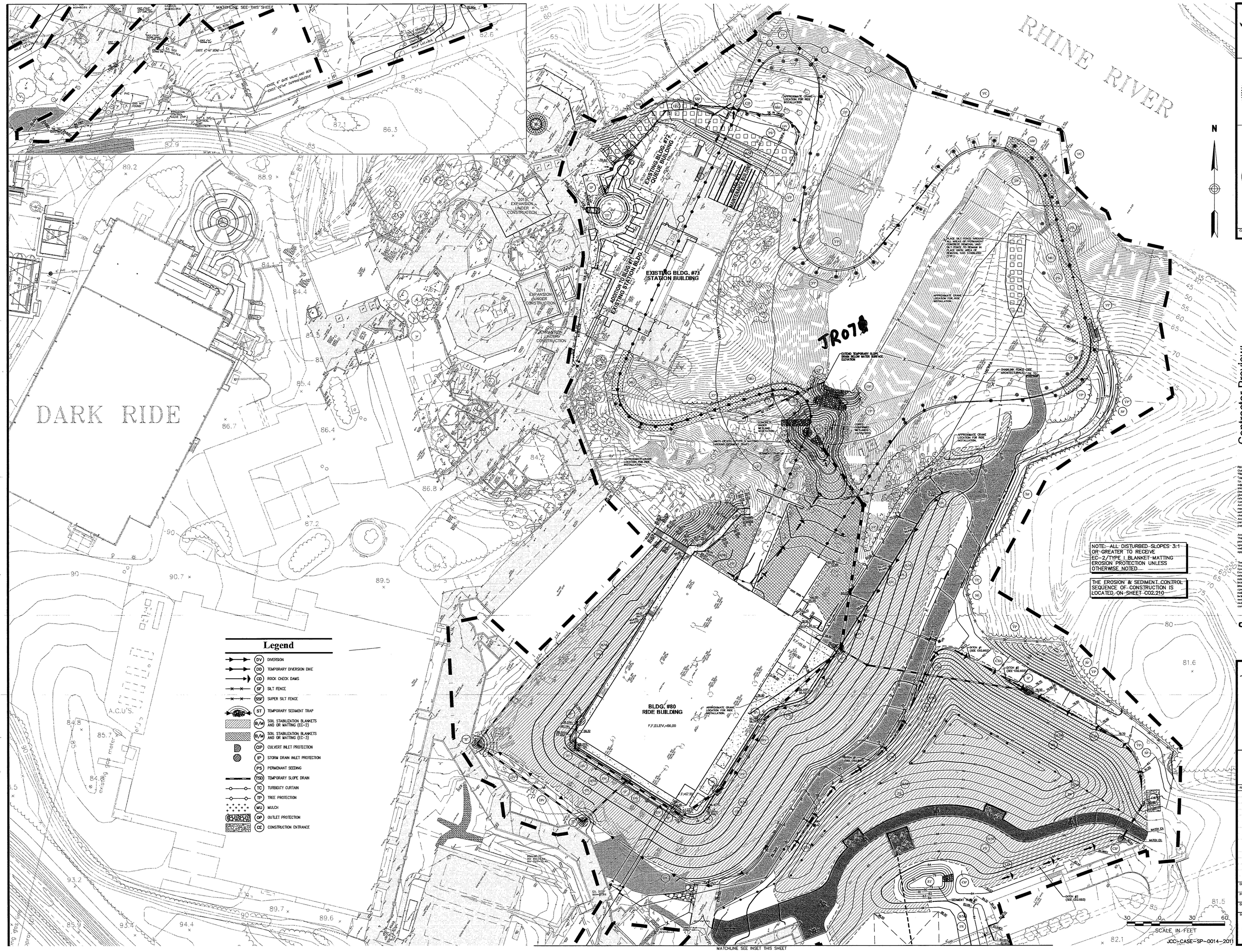
RECORD DRAWING

JCC-SP-0014-2011

JR071



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OWNER REVIEW & CONTRACTOR PREVIEW

Busch GARDENS. WILLIAMSBURG VA

Attraction 2012

Williamsburg, VA

Phase Three
Erosion Control and
Permanent Drainge Plan

Revision No.	Revision Date

Dr BSG	Ck CRO
PGAV 62047-00	Client SEA
Date March 22, 2011	
Sheet Number C02.207	

OVERALL PLAN JR071

SP-0021-2013

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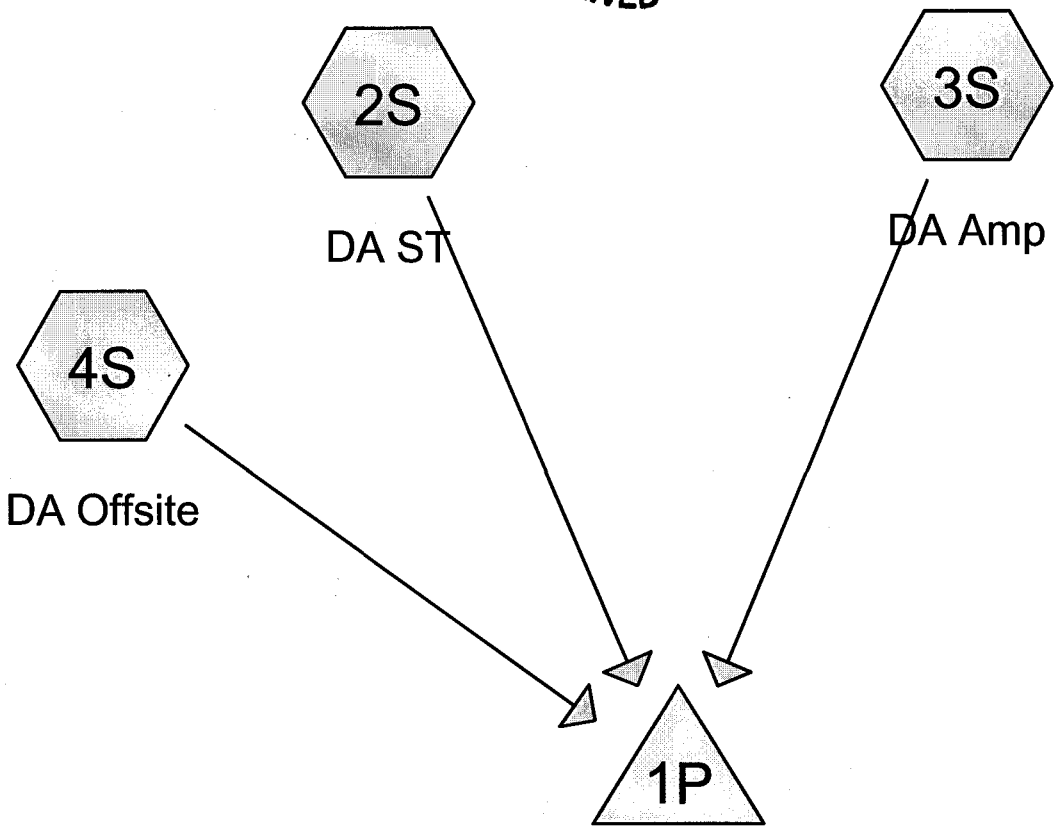


Sediment Forebay
Record Information

SP-21-13
AMENDS SP.14-11
FINAL COMPS

Subcat Reach Pond Link

Routing Diagram for Stormwater Calculations Record Information
Prepared by {enter your company name here}, Printed 3/18/2013
HydroCAD® 10.00 s/n 01038 © 2012 HydroCAD Software Solutions LLC

Summary for Pond 1P: Sediment Forebay Record Information

Inflow Area = 6.100 ac, 0.00% Impervious, Inflow Depth = 0.67" for 2-Year event
Inflow = 11.71 cfs @ 0.09 hrs, Volume= 0.340 af
Outflow = 11.71 cfs @ 0.35 hrs, Volume= 0.346 af, Atten= 0%, Lag= 15.6 min
Secondary = 11.71 cfs @ 0.35 hrs, Volume= 0.346 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Starting Elev= 35.00' Surf.Area= 2,684 sf Storage= 8,281 cf
Peak Elev= 35.14' @ 0.35 hrs Surf.Area= 2,773 sf Storage= 8,876 cf (595 cf above start)

Plug-Flow detention time= 13.2 min calculated for 0.156 af (46% of inflow)
Center-of-Mass det. time= 1.0 min (13.6 - 12.7)

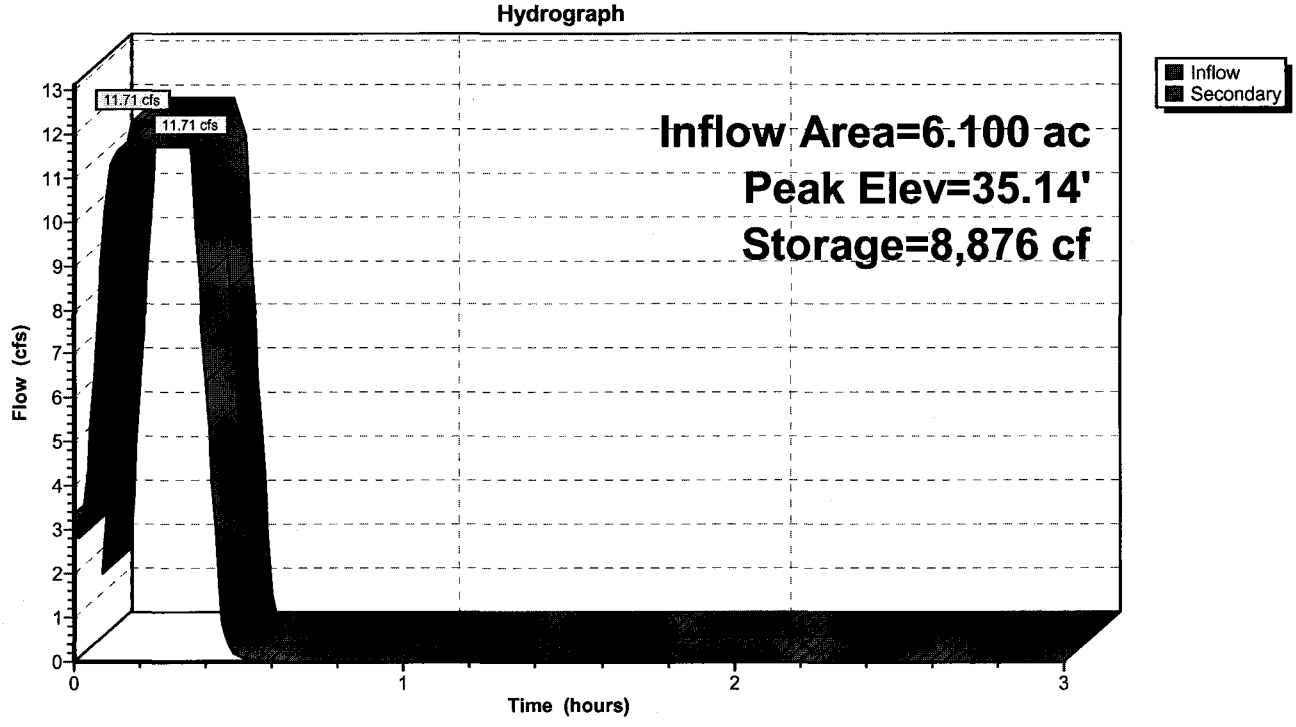
Volume	Invert	Avail.Storage	Storage Description
#1	26.20'	29,671 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
26.20	25	0	0
27.00	250	110	110
28.00	367	309	419
29.00	503	435	854
30.00	658	581	1,434
31.00	900	779	2,213
32.00	1,151	1,026	3,239
33.00	1,415	1,283	4,522
34.00	1,710	1,563	6,084
35.00	2,684	2,197	8,281
40.00	5,872	21,390	29,671

Device	Routing	Invert	Outlet Devices
#1	Secondary	34.90'	**40.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Secondary OutFlow Max=11.71 cfs @ 0.35 hrs HW=35.14' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 11.71 cfs @ 1.22 fps)

Pond 1P: Sediment Forebay Record Information



Summary for Subcatchment 2S: DA ST

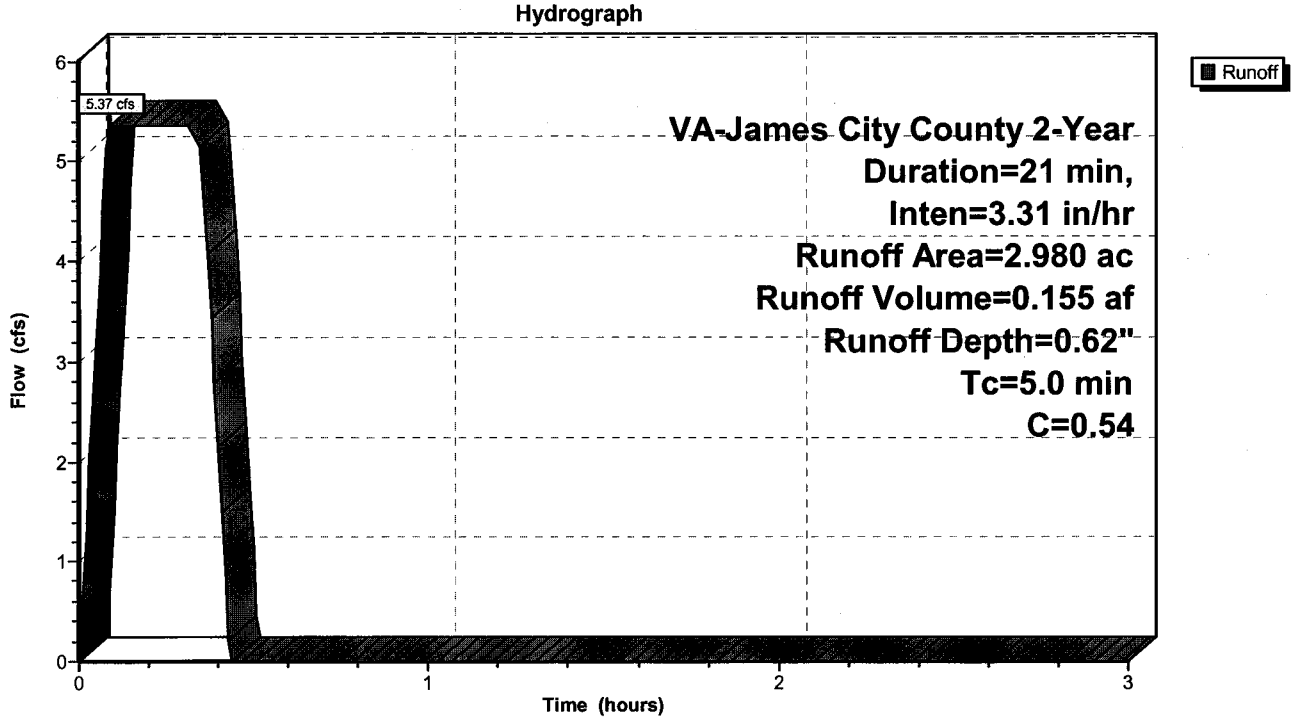
Runoff = 5.37 cfs @ 0.09 hrs, Volume= 0.155 af, Depth= 0.62"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 2-Year Duration=21 min, Inten=3.31 in/hr

Area (ac)	C	Description
2.980	0.54	
2.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, DT**

