



TRANSMITTAL SHEET
ENGINEERING & RESOURCE PROTECTION → STORMWATER

Project: Merrimac Trail Drainage Improvement

County Plan No. SP-0030-2011

Assigned BMP No.: NA

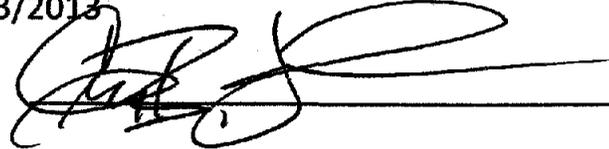
BMP Type: NA

Information Enclosed:

- Record Drawings (Asbuilts)
- Construction Certification
- Computations
- Other :

Name: Gregory B. Johnson

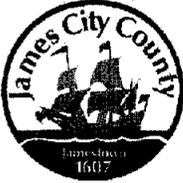
Date: 1/23/2013

Signature: 

Contents for Stormwater Management Facilities As-built Files

Each File is to contain:

- 1. Maintenance Agreement
- 2. Construction certification
- 3. As-Built plan
- 4. Design Calculations
- 6. Correspondence
- 7. Inspection records
- 8. Miscellaneous



**James City County Engineering and Resource
Protection Division
Stormwater Management/BMP Record Drawing and
Construction Certification Review Tracking Form**

Project Name: MAXIMIZE TRAIL DRAINAGE IMPROVEMENTS
 County Plan No. (List any amendments): SR-0030-2011
 Stormwater Management Facility Type: _____
 BMP Phase #: I II III

- Information Package Submittal Date: UNKNOWN
- Completeness Check:
 - Record Drawing Date/By: AKS / bl/oln
 - Construction Certification Date/By: MARC BOWETT 5/14/12
 - RD/CC Standard Forms (Ensure that all forms for the BMP type are included)
 - Insp/Maint Agreement # / Date: _____
 - BMP Maintenance Plan Location: _____
 - Special Considerations: STORM PIPE / DRAINAGE IMPROVEMENT

*SDRAWING HAS DIGITAL
COPY IN EMAIL DATED
8/16/12 FROM
MARC BOWETT.*

- Standard E&SC Notes on Approved Plan Requiring RD/CC or County comment in plan review
 Location (sheet #): C-05 H21
- County BMP ID Code #: NA (DRAWN BY CUSTOMER OF CCOWD)
- Log into Division's "As-Built Tracking Log"
- Obtain basic site information (GPIN, Owner, Address, etc.)
- Log into Access Database (BMP ID #, Plan No., GPIN, Project Name, etc.)
- Copy from Active Project File (correspondence, H&H, design computations, etc.).
- Create As-Built File using Project File information (File label, folder, copy plan/details/design information, etc.).

- Inspector Review of RD/CC (consult with Chief Engineer prior to completion of comments).
- Record Drawing Review against Approved Plan prior to Field Inspection.
- Final Site Inspection (FI) Performed Date: 1/10/13
- Record Drawing (RD) Review Date: 1/15/13
- Construction Certification (CC) Review Date: _____

- Actions:
 - No comments.
 - Comments. Letter Forwarded. Date: _____
 - Record Drawing (RD)
 - Construction Certification (CC)
 - Construction-Related (CR)
 - Site Issues (SI)
 - Other : _____

- Resubmittal (# and date): _____
- Re-inspection (if necessary): _____
- Drainage System Information Acceptable (RD/CC/System Info). Ok for bond release.
- Complete "Surety Request Form".
- Final Inspection of active file copying any relevant information to "As-Built" file.
- On County BMP Inventory (Phase I, II or III).
- Copy Final Inspection Report into County BMP Inspection Program file.
- Provide 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.

Final Sign-Off

Inspector: [Signature]
 Chief Engineer: [Signature]

Date: 1/10/13
 Date: 1/15/13

*** See separate checklist, if needed.



Stormwater Management/BMP Facilities Record Drawing and Construction Certification Forms

(Note: In accordance with the requirements of the Chesapeake Bay Preservation Ordinance, Chapter 23, Section 23-10(4), BMP's shall be designed and constructed in accordance with the manual entitled James City County Guidelines for Design and Construction of Stormwater Management BMP's. Erosion and sediment control policy and approved plans generally require that at the completion of the project and prior to release of surety, an "as-built" plan prepared by a registered Professional Engineer or Certified Land Surveyor must be provided for the drainage system for the project, including any Best Management Practice (BMP) facilities. In addition, for BMP facilities involving the construction of an impounding structure or dam embankment, certification is required by a Professional Engineer who has inspected the structure during its construction. Currently there are over 20 water quality type BMP's accepted by the County.)