Subcatchment 2S: DA ST



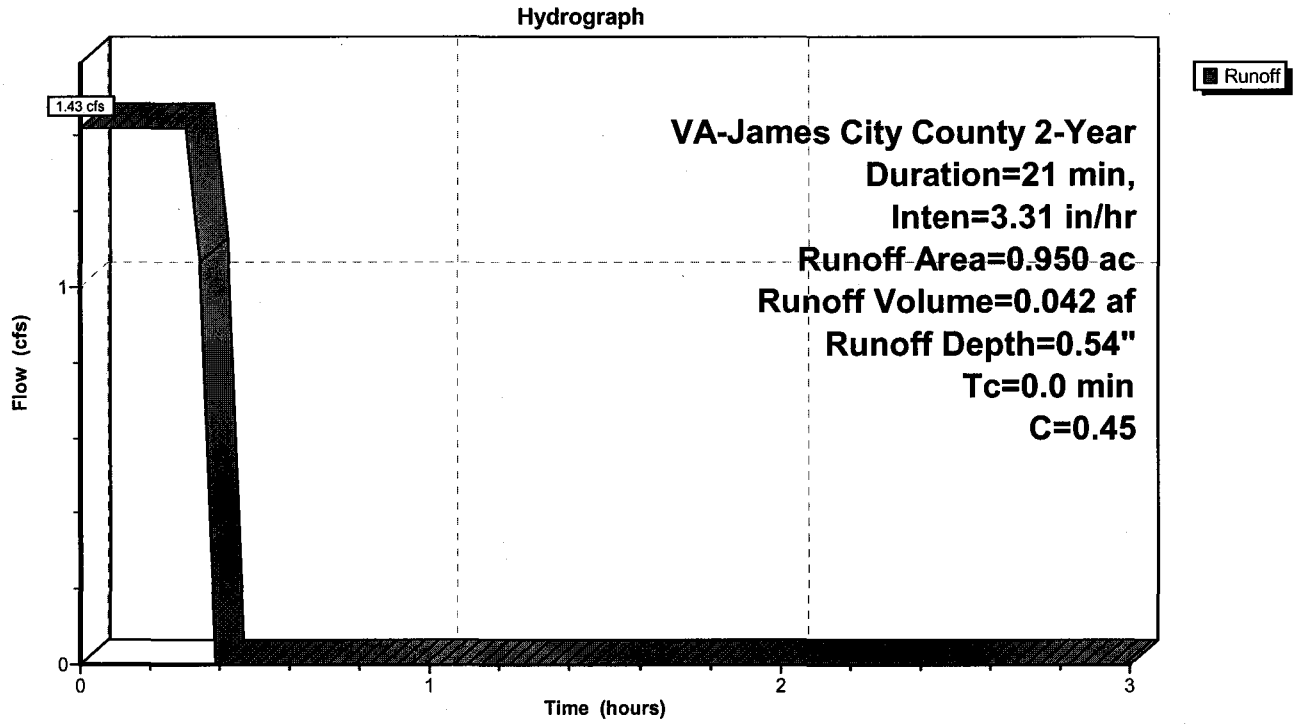
Summary for Subcatchment 3S: DA Amp

Runoff = 1.43 cfs @ 0.00 hrs, Volume= 0.042 af, Depth= 0.54"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 2-Year Duration=21 min, Inten=3.31 in/hr

Area (ac)	C	Description
0.950	0.45	DT
0.950		100.00% Pervious Area

Subcatchment 3S: DA Amp



Summary for Subcatchment 4S: DA Offsite

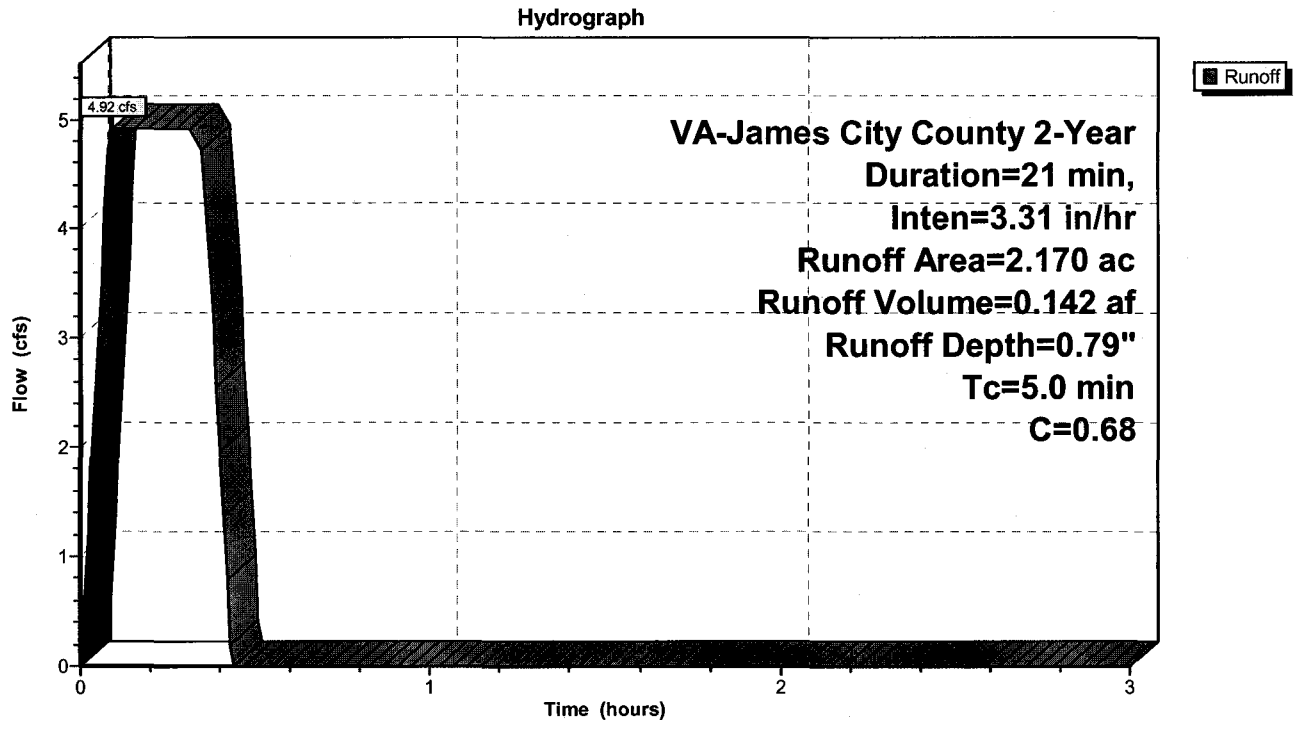
Runoff = 4.92 cfs @ 0.09 hrs, Volume= 0.142 af, Depth= 0.79"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 2-Year Duration=21 min, Inten=3.31 in/hr

Area (ac)	C	Description
2.170	0.68	
2.170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, DT**

Subcatchment 4S: DA Offsite



Summary for Pond 1P: Sediment Forebay Record Information

Inflow Area = 6.100 ac, 0.00% Impervious, Inflow Depth = 0.89" for 10-Year event
Inflow = 15.51 cfs @ 0.09 hrs, Volume= 0.450 af
Outflow = 15.51 cfs @ 0.35 hrs, Volume= 0.457 af, Atten= 0%, Lag= 15.6 min
Secondary = 15.51 cfs @ 0.35 hrs, Volume= 0.457 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Starting Elev= 35.00' Surf.Area= 2,684 sf Storage= 8,281 cf
Peak Elev= 35.19' @ 0.35 hrs Surf.Area= 2,803 sf Storage= 9,082 cf (801 cf above start)

Plug-Flow detention time= 10.2 min calculated for 0.266 af (59% of inflow)
Center-of-Mass det. time= 1.0 min (13.6 - 12.7)

Volume	Invert	Avail.Storage	Storage Description
#1	26.20'	29,671 cf	**Custom Stage Data (Prismatic)** Listed below

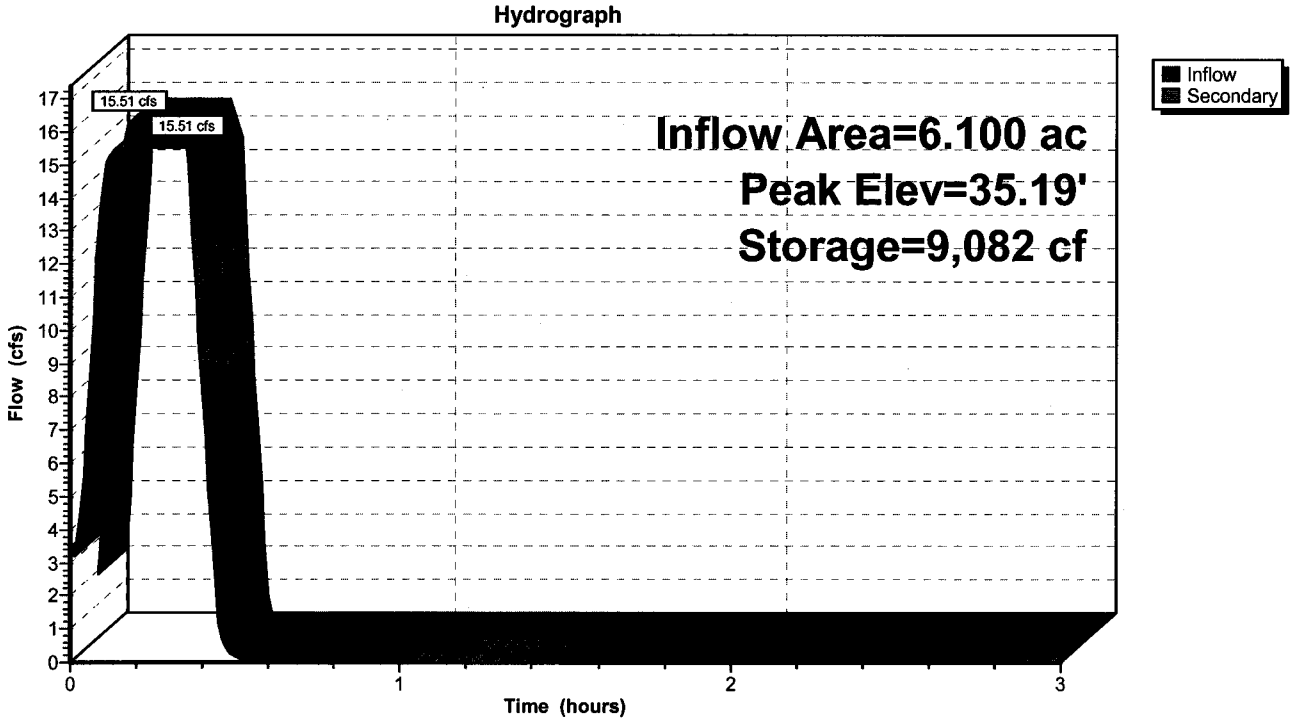
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
26.20	25	0	0
27.00	250	110	110
28.00	367	309	419
29.00	503	435	854
30.00	658	581	1,434
31.00	900	779	2,213
32.00	1,151	1,026	3,239
33.00	1,415	1,283	4,522
34.00	1,710	1,563	6,084
35.00	2,684	2,197	8,281
40.00	5,872	21,390	29,671

35.36 TOP DAM

Device	Routing	Invert	Outlet Devices
#1	Secondary	34.90'	**40.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Secondary OutFlow Max=15.51 cfs @ 0.35 hrs HW=35.19' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 15.51 cfs @ 1.35 fps)

Pond 1P: Sediment Forebay Record Information



Summary for Subcatchment 2S: DA ST

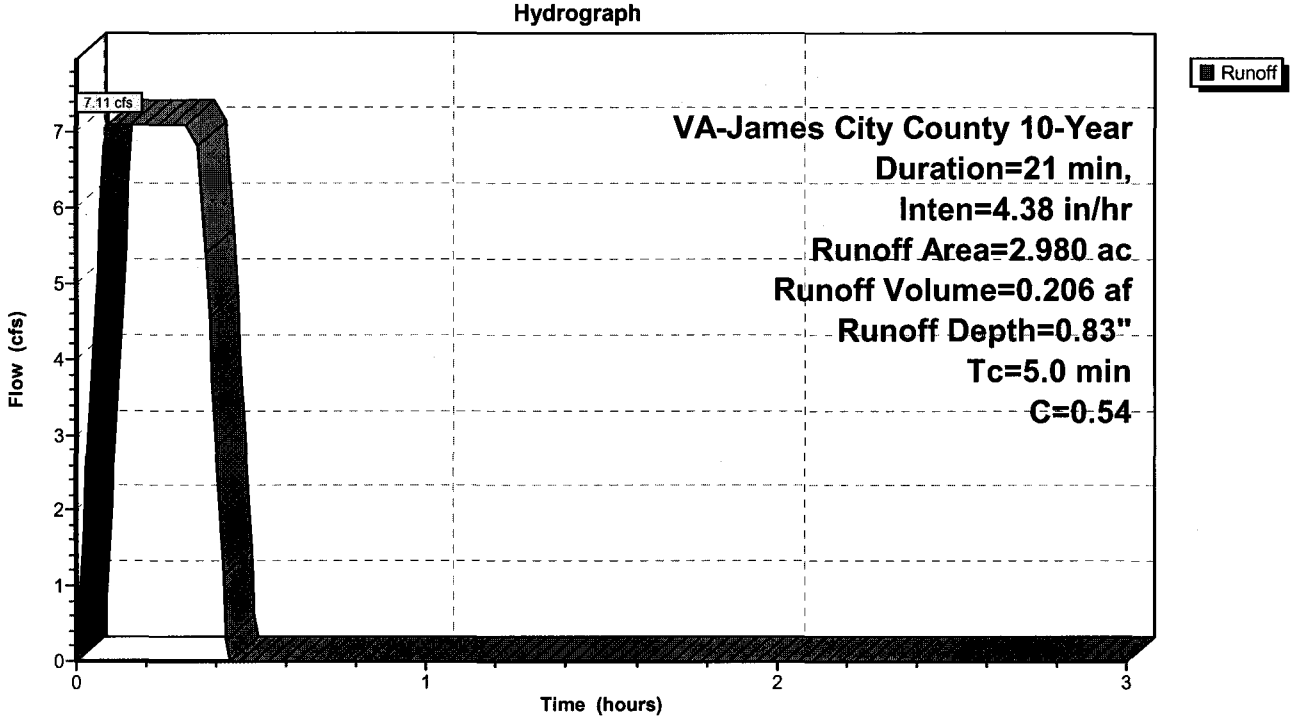
Runoff = 7.11 cfs @ 0.09 hrs, Volume= 0.206 af, Depth= 0.83"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 10-Year Duration=21 min, Inten=4.38 in/hr

Area (ac)	C	Description
2.980	0.54	
2.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, DT**

Subcatchment 2S: DA ST



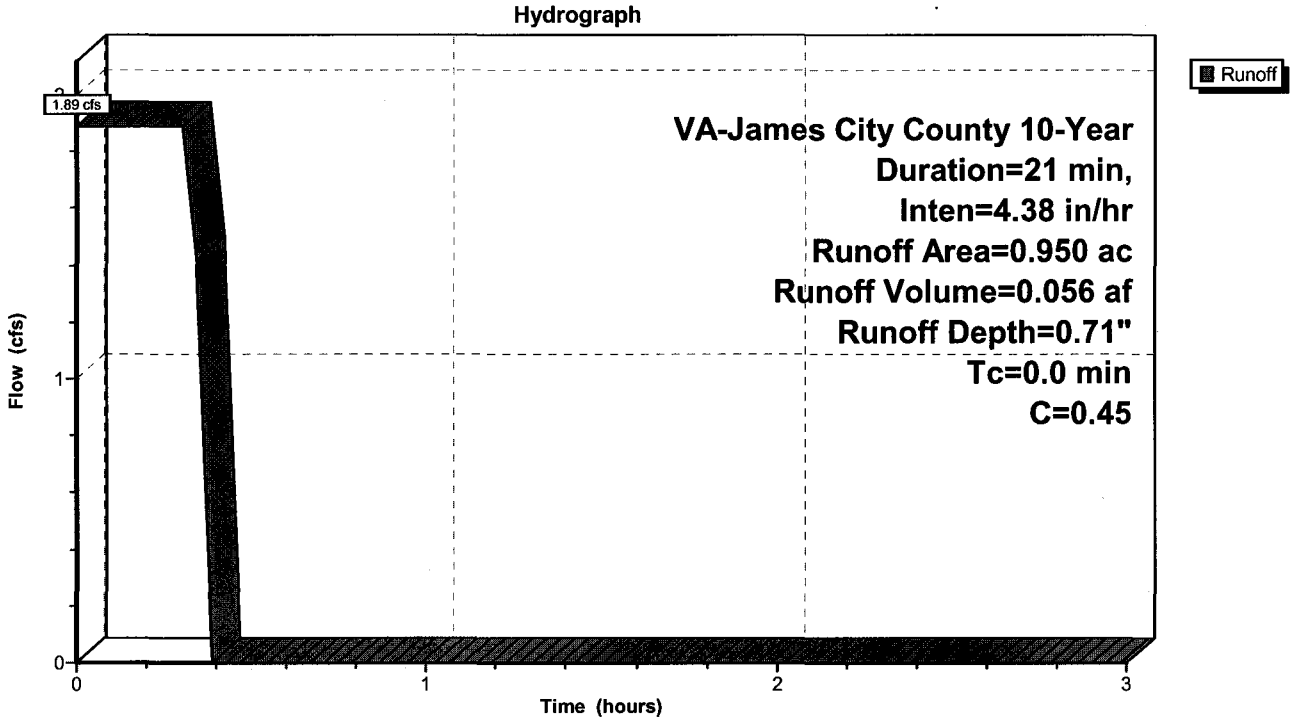
Summary for Subcatchment 3S: DA Amp

Runoff = 1.89 cfs @ 0.00 hrs, Volume= 0.056 af, Depth= 0.71"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 10-Year Duration=21 min, Inten=4.38 in/hr

Area (ac)	C	Description
0.950	0.45	DT
0.950		100.00% Pervious Area

Subcatchment 3S: DA Amp



Summary for Subcatchment 4S: DA Offsite

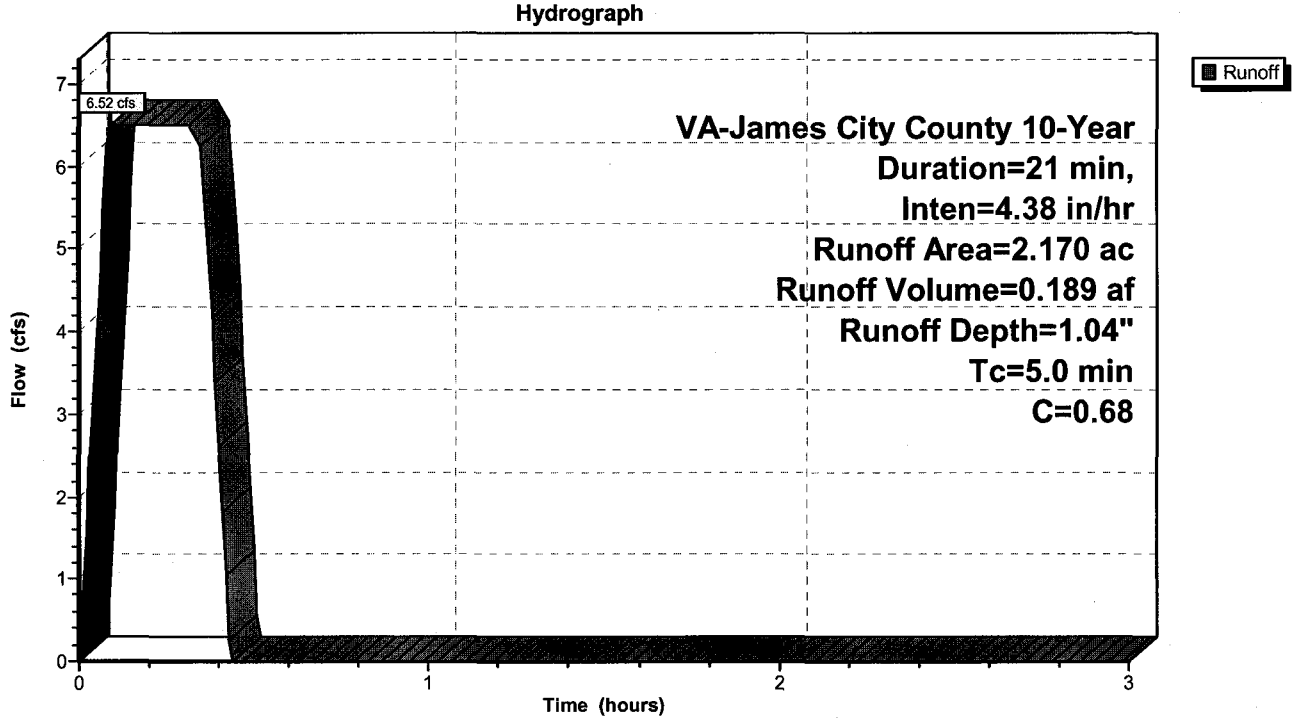
Runoff = 6.52 cfs @ 0.09 hrs, Volume= 0.189 af, Depth= 1.04"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 10-Year Duration=21 min, Inten=4.38 in/hr

Area (ac)	C	Description
2.170	0.68	
2.170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, DT**

Subcatchment 4S: DA Offsite



Summary for Pond 1P: Sediment Forebay Record Information

Inflow Area = 6.100 ac, 0.00% Impervious, Inflow Depth = 1.19" for 100-Year event
Inflow = 20.89 cfs @ 0.09 hrs, Volume= 0.606 af
Outflow = 20.89 cfs @ 0.35 hrs, Volume= 0.613 af, Atten= 0%, Lag= 15.6 min
Secondary = 20.89 cfs @ 0.35 hrs, Volume= 0.613 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
Starting Elev= 35.00' Surf.Area= 2,684 sf Storage= 8,281 cf
Peak Elev= 35.25' @ 0.35 hrs Surf.Area= 2,842 sf Storage= 9,343 cf (1,062 cf above start)

Plug-Flow detention time= 7.7 min calculated for 0.420 af (69% of inflow)
Center-of-Mass det. time= 0.9 min (13.6 - 12.7)

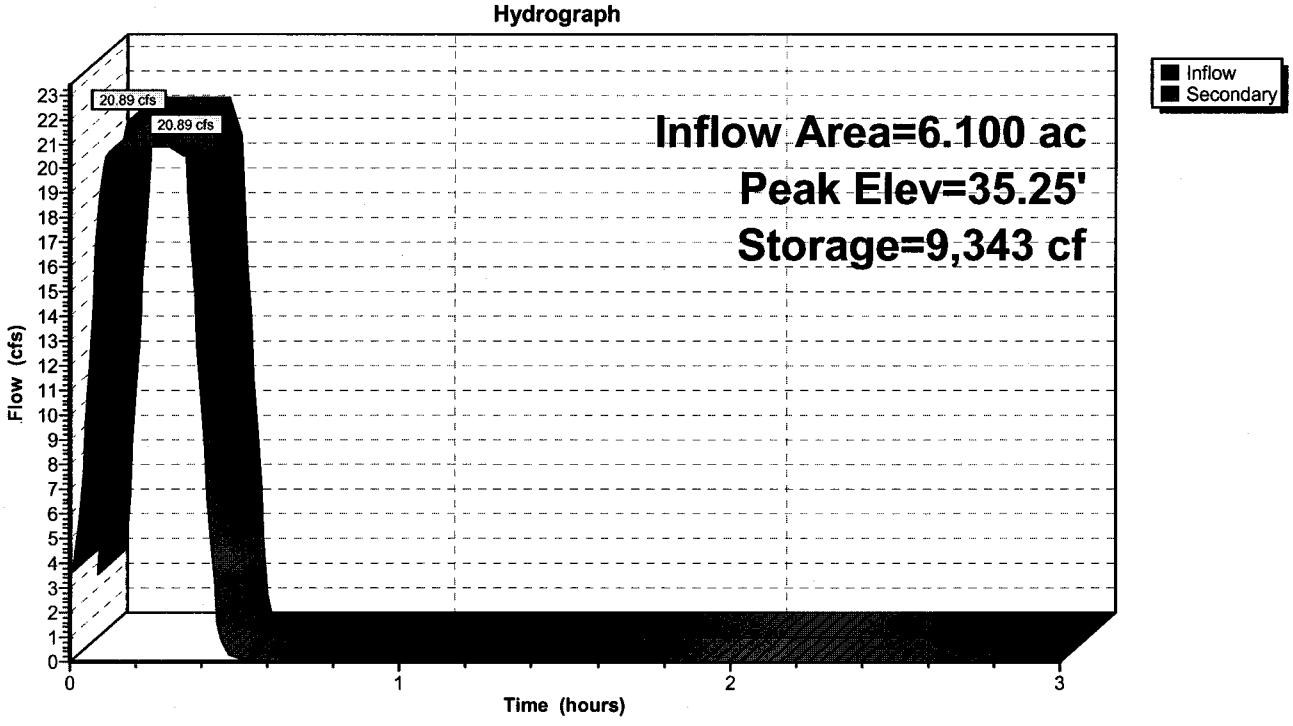
Volume	Invert	Avail.Storage	Storage Description
#1	26.20'	29,671 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
26.20	25	0	0
27.00	250	110	110
28.00	367	309	419
29.00	503	435	854
30.00	658	581	1,434
31.00	900	779	2,213
32.00	1,151	1,026	3,239
33.00	1,415	1,283	4,522
34.00	1,710	1,563	6,084
35.00	2,684	2,197	8,281
40.00	5,872	21,390	29,671

Device	Routing	Invert	Outlet Devices
#1	Secondary	34.90'	**40.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Secondary OutFlow Max=20.89 cfs @ 0.35 hrs HW=35.25' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 20.89 cfs @ 1.50 fps)

Pond 1P: Sediment Forebay Record Information



Summary for Subcatchment 2S: DA ST

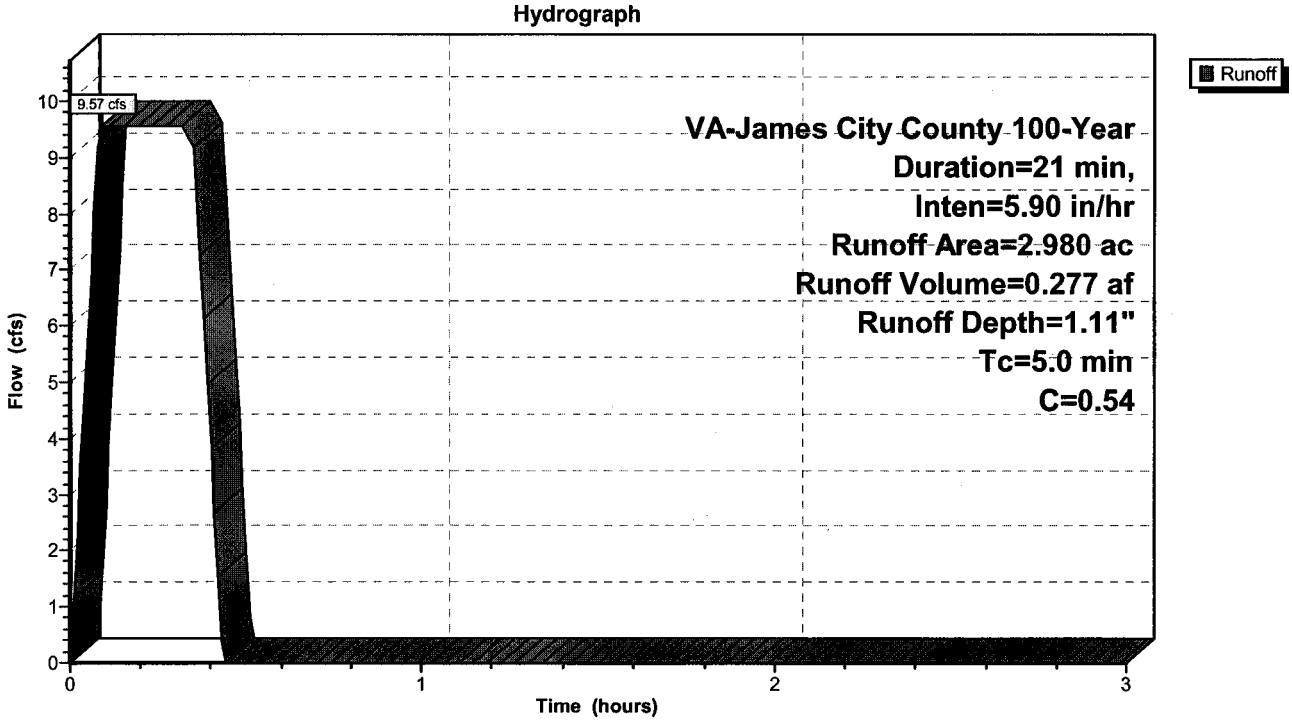
Runoff = 9.57 cfs @ 0.09 hrs, Volume= 0.277 af, Depth= 1.11"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 100-Year Duration=21 min, Inten=5.90 in/hr

Area (ac)	C	Description
2.980	0.54	
2.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, DT**

Subcatchment 2S: DA ST



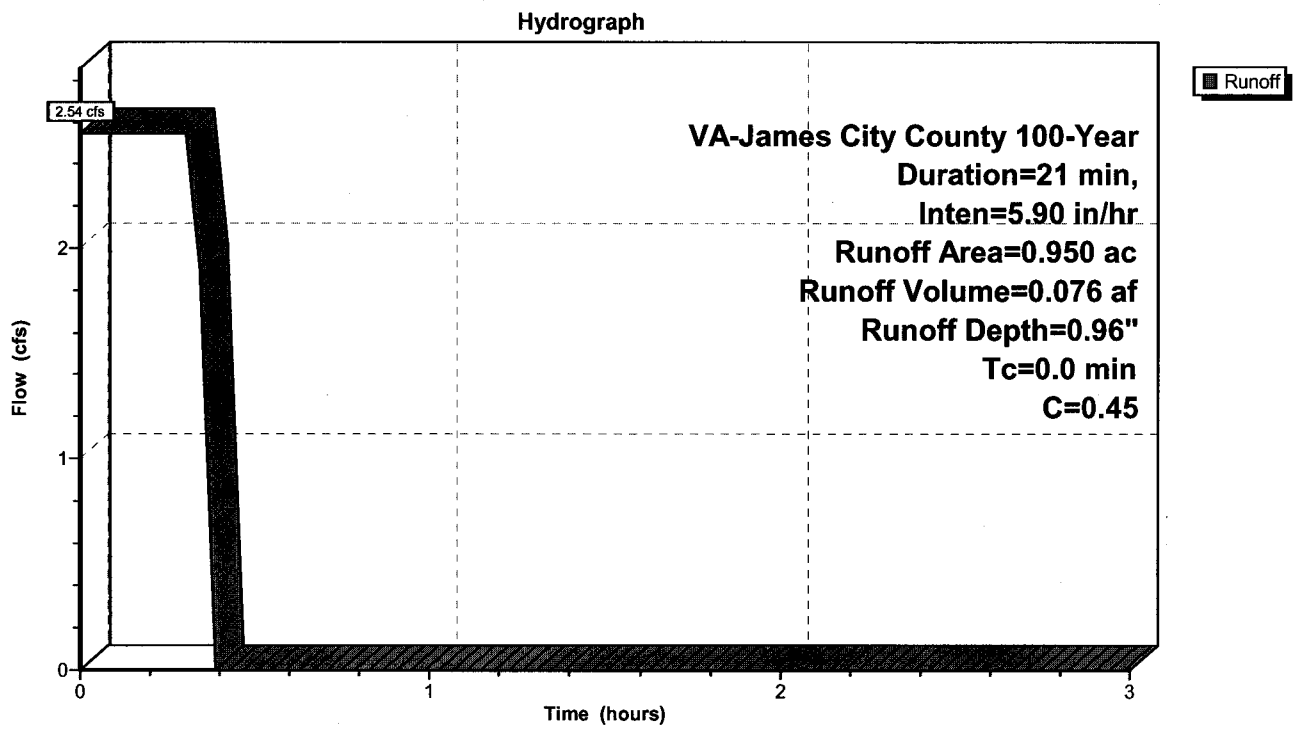
Summary for Subcatchment 3S: DA Amp

Runoff = 2.54 cfs @ 0.00 hrs, Volume= 0.076 af, Depth= 0.96"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 100-Year Duration=21 min, Inten=5.90 in/hr