Section 1 - Site Information:

Project Name: Merrimac Trail Drainage Improvements

Structure/BMP Name: -

Project Location: 7195 / 7213 Merrimac Trail

BMP Location: PROJECT IN P14 LOT OF BUSINESS IN ZONING DISTRICT BMP # 22021

County Plan No.: SP-0030-2011

Project Type: Residential Business Commercial Office Institutional Industrial Public Roadway Other

Tax Map/Parcel No.: (41-3) (1-7B); (41-3) (1-12A)
BMP ID Code (if known): _____
Zoning District: B-1, General Business
Land Use: Commercial, Automobile repair shop
Site Area (sf or acres): 1.25 acres

Brief Description of Stormwater Management/BMP Facility: _____
Storm Sewer realignment and replacement to help a failing existing storm sewer / culvert under Merrimac Trail

Nearest Visible Landmark to SWM/BMP Facility: Intersection of Admas Road with Merrimac Trail (120' to east of site)

Nearest Vertical Ground Control (if known):

JCC Geodetic Ground Control USGS Temporary Arbitrary Other

Station Number or Name: _____

Datum or Reference Elevation: _____

Control Description: _____

Control Location from Subject Facility: _____

Section 2 - Stormwater Management/BMP Facility Construction Information:

Pre-Construction Meeting Held for Construction of SWM/BMP Facility: Yes No Unknown
Approx. Construction Start Date for SWM/BMP Facility: October 10, 2011
Facility Monitored by County Representative during Construction: Yes No Unknown
Name of Site Work Contractor Who Constructed Facility: Howard Brothers Contractors
Name of Professional Firm Who Routinely Monitored Construction: AES Consulting Engineers
Date of Completion for SWM/BMP Facility: End of November 2011
Date of Record Drawing/Construction Certification Submittal: August 14, 2012

(Note: Record Drawing and Construction Certifications are required within thirty (30) days of the completion of Stormwater Management and/or BMP facility construction. Record Drawings and Construction Certifications must be reviewed and approved by the James City County Engineering and Resource Protection Division prior to final inspection, acceptance and bond or surety release.)

Section 3 - Owner/Designer/Contractor Information:

Owner/Developer: *(Note: Site Owner or Applicant responsible for development of the project.)*

Name: James City County Stormwater Division
Mailing Address: 5320 Palmer Lane, Suite 2A
Williamsburg, Virginia 23188
Business Phone: 757-259-1460 Fax: 757-259-5833
Contact Person: Barry Moses Title: _____

Design Professional: *(Note: Professional Engineer or Certified Land Surveyor responsible for the design and preparation of plans and specifications for the Stormwater Management / BMP facility.)*

Firm Name: AES Consulting Engineers
Mailing Address: 5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
Business Phone: 757-253-0040
Fax: 757-220-8994
Responsible Plan Preparer: V. Marc Bennett, P.E.
Title: Senior Project Manager
Plan Name: Merrimac Trail Drainages Improvement Project
Firm's Project No. 9801-E-27
Plan Date: March 25, 2011
Sheet No.'s Applicable to SWM/BMP Facility: 1 / 2 / 3 / 4 / 5

BMP Contractor: *(Note: Site Work Contractor directly responsible for construction of the Stormwater Management/BMP facility.)*

Firm Name: Howard Brothers Contractors
Mailing Address: 14400 Doctors Creek Road
Lanexa, Virginia 23089
Business Phone: 804-966-2762

Fax: _____
Contact Person: Sam Howard, President
Site Foreman/Supervisor: Mike Coy
Specialty Subcontractors and Purpose (for BMP Construction Only): _____

Section 4 - Professional Certifications:

Certifying Professionals: *(Note: A Registered Professional Engineer or Certified Land Surveyor is responsible for preparation of a Record Drawing, sometimes referred to as an As-Built plan, for the drainage system for the project including any Stormwater Management/BMP Facilities. A Registered Professional Engineer is responsible for the inspection, monitoring and certification of Stormwater Management / BMP facilities during its construction.)*

Record Drawing and Construction Certifications for Stormwater Management/BMP Facilities

Record Drawing Certification

Firm Name: _____
Mailing Address: _____

Business Phone: _____
Fax: _____
Name: _____
Title: _____
Signature: _____
Date: _____

I hereby certify to the best of my knowledge and belief that this record drawing represents the actual condition of the Stormwater Management/BMP facility. The facility appears to conform to the provisions of the approved design plan, specifications design, and stormwater management plan, except as specifically noted.