Area (ac)	C	Description
0.950	0.45	DT
0.950		100.00% Pervious Area

Subcatchment 3S: DA Amp



Summary for Subcatchment 4S: DA Offsite

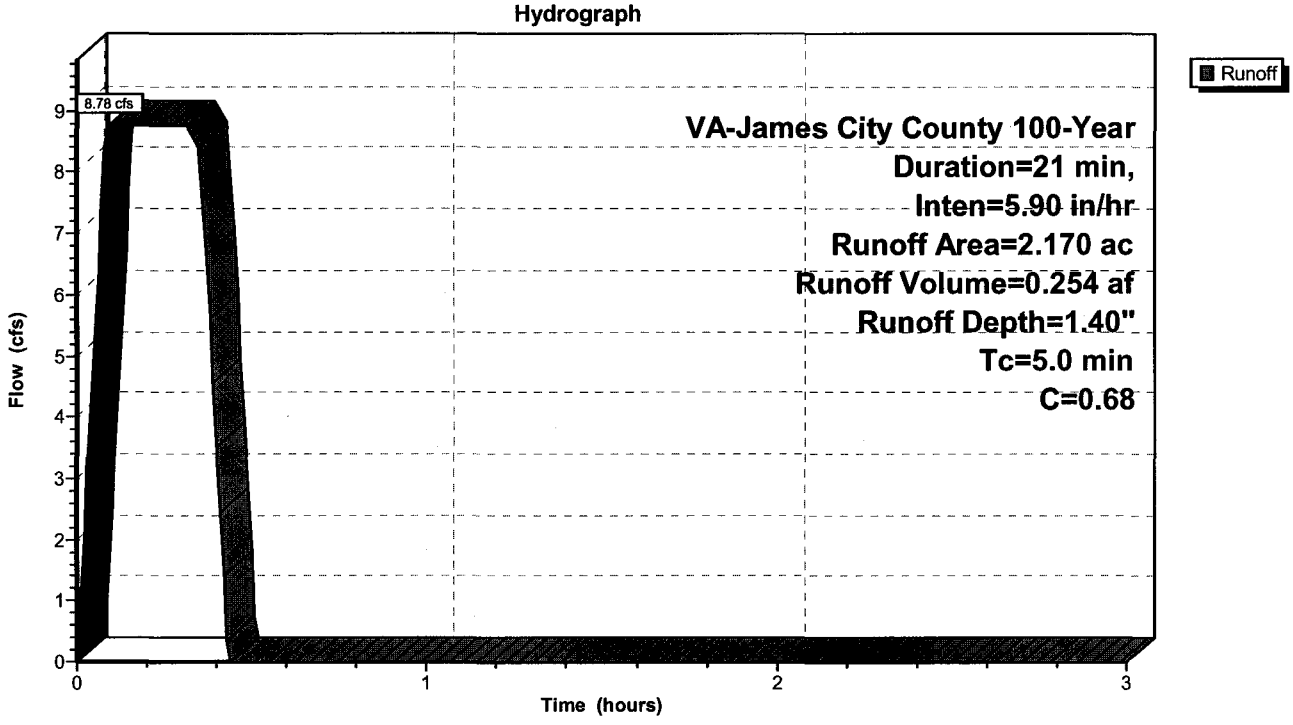
Runoff = 8.78 cfs @ 0.09 hrs, Volume= 0.254 af, Depth= 1.40"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-3.00 hrs, dt= 0.01 hrs
VA-James City County 100-Year Duration=21 min, Inten=5.90 in/hr

Area (ac)	C	Description
2.170	0.68	
2.170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, DT**

Subcatchment 4S: DA Offsite



VHB Inc. DATE: March-13 PROJECT NO. 33299.00

Storm Sewer Record Information Computations

Oktoberfest Attraction Expansion

10-year storm event

55.61 = B (10-YR) 10.00 = D 0.74 = E		AREA DRAIN. "A"	RUNOFF COEF.	CA		INLET TIME	RAIN FALL	RUNOFF "Q"		INVERT ELEVATIONS		PIPE LNGTH	SLOPE	DIA	CAPA-CITY	VEL.	FLOW TIME	REMARKS			Actual
FROM POINT	TO POINT	ACRES	C	INCRE-MENT	ACCUM-ULATED	MIN-UTES	IN.\HR	INCRE-MENT	ACCUM-ULATED	UPPER END	LOWER END	FT.	FT./FT.	IN.	C.F.S.	F.P.S.	MIN.		RIM	MANN. N	
1	2	0.47	0.68	0.32	0.32	5.00	7.50	2.40	2.40	55.63	54.48	20	0.058	15	15.48	9.19	0.04	PR-DI-3B	58.89	0.013	
2	3	0.21	0.43	0.09	0.41	5.04	7.48	0.68	3.07	53.82	53.41	55	0.008	15	5.59	4.78	0.19	PR-DI-3B	58.34	0.013	
3B-1	3B	0.13	0.86	0.11	0.11	5.00	7.50	0.84	0.84	76.86	75.79	89	0.012	12	3.90	4.01	0.37	PR-DI-6	79.97	0.013	1%
3B	3A	0.53	0.74	0.39	0.50	5.37	7.36	2.89	3.71	75.71	73.23	114	0.022	15	9.52	7.18	0.26	PR-DI-7	79.73	0.013	
3A	3	1.34	0.68	0.91	1.42	8.00	6.55	5.97	9.27	56.28	53.61	56	0.048	15	14.09	10.95	0.09	PR-DI-7	76.98	0.013	5.71%
3	4	0.26	0.50	0.13	1.96	8.09	6.53	0.85	12.76	53.31	52.58	62	0.012	24	24.56	7.95	0.13	PR-DI-3B	57.71	0.013	0.9%
4	5	0.18	0.50	0.09	2.05	8.22	6.49	0.58	13.28	52.48	51.91	41	0.014	24	26.66	8.50	0.08	PR-DI-3B	57.28	0.013	1.57%
5	6	0.22	0.53	0.12	2.16	8.30	6.47	0.75	13.99	51.83	51.15	73	0.009	24	21.81	7.28	0.17	PR-DI-3B	56.85	0.013	0.87%
6	7	0.24	0.67	0.16	2.32	8.46	6.43	1.03	14.93	51.07	49.36	95	0.018	24	30.34	9.62	0.16	PR-DI-3B	56.17	0.013	1.76%
302	301	1.48	0.43	0.64	0.64	9.15	6.26	3.98	3.98	72.65	66.60	149	0.041	15	13.01	9.36	0.27	PR-DI-5	77.58	0.013	4.58%
301	7	0.00	0.00	0.00	0.64	9.42	6.26	0.00	3.98	50.90	50.16	29	0.026	15	10.31	7.92	0.06	PR-MH	70.80	0.013	2.14%
7	8	0.69	0.62	0.43	3.39	8.63	6.39	2.73	21.63	40.61	38.55	135	0.015	30	50.63	9.85	0.23	PR-DI-3C	55.01	0.013	
8	8A	0.00	0.00	0.00	3.39	8.86	6.39	0.00	21.63	28.67	28.14	31	0.017	30	53.59	8.56	0.06	PR-MH	49.21	0.013	1.56%
8A	9	0.00	0.00	0.00	3.39	8.86	6.39	0.00	21.63	28.04	26.85	44	0.027	30	67.41	12.26	0.06	PR-MH	40.89	0.013	3.65%
200	201	0.05	0.68	0.03	0.03	5.00	7.50	0.25	0.25	77.49	76.84	40	0.016	6	0.72	3.30	0.20	Trench Drain	79.57	0.013	
201	202	0.04	0.86	0.03	0.07	5.20	7.50	0.26	0.51	73.00	67.00	22	0.273	8	6.31	4.78	0.08	Trench Drain	78.30	0.013	
202A	202	0.12	0.90	0.11	0.11	5.00	7.50	0.81	0.81	77.51	70.67	36	0.190	8	5.26	10.89	0.06	Trench Drain	79.73	0.013	
202	203	0.00	0.00	0.00	0.18	5.28	7.50	0.00	1.32	67.00	65.25	47	0.037	8	2.33	6.87	0.11	C.O.	73.41	0.013	
203	204	0.00	0.00	0.00	0.18	5.39	7.50	0.00	1.32	65.25	64.08	34	0.034	8	2.24	6.65	0.09	C.O.	68.54	0.013	
204	205	0.00	0.00	0.00	0.18	5.48	7.50	0.00	1.32	64.08	60.97	34	0.092	8	3.65	9.65	0.06	C.O.	66.26	0.013	

VHB Inc.
Hydraulic Gradeline Computations 10 Yr Storm - Record Drawings
Oktoberfest Attraction Expansion

DATE: March-13

PROJECT NO : 33299.00

RCP PIPE n= 0.013

INLET STATIO	OUTLET SURFAC	D(O)	Q(O)	L(O)	SF(O)	H(F)	JUNCTION LOSS														FINAL H	INLET SURFAC	RIM ELEV
							V(O)	H(O)	Q(I)	D(I)	V(I)	Q*V	$V^2/2G$	H(I)	ANGLE	E K	H(>)	H(T)	1*3 H(T)	0.5*			
	Sediment Forebay 10-year storm WSEL - Record Information																						
8A	35.19	30	21.63	44	0.0049	0.21	12.26	0.5835	21.63	30	9.85	213	1.51	0.53	61	0.47	0.71	1.82	2.36	2.36	2.58	37.77	40.89
8	37.77	30	21.63	31	0.0049	0.15	9.85	0.3766	21.63	30	9.85	213	1.51	0.53	85	0.66	0.99	1.90	2.47	2.47	2.62	40.39	49.21
7	40.55	30	21.63	135	0.0049	0.66	9.85	0.3766	14.93	30	9.62	144	1.44	0.50	38	0.33	0.47	1.35	1.76	1.76	2.42	42.97	55.01
									3.98	15	7.92	32											
6	51.36	30	14.93	95	0.0023	0.22	9.62	0.3593	13.99	24	7.28	102	0.82	0.29	15	0.10	0.08	0.73	0.95	0.47	0.70	52.06	56.17
5	52.75	24	13.99	73	0.0038	0.28	7.28	0.2057	13.28	24	8.50	113	1.12	0.39	28	0.22	0.25	0.85	1.10	0.55	0.83	53.58	56.85
4	53.58	24	13.28	41	0.0034	0.14	8.50	0.2805	12.76	24	7.95	101	0.98	0.34	62	0.47	0.46	1.09	1.41	0.71	0.85	54.43	57.28
3	54.43	24	12.76	62	0.0032	0.20	7.95	0.2454	9.27	15	10.95	102	1.86	0.65	75	0.64	1.19	2.09	2.72	1.36	1.55	55.98	57.71
									3.07	15	4.78	15											
3A	55.98	15	9.27	56	0.0206	1.15	10.95	0.4655	3.71	15	7.18	27	0.80	0.28	80	0.66	0.53	1.27	1.66	1.66	2.81	58.79	76.98
3B	74.23	15	3.71	114	0.0033	0.38	7.18	0.2001	0.84	12	4.01	3	0.25	0.09	81	0.66	0.16	0.45	0.59	0.59	0.96	75.19	79.73
3B-1	75.79	12	0.84	89	0.0006	0.05	4.01	0.0624										0.06	0.08	0.08	0.13	75.92	79.97
2	55.98	15	3.07	55	0.0023	0.12	4.78	0.0887	2.40	15	9.19	22	1.31	0.46	62	0.47	0.62	1.16	1.51	0.76	0.88	56.86	58.34
1	56.86	15	2.40	20	0.0014	0.03	9.19	0.3279										0.33	0.43	0.21	0.24	57.10	58.89
	0.8d																						
301	51.16	15	3.98	29	0.0038	0.11	7.92	0.2435	3.98	15	9.36	37	1.36	0.48	21	0.16	0.22	0.94	1.22	1.22	1.33	52.49	70.80
302	67.60	15	3.98	149	0.0038	0.57	9.36	0.3401										0.34	0.44	0.44	1.01	68.61	77.58
204	61.50	8	1.32	34	0.0120	0.41	9.65	0.3615	1.32	8	6.65	9	0.69	0.24	8	0.00	0.00	0.60	0.78	0.39	0.80	62.30	66.26
203	64.62	8	1.32	34	0.0120	0.41	6.65	0.1717	1.32	8	6.87	9	0.73	0.26	45	0.43	0.32	0.74	0.97	0.48	0.89	65.51	68.54
202	65.79	8	1.32	47	0.0120	0.56	6.87	0.1832	0.51	8	4.78	2											
									0.81	8	10.89	9	1.84	0.64	24	0.16	0.29	1.12	1.46	0.73	1.29	67.08	73.41
202A	71.20	8	0.81	36	0.0045	0.16	10.89	0.4604										0.46	0.60	0.30	0.46	71.66	79.73
201	67.54	8	0.51	22	0.0018	0.04	4.78	0.0887	0.25	6	3.30	1	0.17	0.06	45	0.43	0.07	0.22	0.29	0.14	0.18	67.72	78.30
200	77.24	6	0.25	40	0.0021	0.08	3.30	0.0423										0.04	0.05	0.03	0.11	77.35	79.57

VHB Inc. DATE: March-13 PROJECT NO. 33299.00

Storm Sewer Record Information Computations

Oktoberfest Attraction Expansion

100-year storm event

36.77 = B (100-YR) 5.25 0.56		AREA DRAIN. "A"	RUNOFF COEF.	CA		INLET TIME	RAIN FALL	RUNOFF "Q"		INVERT ELEVATIONS		PIPE LNGTH	SLOPE	DIA	CAPA-CITY	VEL.	FLOW TIME	REMARKS		
FROM POINT	TO POINT	ACRES	C	INCRE-MENT	ACCUM-ULATED	MIN-UTES	IN.\HR	INCRE-MENT	ACCUM-ULATED	UPPER END	LOWER END	FT.	FT./FT.	IN.	C.F.S.	F.P.S.	MIN.		RIM	MANN. N
1	2	0.47	0.68	0.32	0.32	5.00	9.99	3.19	3.19	55.63	54.48	20	0.058	15	15.48	9.19	0.04	PR-DI-3B	58.89	0.013
2	3	0.21	0.43	0.09	0.41	5.04	9.97	0.90	4.09	53.82	53.41	55	0.008	15	5.59	4.78	0.19	PR-DI-3B	58.34	0.013
3B-1	3B	0.13	0.86	0.11	0.11	5.00	9.99	1.12	1.12	76.86	75.79	89	0.012	12	3.90	4.01	0.37	PR-DI-6	79.97	0.013
3B	3A	0.53	0.74	0.39	0.50	5.37	9.79	3.84	4.94	75.71	73.23	114	0.022	15	9.52	7.18	0.26	PR-DI-7	79.73	0.013
3A	3	1.34	0.68	0.91	1.42	8.00	8.65	7.88	12.24	56.28	53.61	56	0.048	15	14.09	10.95	0.09	PR-DI-7	76.98	0.013
3	4	0.26	0.50	0.13	1.96	8.09	8.62	1.12	16.85	53.31	52.58	62	0.012	24	24.56	7.95	0.13	PR-DI-3B	57.71	0.013
4	5	0.18	0.50	0.09	2.05	8.22	8.57	0.77	17.53	52.48	51.91	41	0.014	24	26.66	8.50	0.08	PR-DI-3B	57.28	0.013
5	6	0.22	0.53	0.12	2.16	8.30	8.54	1.00	18.47	51.83	51.15	73	0.009	24	21.81	7.28	0.17	PR-DI-3B	56.85	0.013
6	7	0.24	0.67	0.16	2.32	8.46	8.49	1.36	19.71	51.07	49.36	95	0.018	24	30.34	9.62	0.16	PR-DI-3B	56.17	0.013
302	301	1.48	0.43	0.64	0.64	9.15	8.26	5.25	5.25	72.65	66.60	149	0.041	15	13.01	9.36	0.27	PR-DI-5	77.58	0.013
301	7	0.00	0.00	0.00	0.64	9.42	8.26	0.00	5.25	50.90	50.16	29	0.026	15	10.31	7.92	0.06	PR-MH	70.80	0.013
7	8	0.69	0.62	0.43	3.39	8.63	8.43	3.61	28.55	40.61	38.55	135	0.015	30	50.63	9.85	0.23	PR-DI-3C	55.01	0.013
8	8A	0.00	0.00	0.00	3.39	8.86	8.43	0.00	28.55	28.67	28.14	31	0.017	30	53.59	8.56	0.06	PR-MH	49.21	0.013
8A	9	0.00	0.00	0.00	3.39	8.86	8.43	0.00	28.55	28.04	26.85	44	0.027	30	67.41	12.26	0.06	PR-MH	40.89	0.013
200	201	0.05	0.68	0.03	0.03	5.00	9.99	0.34	0.34	77.49	76.84	40	0.016	6	0.72	3.58	0.19	Trench Drain	79.57	0.013
201	202	0.04	0.86	0.03	0.07	5.19	9.99	0.34	0.68	73.00	67.00	22	0.273	8	6.31	11.81	0.03	Trench Drain	78.30	0.013
202A	202	0.12	0.90	0.11	0.11	5.00	9.99	1.08	1.08	77.51	70.67	36	0.190	8	5.26	11.81	0.05	Trench Drain	79.50	0.013
202	203	0.00	0.00	0.00	0.18	5.22	9.99	0.00	1.76	67.00	65.25	47	0.037	8	2.33	7.32	0.11	C.O.	73.41	0.013
203	204	0.00	0.00	0.00	0.18	5.32	9.99	0.00	1.76	65.25	64.08	34	0.034	8	2.24	7.08	0.08	C.O.	68.54	0.013
204	205	0.00	0.00	0.00	0.18	5.40	9.99	0.00	1.76	64.08	60.97	34	0.092	8	3.65	10.40	0.05	C.O.	66.26	0.013

VHB Inc. DATE: March-13 PROJECT NO. 33299.00

Storm Sewer Record Information Computations

Oktoberfest Attraction Expansion

100-year storm event

36.77 = B (100-YR) 5.25 0.56		AREA DRAIN. "A"	RUNOFF COEF.	CA		INLET TIME	RAIN FALL	RUNOFF "Q"		INVERT ELEVATIONS		PIPE LNGTH	SLOPE	DIA	CAPA-CITY	VEL.	FLOW TIME	REMARKS		
FROM POINT	TO POINT	ACRES	C	INCRE-MENT	ACCUM-ULATED	MIN-UTES	IN.\HR	INCRE-MENT	ACCUM-ULATED	UPPER END	LOWER END	FT.	FT./FT.	IN.	C.F.S.	F.P.S.	MIN.		RIM	MANN. N
1	2	0.47	0.68	0.32	0.32	5.00	9.99	3.19	3.19	55.63	54.48	20	0.058	15	15.48	9.19	0.04	PR-DI-3B	58.89	0.013
2	3	0.21	0.43	0.09	0.41	5.04	9.97	0.90	4.09	53.82	53.41	55	0.008	15	5.59	4.78	0.19	PR-DI-3B	58.34	0.013
3B-1	3B	0.13	0.86	0.11	0.11	5.00	9.99	1.12	1.12	76.86	75.79	89	0.012	12	3.90	4.01	0.37	PR-DI-6	79.97	0.013
3B	3A	0.53	0.74	0.39	0.50	5.37	9.79	3.84	4.94	75.71	73.23	114	0.022	15	9.52	7.18	0.26	PR-DI-7	79.73	0.013
3A	3	1.34	0.68	0.91	1.42	8.00	8.65	7.88	12.24	56.28	53.61	56	0.048	15	14.09	10.95	0.09	PR-DI-7	76.98	0.013
3	4	0.26	0.50	0.13	1.96	8.09	8.62	1.12	16.85	53.31	52.58	62	0.012	24	24.56	7.95	0.13	PR-DI-3B	57.71	0.013
4	5	0.18	0.50	0.09	2.05	8.22	8.57	0.77	17.53	52.48	51.91	41	0.014	24	26.66	8.50	0.08	PR-DI-3B	57.28	0.013
5	6	0.22	0.53	0.12	2.16	8.30	8.54	1.00	18.47	51.83	51.15	73	0.009	24	21.81	7.28	0.17	PR-DI-3B	56.85	0.013
6	7	0.24	0.67	0.16	2.32	8.46	8.49	1.36	19.71	51.07	49.36	95	0.018	24	30.34	9.62	0.16	PR-DI-3B	56.17	0.013
302	301	1.48	0.43	0.64	0.64	9.15	8.26	5.25	5.25	72.65	66.60	149	0.041	15	13.01	9.36	0.27	PR-DI-5	77.58	0.013
301	7	0.00	0.00	0.00	0.64	9.42	8.26	0.00	5.25	50.90	50.16	29	0.026	15	10.31	7.92	0.06	PR-MH	70.80	0.013
7	8	0.69	0.62	0.43	3.39	8.63	8.43	3.61	28.55	40.61	38.55	135	0.015	30	50.63	9.85	0.23	PR-DI-3C	55.01	0.013
8	8A	0.00	0.00	0.00	3.39	8.86	8.43	0.00	28.55	28.67	28.14	31	0.017	30	53.59	8.56	0.06	PR-MH	49.21	0.013
8A	9	0.00	0.00	0.00	3.39	8.86	8.43	0.00	28.55	28.04	26.85	44	0.027	30	67.41	12.26	0.06	PR-MH	40.89	0.013
200	201	0.05	0.68	0.03	0.03	5.00	9.99	0.34	0.34	77.49	76.84	40	0.016	6	0.72	3.58	0.19	Trench Drain	79.57	0.013
201	202	0.04	0.86	0.03	0.07	5.19	9.99	0.34	0.68	73.00	67.00	22	0.273	8	6.31	11.81	0.03	Trench Drain	78.30	0.013
202A	202	0.12	0.90	0.11	0.11	5.00	9.99	1.08	1.08	77.51	70.67	36	0.190	8	5.26	11.81	0.05	Trench Drain	79.50	0.013
202	203	0.00	0.00	0.00	0.18	5.22	9.99	0.00	1.76	67.00	65.25	47	0.037	8	2.33	7.32	0.11	C.O.	73.41	0.013
203	204	0.00	0.00	0.00	0.18	5.32	9.99	0.00	1.76	65.25	64.08	34	0.034	8	2.24	7.08	0.08	C.O.	68.54	0.013
204	205	0.00	0.00	0.00	0.18	5.40	9.99	0.00	1.76	64.08	60.97	34	0.092	8	3.65	10.40	0.05	C.O.	66.26	0.013

VHB Inc.
Hydraulic Gradeline Computations 100 Yr Storm - Record Drawings
Oktoberfest Attraction Expansion

DATE: March-13

PROJECT NO : 33299.00

RCP PIPE n= 0.013

INLET STATIO	OUTLET SURFAC	D(O)	Q(O)	L(O)	SF(O)	H(F)	JUNCTION LOSS														FINAL H	INLET SURFAC	RIM ELEV
							V(O)	H(O)	Q(I)	D(I)	V(I)	Q*V	$V^2/2G$	H(I)	ANGLE	E K	H(>)	H(T)	1*3 H(T)	0.5*			
	Sediment Forebay 100-year storm WSEL - Record Information																						
8A	35.25	30	28.55	44	0.0085	0.37	12.26	0.5835	28.55	30	9.85	281	1.51	0.53	61	0.47	0.71	1.82	2.36	2.36	2.74	37.99	40.89
8	37.99	30	28.55	31	0.0085	0.26	9.85	0.3766	28.55	30	9.85	281	1.51	0.53	85	0.66	0.99	1.90	2.47	2.47	2.73	40.72	49.21
7	40.72	30	28.55	135	0.0085	1.15	9.85	0.3766	19.71	30	9.62	190	1.44	0.50	38	0.33	0.47	1.35	1.76	1.76	2.91	43.63	55.01
									5.25	15	7.92	42											
6	51.36	30	19.71	95	0.0041	0.38	9.62	0.3593	18.47	24	7.28	134	0.82	0.29	15	0.10	0.08	0.73	0.95	0.47	0.86	52.22	56.17
5	52.75	24	18.47	73	0.0067	0.49	7.28	0.2057	17.53	24	8.50	149	1.12	0.39	28	0.22	0.25	0.85	1.10	0.55	1.04	53.79	56.85
4	53.79	24	17.53	41	0.0060	0.25	8.50	0.2805	16.85	24	7.95	134	0.98	0.34	62	0.47	0.46	1.09	1.41	0.71	0.95	54.74	57.28
3	54.74	24	16.85	62	0.0056	0.34	7.95	0.2454	12.24	15	10.95	134	1.86	0.65	75	0.64	1.19	2.09	2.72	1.36	1.70	56.44	57.71
									4.09	15	4.78	20											
3A	56.44	15	12.24	56	0.0359	2.01	10.95	0.4655	4.94	15	7.18	35	0.80	0.28	80	0.66	0.53	1.27	1.66	1.66	3.67	60.11	76.98
3B	74.23	15	4.94	114	0.0058	0.67	7.18	0.2001	1.12	12	4.01	4	0.25	0.09	81	0.66	0.16	0.45	0.59	0.59	1.25	75.48	79.73
3B-1	75.79	12	1.12	89	0.0010	0.09	4.01	0.0624										0.06	0.08	0.08	0.17	75.96	79.97
2	56.44	15	4.09	55	0.0040	0.22	4.78	0.0887	3.19	15	9.19	29	1.31	0.46	62	0.47	0.62	1.16	1.51	0.76	0.98	57.42	58.34
1	57.42	15	3.19	20	0.0024	0.05	9.19	0.3279										0.33	0.43	0.21	0.26	57.68	58.89
	0.8d																						
301	51.16	15	5.25	29	0.0066	0.19	7.92	0.2435	5.25	15	9.36	49	1.36	0.48	21	0.16	0.22	0.94	1.22	1.22	1.41	52.57	70.80
302	67.60	15	5.25	149	0.0066	0.99	9.36	0.3401										0.34	0.44	0.44	1.43	69.03	77.58
204	61.50	8	1.76	34	0.0213	0.72	10.40	0.4199	1.76	8	7.08	12	0.78	0.27	8	0.00	0.00	0.69	0.90	0.45	1.17	62.68	66.26
203	64.62	8	1.76	34	0.0213	0.72	7.08	0.1946	1.76	8	7.32	13	0.83	0.29	45	0.43	0.36	0.84	1.10	0.55	1.27	65.89	68.54
202	65.89	8	1.76	47	0.0213	1.00	7.32	0.2080	0.68	8													
									1.08	8	11.81	13	2.17	0.76	24	0.16	0.35	1.31	1.71	0.85	1.85	67.74	68.54
202A	67.74	8	1.08	36	0.0080	0.29	0.00	0.0000										0.00	0.00	0.00	0.29	68.03	79.50
201	67.74	8	0.68	22	0.0032	0.07	0.00	0.0000	0.34	6	3.58	1	0.20	0.07	45	0.43	0.09	0.16	0.20	0.10	0.17	67.91	78.30
200	77.24	6	0.34	40	0.0037	0.15	3.58	0.0498										0.05	0.06	0.03	0.18	77.42	79.57

INITIAL CCTV 2/18/13

Busch Gardens Post-TV Review
Storm Sewer Inspection
Williamsburg, VA
TSU # 21399

Thursday, February 28, 2013

Post-TV Review Comments

Upstream Structure	Downstream Structure	Diameter (in.)	Length CCTV'd (FT)	Upstream MH Depth (FT)	Downstream MH Depth (FT)	Pipe Material	Date CCTV Completed	Comments
DI-2	DI-3	15	114.6	3.6	20.3	RCP	2/18/2013	minor longitudinal cracks - no signs of active infiltration; concrete deposits at 112' upstream from DI-3
DI-1	DI-2	12	90.1	2.10	3.6	PVC	2/18/2013	medium offset joint @ 58' upstream from DI-2
CB-5	CB-6	15	56.2	4.1	4.6	RCP	2/18/2013	no comments - ok
CB-4	CB-5	15	20.1	3.3	4.1	RCP	2/18/2013	deposits attached @ 18' upstream from CB-5
DI-3	CB-6	15	56.1	20.3	4.4	RCP	2/18/2013	circumferential crack @ 51' upstream from CB-6; concrete deposits @ 53' upstream from CB-6
CB-6	CB-7	24	62.1	4.40	4.7	RCP	2/18/2013	concrete deposits from 0' to 4' downstream of CB-6; pipe sag from 49' to 57' downstream from CB-6
CB-7	CB-8	24	39.8	4.7	5.00	RCP	2/18/2013	no comments - ok
CB-8	CB-9	24	73.8	5.0	4.1	RCP	2/18/2013	no comments - ok
CB-9	CB-12	24	94.4	4.1	14.6	RCP	2/18/2013	no comments - ok
15	16	15	34.7	INLET	OUTLET	RCP	2/18/2013	standing water 0' to 21' upstream from 16; joint separated @ 6' upstream from 16; intruding gasket @ 13' upstream from 16
DI-10	MH-11	15	149.6	4.10	19.7	RCP	2/18/2013	concrete deposits from 0' to 5' and @ 148' downstream of DI-10; minor cracks - no sign of active infiltration
MH-11	CB-12	15	30.2	19.7	14.6	RCP	2/18/2013	concrete deposits @ 26' upstream from CB-12; active infiltration visible through wall in MH-11
CB-12	MH-13	30	132.3	14.6	20.6	RCP	2/18/2013	minor cracks throughout pipe; small sag @ 118' to 132' downstream from CB-12 (water level height may be attributed to small amount of debris in pipe @ 131' downstream from CB-12)
MH-13	MH-14	30	29.2	20.6	12.7	RCP	2/18/2013	concrete deposits in mouth of pipe of MH-13
MH-14	EOP-17	30	45.5	12.7	OUTFALL	RCP	2/18/2013	infiltration runner @ 8' downstream from MH-14
		Total:	1,028.3					

COMMONWEALTH OF VIRGINIA
JONATHAN LEE THOMAS
Lic. No. 043023
2-28-13
PROFESSIONAL ENGINEER

RECEIVED
MAY 09 2013
Environmental Division

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		1
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Jetting	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	DI-2
City	WILLIAMSBURG	Drainage Area		Dowstream MH	DI-3
Loc. details	SW SIDE OF BLDG 80	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Easement/Right of way	Length surveyed	114.55 ft	Section Length	114.55 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	15.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:300	Position	Code	Observation	MPEG	Photo	Grade
DEPTH 20.3'						
DI-3	0.00	ACB	Catch Basin / DI-3	00:00:35		
	111.25	DAZ	Deposits Attached Other, 15 %of cross sectional area, at 04 o'clock, , within 8 inches of joint: YES / CEMENT	00:06:54		M 3
DI-2	114.55	ACB	Catch Basin / DI-2	00:07:25		
DEPTH 3.6'						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	3100	0	3	3		3	3

City : WILLIAMSBURG

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		2
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Jetting	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	DI-1
City	WILLIAMSBURG	Drainage Area		Dowstream MH	DI-2
Loc. details	SW OF BLDG 80	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Easement/Right of way	Length surveyed	90.10 ft	Section Length	90.10 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	12.00 Inch
Year Rehabilitated		Material	Polyvinyl Chloride
Tape / Media No.		Lining Method	

Add. Information :

1:240	Position	Code	Observation	MPEG	Photo	Grade
DEPTH 3.6'						
DI-2	0.00	ACB	Catch Basin / DI-2	00:00:28		
	0.00	MWL	Water Level, 5 %of cross sectional area	00:01:21		
	58.25	JSM	Joint Separated Medium	00:03:56	2_3A	S 1
	60.90	LR	Alignment Right, 5 %	00:04:28	2_4A	M 1
	90.10	ACB	Catch Basin / DI-1	00:06:04		
DI-1						
DEPTH 2.10'						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
1100	1100	1	1	2		1	1

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		3
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Jetting	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	CB-5
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-6
Loc. details	SW SIDE OF BLDG. 80	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Building	Length surveyed	56.15 ft	Section Length	56.15 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	15.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:150	Position	Code	Observation	MPEG	Photo	Grade
DEPTH 4.6'						
CB-6	0.00	ACB	Catch Basin / CB-6	00:00:38		
	45.30	CM	Crack Multiple, from 10 to 12 o'clock, within 8 inches of joint: YES	00:03:02	3_2A	S 3
	56.15	ACB	Catch Basin / CB-5	00:04:11		
CB-5						
DEPTH 4.1'						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3100	0000	3	0	3		0	3

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		4
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Jetting	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	CB-4
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-5
Loc. details	CONCRETE / SW CORNER OF BLDG. 80	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Building	Length surveyed	20.05 ft	Section Length	20.05 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	15.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:60	Position	Code	Observation	MPEG	Photo	Grade
DEPTH 4.1'						
CB-5	0.00	ACB	Catch Basin / CB-5	00:00:17		
	17.25	DAZ	Deposits Attached Other, 10 %of cross sectional area, from 05 to 07 o'clock, , within 8 inches of joint: YES / CEMENT	00:01:46		M 2
	20.05	ACB	Catch Basin / CB-4	00:02:26		
CB-4						
DEPTH 3.3'						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	2100	0	2	2		2	2

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		5
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Jetting	

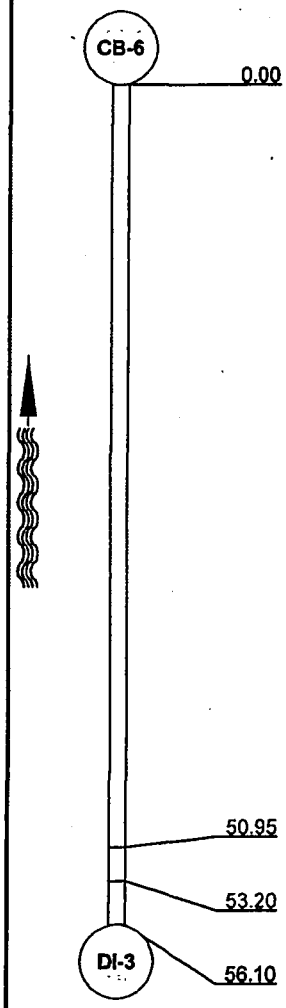
Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	DI-3
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-6
Loc. details	CURB AREA / SW SIDE OF BLDG. 80	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Building	Length surveyed	56.10 ft	Section Length	56.10 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	15.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:150

DEPTH 4.4'