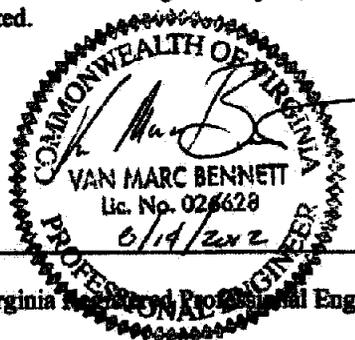
(Seal)

Virginia Registered Professional Engineer or Certified Land Surveyor

Construction Certification

Firm Name: AES Consulting Engineers
Mailing Address: 5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
Business Phone: 757-253-0040
Fax: 757-220-8994
Name: Van Marc Bennett
Title: Senior Project Manager
Signature: _____
Date: August 14, 2012

I hereby certify to the best of my knowledge and belief that this Stormwater Management/BMP facility was monitored and constructed in accordance with the provisions of the approved plan, specifications, and stormwater management plan, except as specifically noted.



(Seal)

Virginia Registered Professional Engineer

SITE PLAN FOR MERRIMAC TRAIL DRAINAGE IMPROVEMENTS

INVITATION FOR BID NUMBER 11-4390

ROBERTS DISTRICT JAMES CITY COUNTY VIRGINIA

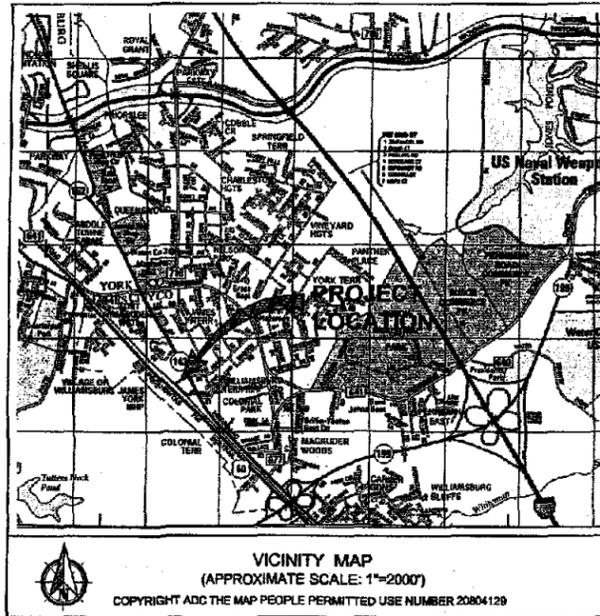
GENERAL NOTES:

SITE IS CURRENTLY ZONED GENERAL BUSINESS, B1.

1. SITE ADDRESS: 7185 MERRIMAC TRAIL
WILLIAMSBURG, VA 23185
2. TAX MAP PARCEL ID 4130100012A
3. APPLICANT: JAMES CITY COUNTY STORMWATER DIVISION
5320 PALMER LANE, #2A
WILLIAMSBURG VA, 23188
CONTACT: BARRY MOSES, P.E.
PHONE: (757) 259-1441
FAX: (757) 259-5833
EMAIL: BMOSES@JAMES-CITY.VA.US
4. PROPERTY SHOWN HEREON LIES IN ZONE "X", (AREA DETERMINED TO BE OUTSIDE THE 500 YEAR FLOOD PLAIN) PER F.L.R.M. #51095C0145C, DATED 9/26/07.
5. PROJECT LIES WITHIN COLLEGE CREEK WATERSHED.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING MISS UTILITY (1-800-652-7001) FOR EXISTING UNDERGROUND UTILITY LOCATIONS PRIOR TO COMMENCING CONSTRUCTION.
7. EXISTING UTILITY LOCATIONS SHOWN ARE BASED UPON UTILITY MARKINGS AT THE TIME OF TOPOGRAPHIC SURVEY. THE ENGINEER ASSUMES NO LIABILITY AS TO THE ACCURACY OF THIS INFORMATION. THE GENERAL CONTRACTOR SHALL HAVE UTILITIES MARKED AND/OR VERIFIED (POT-HOLED) PRIOR TO CONSTRUCTION ACTIVITIES.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS FOR THIS PROJECT.
9. THE PROFESSIONAL WHOSE SEAL IS AFFIXED HEREON SHALL ACT AS THE "RESPONSIBLE LAND DISTURBER" FOR PURPOSES OF PLAN APPROVAL ONLY. PRIOR TO ISSUANCE OF THE LAND DISTURBING PERMIT, A RESPONSIBLE LAND DISTURBER FOR THE CONSTRUCTION ACTIVITIES SHALL BE PROVIDED.
10. ALL OBJECTIONABLE AND DELETERIOUS MATERIALS IS TO BE REMOVED FROM THE SITE AND DISPOSED OF IN A STATE APPROVED FACILITY MEETING THE REQUIREMENTS OF ALL APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS.
11. THIS SITE LIES WITHIN A PRIMARY SERVICE AREA.
12. CONTOUR INTERVAL IS 1 FOOT.
13. PLAN SURVEY AND TOPOGRAPHIC DATA WAS BASED UPON NGVD 1929 AND NAD 1983.