Position	Code	Observation	MPEG	Photo	Grade
0.00	ACB	Catch Basin / CB-6	00:00:29		
50.95	FC	Fracture Circumferential, from 12 to 12 o'clock, within 8 inches of joint: YES	00:04:40	5_2A	S 2
53.20	DAZ	Deposits Attached Other, 10 %of cross sectional area, from 05 to 07 o'clock, , within 8 inches of joint: YES / CEMENT	00:05:21	5_3A	M 2
56.10	ACB	Catch Basin / DI-3	00:06:15		

DEPTH 20.3'

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
2100	2100	2	2	4		2	2

City : WILLIAMSBURB

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		6
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Heavy Cleaning	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	CB-6
City	WILLIAMSBURB	Drainage Area		Dowstream MH	CB-7
Loc. details	CURB AREA / SW SIDE OF BLDG. 80	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Building	Length surveyed	62.10 ft	Section Length	62.10 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	24.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:165 Position	Code	Observation	MPEG	Photo	Grade
DEPTH 4.4'					
CB-6 0.00	ACB	Catch Basin / CB-6	00:00:24		
2.00	DAZ	Deposits Attached Other, 10 %of cross sectional area, from 05 to 07 o'clock, , within 8 inches of joint: YES / CEMENT	00:01:24		M 2
48.80	MWLS	Water Level, Sag in pipe, 5 %of cross sectional area	00:03:43		S 2
57.85	CC	Crack Circumferential, from 08 to 10 o'clock, within 8 inches of joint: YES	00:04:18	6_4A	S 1
62.10	ACB	Catch Basin / CB-7	00:04:57		
CB-7					
DEPTH 4.7'					

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
2111	2100	3	2	5		2	1.67

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		7
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Heavy Cleaning	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	CB-7
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-8
Loc. details	CONCRETE / SE CORNER OF BLDG. 80	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Building	Length surveyed	39.75 ft	Section Length	39.75 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	24.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:105 Position	Code	Observation	MPEG	Photo	Grade
DEPTH 4.7'					
CB-7 0.00	ACB	Catch Basin / CB-7	00:00:22		
39.75	ACB	Catch Basin / CB-8	00:02:31		
CB-8					
DEPTH 5.0'					

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	0000	0	0	0		0	0

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		8
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Heavy Cleaning	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	CB-8
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-9
Loc. details	CURB AREA / SE SIDE OF BLDG. 80	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Building	Length surveyed	73.80 ft	Section Length	73.80 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	24.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:195	Position	Code	Observation	MPEG	Photo	Grade
DEPTH 5.0'						
CB-8	0.00	ACB	Catch Basin / CB-8	00:00:22		
	73.80	ACB	Catch Basin / CB-9	00:04:09		
CB-9						
DEPTH 4.1'						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	0000	0	0	0		0	0

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		9
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Heavy Cleaning	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	CB-9
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-12
Loc. details	CONCRETE / E. SIDE OF BLDG. 80	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Building	Length surveyed	94.35 ft	Section Length	94.35 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	24.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:240	Position	Code	Observation	MPEG	Photo	Grade
DEPTH 4.1'						
CB-9	0.00	ACB	Catch Basin / CB-9	00:00:28		
	51.50	CC	Crack Circumferential, from 12 to 12 o'clock, within 8 inches of joint: NO	00:02:27	9_2A	S 1
CB-12	94.35	ACB	Catch Basin / CB-12	00:04:06		
DEPTH 14.6'						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
1100	0000	1	0	1		0	1

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		10
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Jetting	

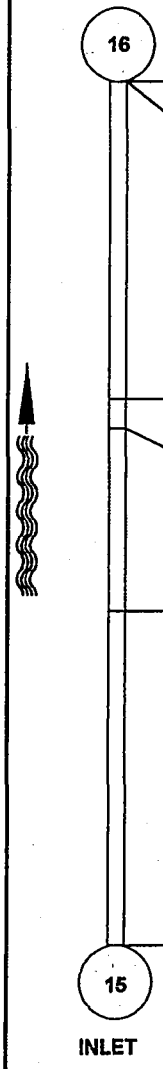
Street123	NO INFO	Use of Sewer	Stormwater	Upstream MH	15
City	WILLIAMSBURG	Drainage Area		Dowstream MH	16
Loc. details	GRASS	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Ditch	Length surveyed	34.70 ft	Section Length	34.70 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	15.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:90

OUTLET



INLET

Position	Code	Observation	MPEG	Photo	Grade
0.00	AEP	End of Pipe / 16	00:00:30		
0.00	MWL	Water Level, 15 %of cross sectional area	00:00:55	10_2A	
12.75	ISSRH	Intruding Sealing Ring Hanging, 15 %of cross sectional area, from 11 to 02 o'clock	00:01:51	10_3A	M 3
13.95	SMW	Surface Missing Wall, at 09 o'clock, within 8 inches of joint: YES	00:02:25	10_4A	S 5
21.25	MWL	Water Level, 5 %of cross sectional area	00:02:55		
34.70	AEP	End of Pipe / 15	00:03:32		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
5100	3100	5	3	8		3	4

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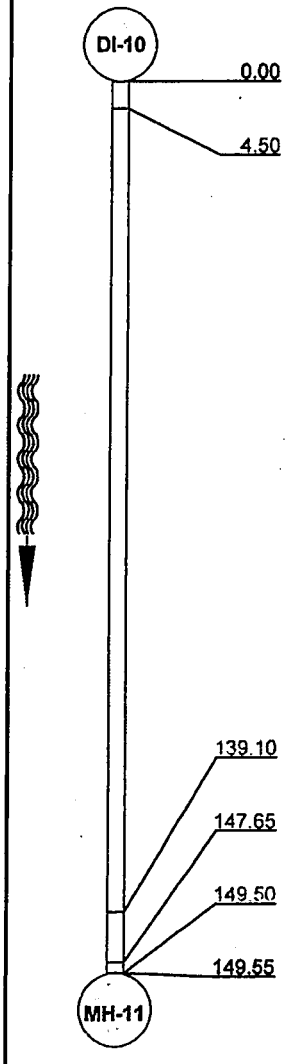
Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		11
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Jetting	

Street123	NO INFO.	Use of Sewer	Stormwater	Upstream MH	DI-10
City	WILLIAMSBURG	Drainage Area		Dowstream MH	MH-11
Loc. details	GRASS / ESMT.	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Ditch	Length surveyed	149.55 ft	Section Length	149.55 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	15.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :



1:375 Position	Code	Observation	MPEG	Photo	Grade
DEPTH 4.10'					
0.00	ACB	Catch Basin / DI-10	00:00:35		
4.50	DAZ	Deposits Attached Other, 10 %of cross sectional area, from 05 to 07 o'clock, , within 8 inches of joint: YES / CONCRETE	00:02:12		M 2
139.10	CM	Crack Multiple, from 05 to 07 o'clock, within 8 inches of joint: NO	00:06:02	11_3A	S 3
147.65	DAZ	Deposits Attached Other, 5 %of cross sectional area, from 05 to 07 o'clock, , within 8 inches of joint: YES / CEMENT	00:06:27		M 2
149.50	ID	Infiltration Dripper, from 12 to 12 o'clock, within 8 inches of joint: NO / INSIDE MH	00:07:31	11_5A	M 3
149.55	AMH	Downstream Manhole, Survey Ends / MH-11	00:07:48		
DEPTH 19.7'					

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3100	3122	3	7	10		2.33	2.6

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		12
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Jetting	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	MH 11
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-12
Loc. details	GRASS	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Building	Length surveyed	30.15 ft	Section Length	30.15 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	15.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:90	Position	Code	Observation	MPEG	Photo	Grade
DEPTH 14.6'						
CB-12	0.00	ACB	Catch Basin / CB-12	00:00:24		
	25.75	DAZ	Deposits Attached Other, 5 %of cross sectional area, from 05 to 07 o'clock, , within 8 inches of joint: YES / CEMENT	00:02:29		M 2
	30.15	AMH	Upstream Manhole, Survey Ends / MH-11	00:03:06		
MH 11						
DEPTH 19.7'						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	2100	0	2	2		2	2

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Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		13
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Heavy Cleaning	

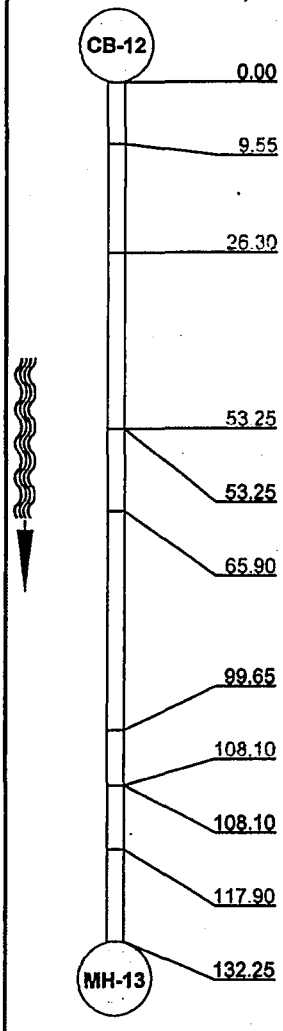
Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	CB-12
City	WILLIAMSBURG	Drainage Area		Dowstream MH	MH-13
Loc. details	ASPHALT / GRASS / NE CORNER OF BLDG.	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Building	Length surveyed	132.25 ft	Section Length	132.25 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	30.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:345

DEPTH 14.6'



Position	Code	Observation	MPEG	Photo	Grade
0.00	ACB	Catch Basin / CB-12	00:00:23		
9.55	CM	Crack Multiple, from 09 to 12 o'clock, within 8 inches of joint: YES	00:03:03		S 3
26.30	CM	Crack Multiple, from 01 to 03 o'clock, within 8 inches of joint: YES	00:03:51	13_3A	S 3
53.25	CM	Crack Multiple, from 09 to 01 o'clock, within 8 inches of joint: YES	00:05:11	13_4A	S 3
53.25	IS	Infiltration Stain, from 07 to 10 o'clock, within 8 inches of joint: NO	00:05:33	13_5A	
65.90	MWLS	Water Level, Sag in pipe, 5 %of cross sectional area	00:06:21		S 2
99.65	IS	Infiltration Stain, from 03 to 05 o'clock, within 8 inches of joint: YES	00:07:41		
108.10	CM	Crack Multiple, from 02 to 03 o'clock, within 8 inches of joint: YES	00:08:27	13_8A	S 3
108.10	IS	Infiltration Stain, from 03 to 05 o'clock, within 8 inches of joint: YES	00:08:42		
117.90	MWLS	Water Level, Sag in pipe, 10 %of cross sectional area	00:09:08		S 2
132.25	AMH	Downstream Manhole, Survey Ends / MH-13	00:10:27		

DEPTH 20.6'

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3422	0000	16	0	16		0	2.67

City : WILLIAMSBURG

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		14
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Heavy Cleaning	

Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	MH-13
City	WILLIAMSBURG	Drainage Area		Dowstream MH	MH-14
Loc. details	ESMT	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Building	Length surveyed	29.20 ft	Section Length	29.20 ft

Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	30.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:75 Position	Code	Observation	MPEG	Photo	Grade
DEPTH 20.6'					
MH-13 0.00	AMH	Upstream Manhole, Survey Begins / MH-13	00:00:23		
0.00	DAZ	Deposits Attached Other, 20 %of cross sectional area, from 04 to 08 o'clock, , within 8 inches of joint: YES / CEMENT FROM MH	00:01:46		M 3
9.00	MWLS	Water Level, Sag in pipe, 15 %of cross sectional area	00:03:35		S 2
29.20	DAZ	Deposits Attached Other, 15 %of cross sectional area, from 05 to 07 o'clock, , within 8 inches of joint: YES / CEMENT IN MH	00:05:02		M 3
29.20 MH-14	AMH	Downstream Manhole, Survey Ends / MH 14	00:05:07		
DEPTH 12.7'					

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
2100	3200	2	6	8		3	2.67

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Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
2/18/2013		Dry	ROB BRENNEMAN		15
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-802-265		BUSCH GARDENS	2/18/2013	Heavy Cleaning	

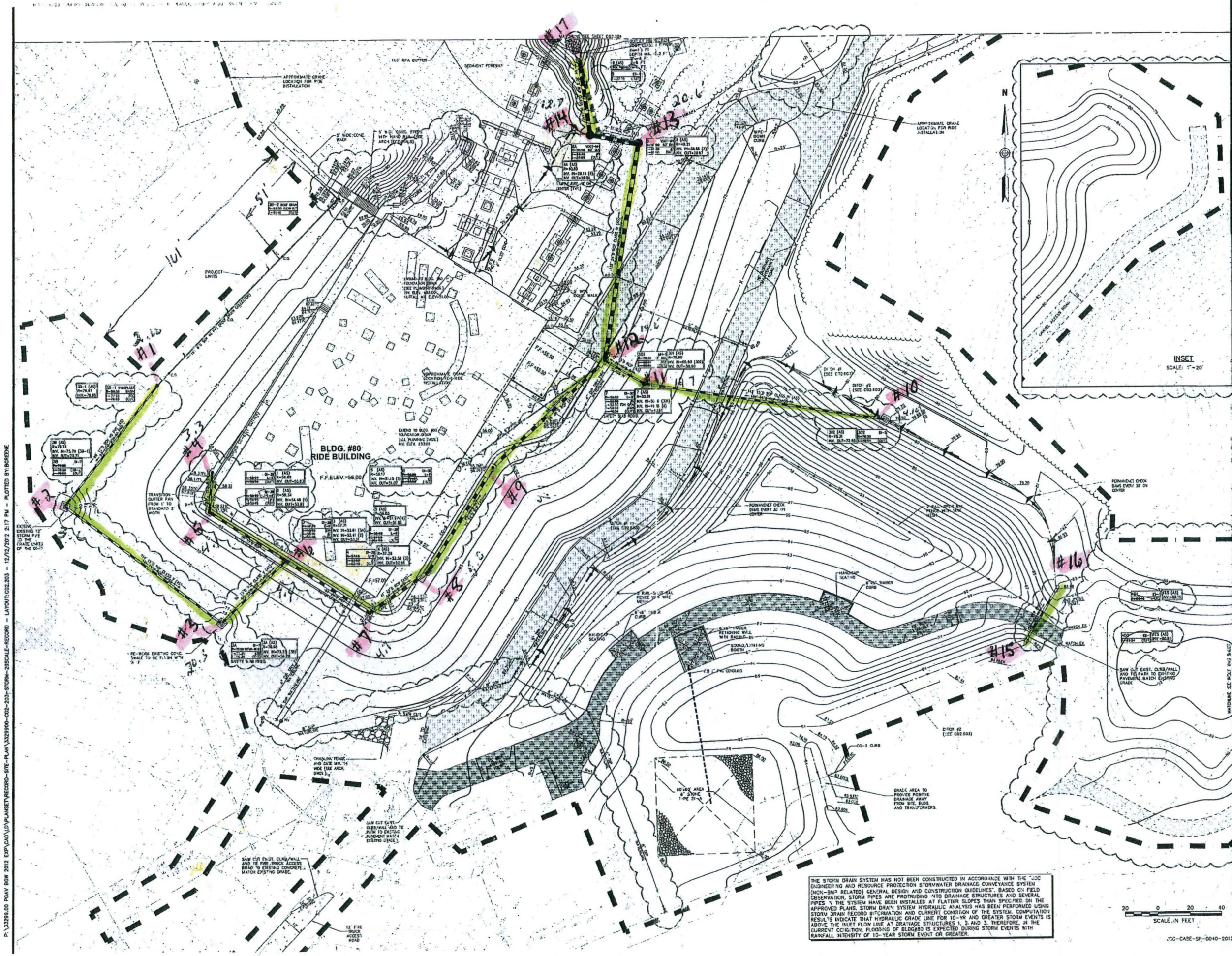
Street123	BLDG. 80	Use of Sewer	Stormwater	Upstream MH	MH-14
City	WILLIAMSBURG	Drainage Area		Dowstream MH	EOP-17
Loc. details	GRASS	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Easement/Right of way	Length surveyed	45.45 ft	Section Length	45.45 ft

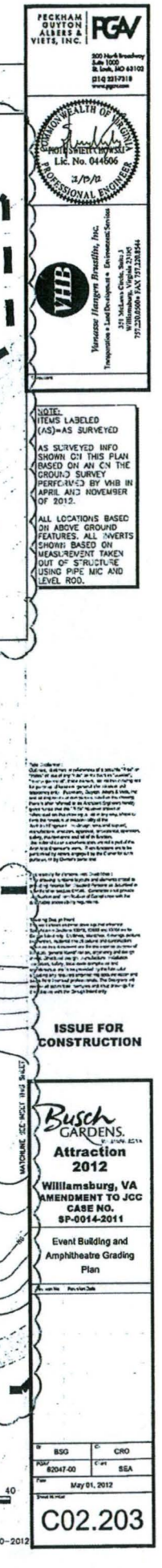
Purpose of Survey	Routine Assessment	Joint Length	
Year Laid		Dia./Height	30.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :

1:120	Position	Code	Observation	MPEG	Photo	Grade
DEPTH 12.7'						
MH-14	0.00	AMH	Upstream Manhole, Survey Begins / MH-14	00:00:26		
	7.90	IR	Infiltration Runner, at 04 o'clock, within 8 inches of joint: YES	00:01:34	15_2A	M 4
	45.45	AEP	End of Pipe / 17	00:03:28		
EOP-17						
OUTFALL						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	4100	0	4	4		4	4





THE STORM DRAIN SYSTEM HAS NOT BEEN CONSTRUCTED IN ACCORDANCE WITH THE "JCC ENGINEERING AND RESOURCE PROTECTION STORMWATER DRAINAGE CONVEYANCE SYSTEM (NON-BMP RELATED) GENERAL DESIGN AND CONSTRUCTION GUIDELINES". BASED ON FIELD OBSERVATION, STORM PIPES ARE PROTRUDING INTO DRAINAGE STRUCTURES AND SEVERAL PIPES IN THE SYSTEM HAVE BEEN INSTALLED AT FLATTER SLOPES THAN SPECIFIED ON THE APPROVED PLANS. STORM DRAIN SYSTEM HYDRAULIC ANALYSIS HAS BEEN PERFORMED USING STORM DRAIN RECORD INFORMATION AND CURRENT CONDITION OF THE SYSTEM. COMPUTATION RESULTS INDICATE THAT HYDRAULIC GRADE LINE FOR 10-YR AND GREATER STORM EVENTS IS ABOVE THE INLET FLOW LINE AT DRAINAGE STRUCTURES 1, 2, AND 3. THEREFORE, IN THE CURRENT CONDITION, FLOODING OF BLDG#80 IS EXPECTED DURING STORM EVENTS WITH RAINFALL INTENSITY OF 10-YEAR STORM EVENT OR GREATER.

PECKHAM GUYTON ALBERS & VIETS, INC. | PGAV
300 North Broadway Suite 1000 St. Louis, MO 63102 314 231-7318 www.pgav.com

COMMONWEALTH OF VIRGINIA
Lic. No. 044606
3/9/12
PROFESSIONAL ENGINEER

VHB
Vanasse Hangen Brustlin, Inc.
Transportation • Land Development • Environmental Services
8613 Cross Park Drive
Williamsburg, Virginia 23185
757.220.8500 • FAX 757.220.8544

NOTE:
ITEMS LABELED (AS)=AS SURVEYED

AS SURVEYED INFO SHOWN ON THIS PLAN BASED ON AN ON THE GROUND SURVEY PERFORMED BY VHB IN APRIL AND NOVEMBER OF 2012.

ALL LOCATIONS BASED ON ABOVE GROUND FEATURES. ALL INVERTS SHOWN BASED ON MEASUREMENT TAKEN OUT OF STRUCTURE USING PIPE MIC AND LEVEL ROD.

ISSUE FOR CONSTRUCTION

Busch GARDENS.
Attraction 2012
Williamsburg, VA
AMENDMENT TO JCC CASE NO. SP-0014-2011

Event Building and Amphitheatre Grading Plan

BSG	CRO
82047-00	BSA
May 01, 2012	

C02.203

P:\32595.00 PGAV BGW 2012 EDP\CAD\LD\PLANSET\RECORD-SITE-PLAN\3329900-C02-203-STORM-20SCALE-RECORD - LAYOUT:C02.203 - 12/12/2012 2:17 PM - PLOTTED BY:BORRENE

INITIAL CCTV 3/14/13

Report Link	Project	Date	Location	Pipe ID	Manhole Numbers	Pipe Length	Size
View Session: 1	- 21399 BUSCH GARDENS	3/14/2013 10:21	BUSCH GARDENS		CLEANOUT 1 To OUTFALL	117.2	162 MB
View Session: 2	- 21399 BUSCH GARDENS	3/14/2013 09:49	BUSCH GARDENS		CB To CLEANOUT 1	36.6	99.6 MB
View Session: 3	- 21399 BUSCH GARDENS	3/14/2013 09:27	BUSCH GARDENS		ROOF DRAIN To CB-1	10.8	110 MB
View Session: 4	- 21399 BUSCH GARDENS	3/14/2013 08:51	BUSCH GARDENS		ROOF DRAIN To CB-1	12.1	153 MB
					Total:	**176.7**	**525 MB**

Summary Reports
18320133948

You may need to download MPEG4 Codec to view Video
http://www.koepi.info/xvid.html

Environmental Division

MAY 09 2013

RECEIVED

Report Link	Date	Distance	Height (Diameter)	Upstream MH	Downstream MH
Report Link	3/14/2013 8:51:00 AM	12.1	6	ROOF DRAIN	CB-1
Report Link	3/14/2013 9:27:00 AM	10.8	6	ROOF DRAIN	CB-1
	Sub-Total Date	**Sub-Total Distance**	**Sub-Total Height (Diameter)**	**Sub-Total Upstream MH**	**Sub-Total Downstream MH**
	1	22.9	1	1	1
Report Link	3/14/2013 9:49:00 AM	36.6	8	CB	CLEANOUT 1
Report Link	3/14/2013 10:21:00 AM	117.2	8	CLEANOUT 1	OUTFALL
	Sub-Total Date	**Sub-Total Distance**	**Sub-Total Height (Diameter)**	**Sub-Total Upstream MH**	**Sub-Total Downstream MH**
	1	153.8	1	2	2
	Total Date	**Total Distance**	**Total Height (Diameter)**	**Total Upstream MH**	**Total Downstream MH**
	1	176.7	2	3	3

Contact
Tri State Utilities
757-366-9505
Address
2111 Smith Avenue
Chesapeake Virginia , VA
23320
Website
http://www.tristateutilities.com/

Project Information

Surveyor Name	ROBERT SMITH	**Certificate Number**	U-1003-684
Truck Number	34		
Owner	BUSCH GARDENS	**Customer**	HENDERSON
Drainage Area	PARK	**Job Number**	21399
Pipe Segment Reference		**Date**	3/14/2013 10:21
Street	BUSCH GARDENS	**City**	WILLIAMSBURG
Comments			

Manhole

Upstream MH	CLEANOUT 1	**Rim to Invert (U)**	
Grade to Invert (U)		**Rim to Grade (U)**	
Downstream MH	OUTFALL	**Rim to Invert (D)**	
Grade to Invert (D)		**Rim to Grade (D)**	
Sewer Use	Stormwater	**Direction of Survey**	Downstream

Pipe

Height (Diameter)	8	**Width**	8
Shape	Circular	**Material**	Polyvinyl Chloride
Lining Method		**Pipe Joint Length**	
Tape Measured Length	30	**Length Surveyed**	117.2
Year Laid		**Year Renewed**	

Misc

Flow Control	Not Controlled	**Media Label**	Digital
Purpose	Maintenance Related	**Sewer Category**	SW
Pre-Cleaning	No Pre-Cleaning	**Date Cleaned**	3/14/2013 09:26
Weather	Dry	**Location Code**	Building
Additional Info		**Location Details**	BY VERBOLTAN THE RIDE
Reverse Setup ID		**Sheet (Group) Number**	
Imperial Units (US)	True	**Completed**	Yes

Count Groups

Number of Taps	2	**Number of Roots**	0
Num Cracks / Fractures	0	**Number of Broken / Holes / Collapse**	0
Number of Deposits	0	**Number of Capped/Abd Taps**	0

Project: 21399 BUSCH GARDENS

Date: 3/14/2013 10:21:00 AM
Street: BUSCH GARDENS
Length Surveyed: 117.2
Pacp Quick Overall Rating: 4221
Height (Diameter): 8

Pipe Segment Reference:
Upstream MH: CLEANOUT 1
Downstream MH: OUTFALL
Direction of Survey: Downstream
Material: Polyvinyl Chloride

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: CLEANOUT 1

(0.0) ACOM - Cleanout Mainline Remark: CLEANOUT 1

(4.0) TF - Tap Factory - Position: 3

(49.9) JOM - Joint Offset Medium

(52.6) TF - Tap Factory - Position: 9 Remark: CLEANOUT

(52.6) LR - Alignment Right

(84.0) LL - Alignment Left

(104.9) LL - Alignment Left

(117.2) ADP - Discharge Point Remark: OUTFALL

Total Distance: 117.2

ID Number: OUTFALL

Created with the POSM report generator

Contact
Tri State Utilities
757-366-9505
Address
2111 Smith Avenue
Chesapeake Virginia , VA
23320
Website
http://www.tristateutilities.com/

Project Information

Surveyor Name	ROBERT SMITH	**Certificate Number**	U-1003-684
Truck Number	34		
Owner	BUSCH GARDENS	**Customer**	HENDERSON
Drainage Area	PARK	**Job Number**	21399
Pipe Segment Reference		**Date**	3/14/2013 09:49
Street	BUSCH GARDENS	**City**	WILLIAMSBURG
Comments			

Manhole

Upstream MH	CB	**Rim to Invert (U)**	
Grade to Invert (U)		**Rim to Grade (U)**	
Downstream MH	CLEANOUT 1	**Rim to Invert (D)**	
Grade to Invert (D)		**Rim to Grade (D)**	
Sewer Use	Stormwater	**Direction of Survey**	Downstream

Pipe

Height (Diameter)	8	**Width**	8
Shape	Circular	**Material**	Polyvinyl Chloride
Lining Method		**Pipe Joint Length**	
Tape Measured Length	36	**Length Surveyed**	36.6
Year Laid		**Year Renewed**	

Misc

Flow Control	Not Controlled	**Media Label**	Digital
Purpose	Maintenance Related	**Sewer Category**	SW
Pre-Cleaning	No Pre-Cleaning	**Date Cleaned**	3/14/2013 09:26
Weather	Dry	**Location Code**	Building
Additional Info	—	**Location Details**	—
Reverse Setup ID		**Sheet (Group) Number**	
Imperial Units (US)	True	**Completed**	Yes

Count Groups

Number of Taps	0	**Number of Roots**	0
Num Cracks / Fractures	0	**Number of Broken / Holes / Collapse**	0
Number of Deposits	0	**Number of Capped/Abd Taps**	0

Created with the POSM report generator

Project: 21399 BUSCH GARDENS

Date: 3/14/2013 9:49:00 AM
Street: BUSCH GARDENS
Length Surveyed: 36.6
Pacp Quick Overall Rating: 2111
Height (Diameter): 8

Pipe Segment Reference:
Upstream MH: CB
Downstream MH: CLEANOUT 1
Direction of Survey: Downstream
Material: Polyvinyl Chloride

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: CB

(0.0) AMH - Manhole Remark: CB

(32.2) JOM - Joint Offset Medium

(33.8) MWLS - Water Level Sag

(36.6) ACOM - Cleanout Mainline Remark: CLEANOUT

Total Distance: 36.6

ID Number: CLEANOUT 1

Created with the PDSM report generator

Contact
Tri State Utilities
757-366-9505
Address
2111 Smith Avenue
Chesapeake Virginia , VA
23320
Website
http://www.tristateutilities.com/

Project Information

Surveyor Name	ROBERT SMITH	**Certificate Number**	U-1003-684
Truck Number	34		
Owner	BUSCH GARDENS	**Customer**	HENDERSON
Drainage Area	PARK	**Job Number**	21399
Pipe Segment Reference		**Date**	3/14/2013 09:27
Street	BUSCH GARDENS	**City**	WILLIAMSBURG
Comments			

Manhole

Upstream MH	ROOF DRAIN	**Rim to Invert (U)**	
Grade to Invert (U)		**Rim to Grade (U)**	
Downstream MH	CB-1	**Rim to Invert (D)**	
Grade to Invert (D)		**Rim to Grade (D)**	
Sewer Use	Stormwater	**Direction of Survey**	Downstream

Pipe

Height (Diameter)	6	**Width**	6
Shape	Circular	**Material**	Polyvinyl Chloride
Lining Method		**Pipe Joint Length**	
Tape Measured Length	160	**Length Surveyed**	10.8
Year Laid		**Year Renewed**	

Misc

Flow Control	Not Controlled	**Media Label**	Digital
Purpose	Maintenance Related	**Sewer Category**	SW
Pre-Cleaning	No Pre-Cleaning	**Date Cleaned**	3/14/2013 09:26
Weather	Dry	**Location Code**	Building
Additional Info	BESIDE BUMPER CAR BUILDING.	**Location Details**	
Reverse Setup ID		**Sheet (Group) Number**	
Imperial Units (US)	True	**Completed**	Yes

Count Groups

Number of Taps	0	**Number of Roots**	0
Num Cracks / Fractures	0	**Number of Broken / Holes / Collapse**	0
Number of Deposits	0	**Number of Capped/Abd Taps**	0

Project: 21399 BUSCH GARDENS

Date: 3/14/2013 9:27:00 AM
Street: BUSCH GARDENS
Length Surveyed: 10.8
Pacp Quick Overall Rating: 4100
Height (Diameter): 6

Pipe Segment Reference:
Upstream MH: ROOF DRAIN
Downstream MH: CB-1
Direction of Survey: Downstream
Material: Polyvinyl Chloride

Severity
Light
Moderate
Average
Heavy
Severe

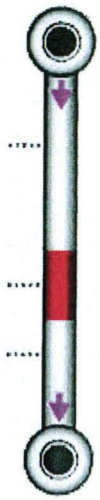
ID Number: ROOF DRAIN

(0.0) ACOM - Cleanout Mainline Remark: ROOF DRAIN

(10.8) LU - Alignment Up

(10.8) MSA - Abandoned Survey Remark: ROOF DRAIN

Total Distance: 10.8



ID Number: CB-1

Created with the PDSM **report generator**

Contact
Tri State Utilities
757-366-9505
Address
2111 Smith Avenue
Chesapeake Virginia , VA
23320
Website
http://www.tristateutilities.com/

Project Information

Surveyor Name	ROBERT SMITH	**Certificate Number**	U-1003-684
Truck Number	34		
Owner	BUSCH GARDENS	**Customer**	HENDERSON
Drainage Area	PARK	**Job Number**	21399
Pipe Segment Reference		**Date**	3/14/2013 08:51
Street	BUSCH GARDENS	**City**	WILLIAMSBURG
Comments			

Manhole

Upstream MH	ROOF DRAIN	**Rim to Invert (U)**	
Grade to Invert (U)		**Rim to Grade (U)**	
Downstream MH	CB-1	**Rim to Invert (D)**	
Grade to Invert (D)		**Rim to Grade (D)**	
Sewer Use	Stormwater	**Direction of Survey**	Upstream

Pipe

Height (Diameter)	6	**Width**	6
Shape	Circular	**Material**	Polyvinyl Chloride
Lining Method		**Pipe Joint Length**	
Tape Measured Length	160	**Length Surveyed**	12.1
Year Laid		**Year Renewed**	

Misc

Flow Control	Not Controlled	**Media Label**	Digital
Purpose	Maintenance Related	**Sewer Category**	SW
Pre-Cleaning	No Pre-Cleaning	**Date Cleaned**	3/14/2013 08:53
Weather	Dry	**Location Code**	Building
Additional Info	BESIDE BUMPER CAR BUILDING. REVERSE INSPECTION WITH PUSH CAMERA	**Location Details**	
Reverse Setup ID		**Sheet (Group) Number**	
Imperial Units (US)	True	**Completed**	Yes

Count Groups

Number of Taps	1	**Number of Roots**	0
Num Cracks / Fractures	0	**Number of Broken / Holes / Collapse**	0
Number of Deposits	0	**Number of Capped/Abd Taps**	0

Project: 21399 BUSCH GARDENS

Date: 3/14/2013 8:51:00 AM
Street: BUSCH GARDENS
Length Surveyed: 12.1
Pacp Quick Overall Rating: 4200
Height (Diameter): 6

Pipe Segment Reference:
Upstream MH: ROOF DRAIN
Downstream MH: CB-1
Direction of Survey: Upstream
Material: Polyvinyl Chloride