INDEX OF SHEETS:

SHEET NO.	SHEET DESCRIPTION
1	COVER SHEET
2	ENVIRONMENTAL INVENTORY
3	GRADING, DRAINAGE, AND SITE PLAN
4	STORM SYSTEM PROFILES
5	NOTES & DETAILS



CERTIFIED RESPONSIBLE LAND DISTURBER*:

VAN MARC BENNETT, P.E.
AES CONSULTING ENGINEERS
5248 OLDE TOWNE ROAD, SUITE 1
WILLIAMSBURG, VIRGINIA 23188
TELEPHONE: 757-253-0040

* FOR SITE PLAN REVIEW PROCESS ONLY.

SITE DATA:

SITE ADDRESS: 7185 MERRIMAC TRAIL
WILLIAMSBURG, VA 23185

ZONING: B1 - GENERAL BUSINESS

CONSTRUCTION AREA: 11,215 S.F.±, 0.26 AC.±

FLOOD HAZARD MAP: THIS PROPERTY IS IN ZONE X AS SHOWN ON MAP NUMBER 51095C0145C, PANEL 0145, FOR COMMUNITY NUMBER 510201, DATED 9/26/2007 OF THE FLOOD INSURANCE RATE MAPS FOR JAMES CITY COUNTY, VA. ZONE X IS DEFINED AS OUTSIDE THE 500-YEAR FLOOD PLAIN.

LEGEND

EXISTING	PROPOSED	EXISTING	PROPOSED
EL. 4000	WATER	--- ---	CENTERLINE/BASELINE
EL. 3000	SANITARY SEWER	--- ---	RIGHT OF WAY
EL. 2000	STORM SEWER	--- ---	PROPERTY LINE
EL. 1000	FORCE MAIN	--- ---	§ DITCH/SWALE
○	SANITARY MANHOLE	--- ---	CONCRETE LINED DITCH
○	STORM MANHOLE	--- ---	EXISTING TREELINE
○	CURB DROP INLET	--- ---	LIMITS OF CLEARING
○	YARD DROP INLET	--- ---	RIP RAP
○	FLARED END SECTION	--- ---	CURB
○	VALVE	--- ---	CURB AND GUTTER
○	FIRE HYDRANT ASSEMBLY	--- ---	REVERSE GUTTER PAN
○	BLOW-OFF VALVE	--- ---	EDGE OF PAVEMENT
○	AIR RELEASE ASSEMBLY	--- ---	EXISTING GROUND ELEVATION
○	CLEAN OUT	--- ---	PROPOSED SPOT GRADE
○	WATER METER	--- ---	CONTOUR
○	STREETLIGHT	--- ---	

COUNTY PROJECT NO.:
ORIGINAL SUBMITTAL DATE:
APPROVAL DATE:

No.	Date	Revised



50% Clear Zone Road Right of Way 1
AES CONSULTING ENGINEERS
Phone: (757) 253-0040
Fax: (757) 253-0040
www.aes-engineers.com