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: ROOF DRAIN

(0.0) AMH - Manhole Remark: CB-1

(4.0) LU - Alignment Up

(10.2) LR - Alignment Right

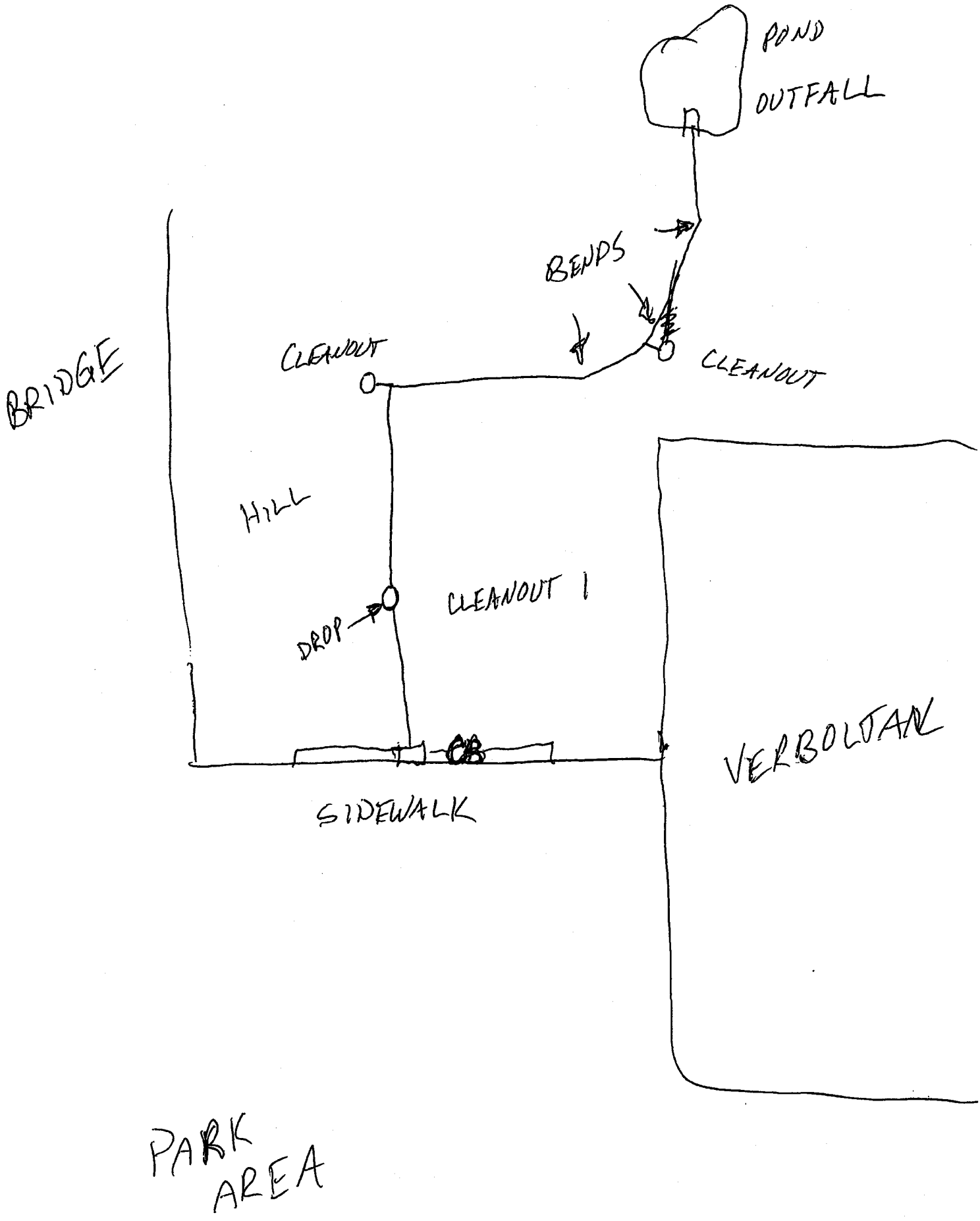
(11.9) MSA - Abandoned Survey Remark: CB-1

(12.1) TF - Tap Factory - Position: 12

Total Distance: 12.1

ID Number: CB-1

Created with the PDSM report generator


POND
OUTFALL
BENDS
CLEANOUT
CLEANOUT
BRIDGE
HILL
CLEANOUT 1
DROP
CB
SIDEWALK
VERBOLTAN
PARK
AREA

POST - REHABILITATION CCTV 5/8/13

City :

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
Email:

∑Ø / Main sections / Inspection: 1

Project name	Project # :	Responsible :	Date :
21399 BUSCH GARDENS EXPANSIO	21399	HENDERSON	2/18/2013

No.	Start MH	End MH	Date	Street	Cleaning	Material	Feet	Pipe Diameter
21	MH-11	CB-12	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	30.05	15
16	DI-2	DI-3	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	115.15	15
20	DI-10	MH-11	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	149.70	15
18	CB-4	CB-5	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	19.25	15
17	CB-5	CB-6	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	56.75	15

Pipe size: CIRCULAR 15 = 370.9 ft (75 ft)

No.	Start MH	End MH	Date	Street	Cleaning	Material	Feet	Pipe Diameter
19	CB-6	CB-7	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	62.05	24

Pipe size: CIRCULAR 24 = 62.05 ft (24 ft)

No.	Start MH	End MH	Date	Street	Cleaning	Material	Feet	Pipe Diameter
24	MH-14	OUTFALL 17	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	42.05	30
23	MH-13	MH-14	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	30.50	30
22	CB-12	MH-13	4/25/2013	BUSCH GARDENS	No Pre-Cleaning	Reinforced Concrete Pipe	132.80	30

Pipe size: CIRCULAR 30 = 205.35 ft (90 ft)

All sections = 638.3 ft (189 ft)

Environmental Division
MAY 09 2013
RECEIVED

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

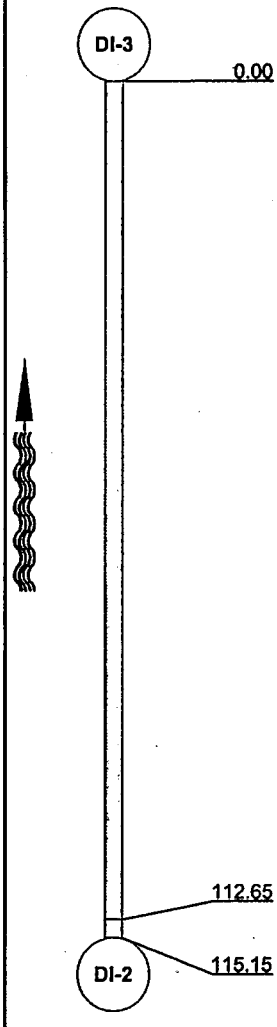
Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		1
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer	Stormwater	Upstream MH	DI-2
City	WILLIAMSBURG	Drainage Area		Dowstream MH	DI-3
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Easement/Right of way	Length surveyed	115.15 ft	Section Length	115.15 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	15.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.	115'	Lining Method	

Add. Information :



1:300	Position	Code	Observation	MPEG	Photo	Grade
	0.00	AMH	Downstream Manhole, Survey Begins / DI-3	00:00:25		
	112.65	DAZ	Deposits Attached Other, 10 %of cross sectional area, from 07 to 08 o'clock, , within 8 inches of joint: NO	00:05:57		M 2
	115.15	AMH	Upstream Manhole, Survey Ends / DI-3	00:06:16		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	2100	0	2	2		2	2

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		2
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer	Stormwater	Upstream MH	CB-5
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-6
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Easement/Right of way	Length surveyed	56.75 ft	Section Length	56.75 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	15.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.	56'	Lining Method	

Add. Information : RÉVERSE INSPECTION

1:150	Position	Code	Observation	MPEG	Photo	Grade
CB-6	0.00	AMH	Downstream Manhole, Survey Begins / CB-6	00:00:13		
	56.75	AMH	Upstream Manhole, Survey Ends / CB-5	00:03:29		
CB-5						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	0000	0	0	0		0	0

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

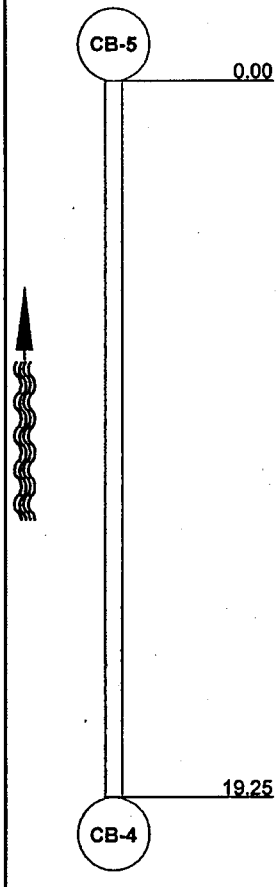
Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		3
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer	Stormwater	Upstream MH	CB-4
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-5
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Easement/Right of way	Length surveyed	19.25 ft	Section Length	19.25 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	15.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.	21'	Lining Method	

Add. Information : REVERSE INSPECTION



1:60	Position	Code	Observation	MPEG	Photo	Grade
	0.00	AMH	Downstream Manhole, Survey Begins / CB-5	00:00:09		
	—				—	
	19.25	AMH	Upstream Manhole, Survey Ends / CB-4	00:01:12		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	0000	0	0	0		0	0

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		4
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer	Stormwater	Upstream MH	CB-6
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-7
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Easement/Right of way	Length surveyed	62.05 ft	Section Length	62.05 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	24.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.	62'	Lining Method	

Add. Information :

1:165	Position	Code	Observation	MPEG	Photo	Grade
CB-6	0.00	AMH	Upstream Manhole, Survey Begins / CB-6	00:00:09		
	62.05	AMH	Downstream Manhole, Survey Ends / CB-7	00:00:00		
CB-7						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	0000	0	0	0		0	0

Tri State Utilities
2111 Smith Avenue
Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		5
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer	Stormwater	Upstream MH	DI-10
City	WILLIAMSBURG	Drainage Area		Dowstream MH	MH-11
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Easement/Right of way	Length surveyed	149.70 ft	Section Length	149.70 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	15.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.	151'	Lining Method	

Add. Information :

1:375	Position	Code	Observation	MPEG	Photo	Grade
DI-10	0.00	AMH	Upstream Manhole, Survey Begins / DI-10	00:00:09		
	4.65	DAZ	Deposits Attached Other, 10 %of cross sectional area, from 05 to 08 o'clock, , within 8 inches of joint: YES	00:02:47	20_2B	M 2
	149.70	AMH	Downstream Manhole, Survey Ends / MH-11	00:06:44		
MH-11						

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	2100	0	2	2		2	2

Tri State Utilities
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Chesapeake, VA 23320
Tel: (757) 366-9505
Fax: (757) 366-5150
E-mail:

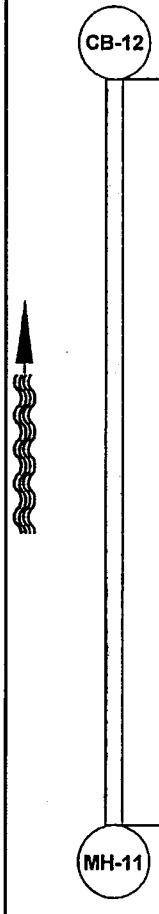
Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		6
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer	Stormwater	Upstream MH	MH-11
City	WILLIAMSBURG	Drainage Area		Dowstream MH	CB-12
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Upstream
Location Code	Easement/Right of way	Length surveyed	30.05 ft	Section Length	30.05 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	15.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information : REVERSE INSPECTION



1:90	Position	Code	Observation	MPEG	Photo	Grade
	0.00	AMH	Downstream Manhole, Survey Begins / CB-12	00:00:10		
	30.05	AMH	Upstream Manhole, Survey Ends / MH-11	00:04:06		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	0000	0	0	0		0	0

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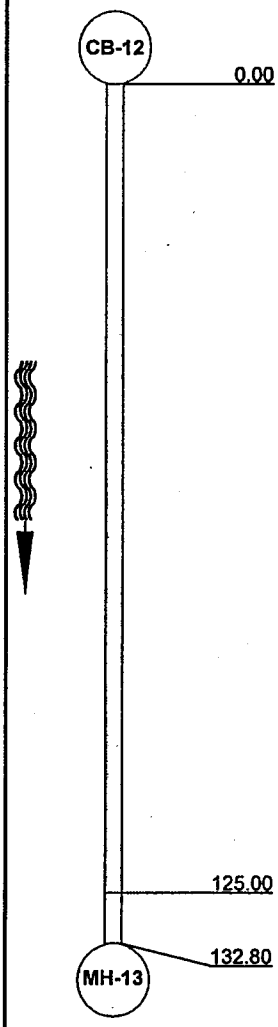
Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		7
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer		Upstream MH	CB-12
City	WILLIAMSBURG	Drainage Area		Dowstream MH	MH-13
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Easement/Right of way	Length surveyed	132.80 ft	Section Length	132.80 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	30.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :



1:345 Position	Code	Observation	MPEG	Photo	Grade
0.00	AMH	Upstream Manhole, Survey Begins / CB-12	00:00:09		
125.00	MWLS	Water Level, Sag in pipe, 20 %of cross sectional area	00:07:53		S 2
132.80	AMH	Downstream Manhole, Survey Ends / MH-13	00:08:28		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
2100	0000	2	0	2		0	2

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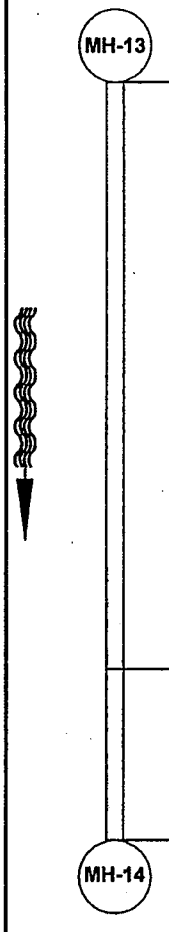
Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		8
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer	Stormwater	Upstream MH	MH-13
City	WILLIAMSBURG	Drainage Area		Dowstream MH	MH-14
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Easement/Right of way	Length surveyed	30.50 ft	Section Length	30.50 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	30.00 inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.	31'	Lining Method	

Add. Information :



1:90	Position	Code	Observation	MPEG	Photo	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / MH-13	00:00:09		
	23.60	SMW	Surface Missing Wall, from 11 to 12 o'clock, within 8 inches of joint: YES	00:04:50	23_2B	S 5
	30.50	AMH	Downstream Manhole, Survey Ends / MH-14	00:05:28		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
5100	0000	5	0	5		0	5

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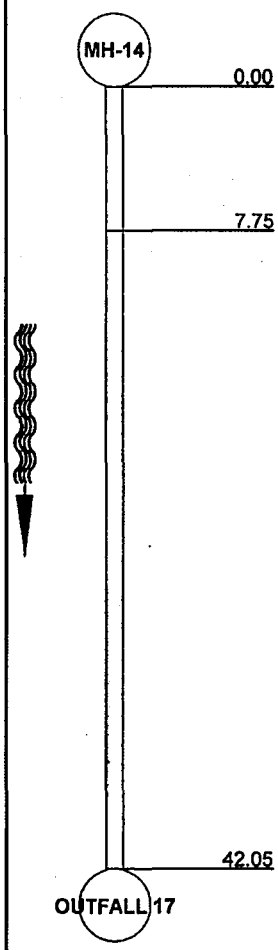
Inspection Report / Inspection: 1

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/25/2013		Dry	ROBERT SMITH		9
Certificate No.	**Survey Customer**	**System Owner**	**Date Cleaned**	**Pre-Cleaning**	**Sewer Category**
U-1003-684		BUSCH GARDENS		No Pre-Cleaning	

Street123	BUSCH GARDENS	Use of Sewer	Stormwater	Upstream MH	MH-14
City	WILLIAMSBURG	Drainage Area		Dowstream MH	OUTFALL 17
Loc. details	BESIDE THE VERBOLTEN	Flow Control	Not Controlled	Dir. of Survey	Downstream
Location Code	Easement/Right of way	Length surveyed	42.05 ft	Section Length	42.05 ft

Purpose of Survey	Post-Rehabilitation Survey	Joint Length	
Year Laid		Dia./Height	30.00 Inch
Year Rehabilitated		Material	Reinforced Concrete Pipe
Tape / Media No.		Lining Method	

Add. Information :



1:120	Position	Code	Observation	MPEG	Photo	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / MH-14	00:00:09		
	7.75	IR	Infiltration Runner, from 04 to 06 o'clock, within 8 inches of joint: YES	00:00:47		M 4
	42.05	ADP	Discharge Point / 17	00:02:03		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	4100	0	4	4		4	4