AES
CONSULTING ENGINEERS

Hampton Roads | Central Virginia | Middle Peninsula

MERRIMAC TRAIL
DRAINAGE IMPROVEMENTS

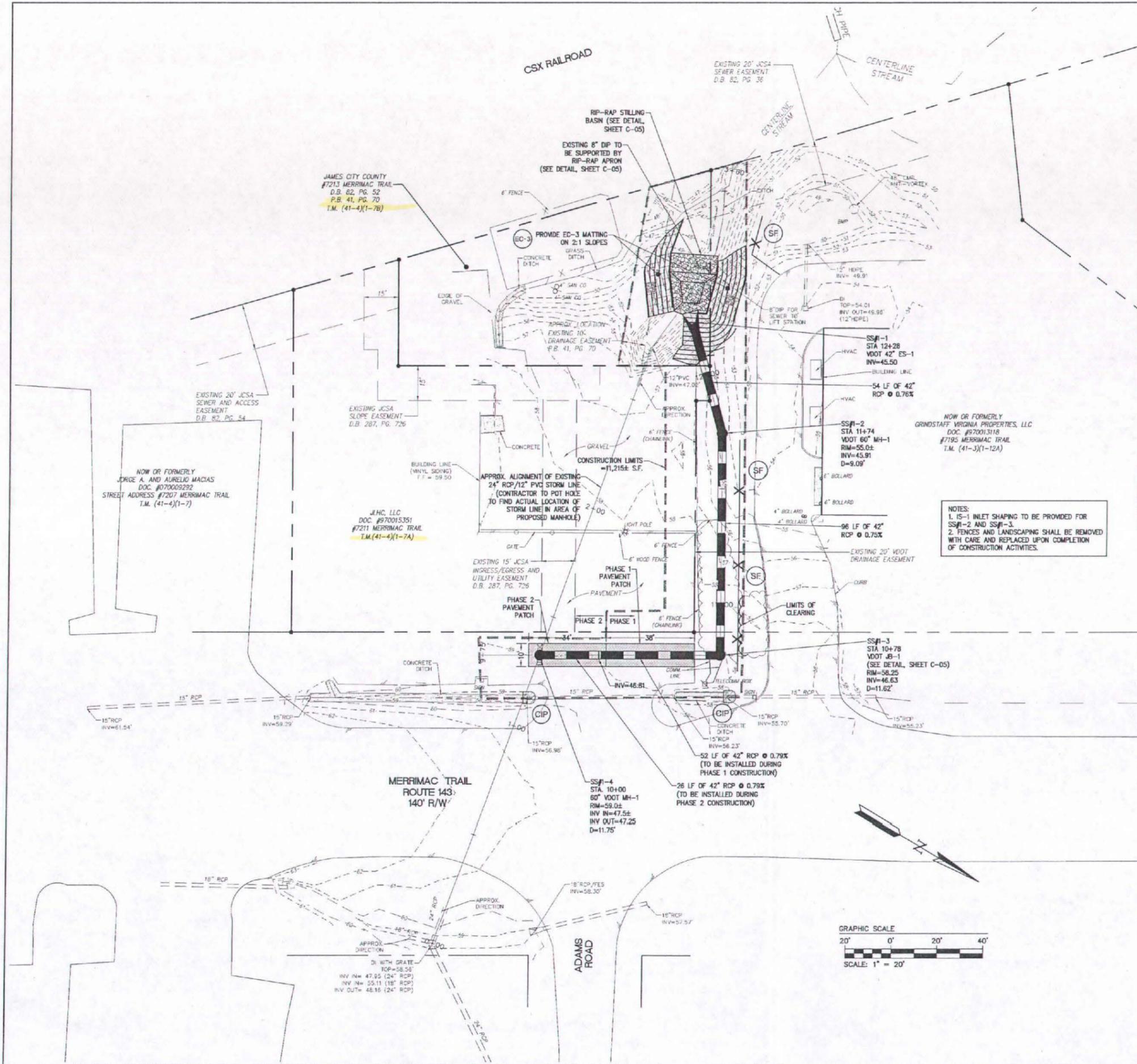
DISTRICT JAMES CITY COUNTY VIRGINIA

Project Contact: VMB
Project Number: 9901-E-27
Scale: Date: 3/14/11
AS NOTED

Sheet Title:
COVER SHEET

Sheet Number:
1

S:\06a8801E-Engineering\27-JCC Merrimac Trl Storm Sewer\Engineering\trans\901-E-27_C-03_Grading, Drainage, and Site Plan.dwg, 3/14/2011 2:05:14 PM, graham.com



SEQUENCE OF CONSTRUCTION

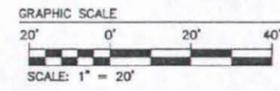
- THE GENERAL CONTRACTOR SHALL TAKE NOTE OF ALL OVERGROUND UTILITIES AT THE SITE.
 - THE GENERAL CONTRACTOR SHALL SECURE ALL BONDS OR LETTERS OF CREDIT REQUIRED FOR THE PENDING CONSTRUCTION ACTIVITIES AT THIS SITE.
 - GENERAL CONTRACTOR SHALL RETAIN A GEOTECHNICAL ENGINEER FOR SUBGRADE TESTING, SOIL EVALUATIONS, COMPACTION AND BACKFILL TESTING, AND GUIDANCE / CONSULTING DURING THE PLACEMENT OF FILL.
 - THE GENERAL CONTRACTOR IS RESPONSIBLE FOR POSSESSING THE MOST RECENT EDITION OF THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK (VESCH) ON THE CONSTRUCTION SITE DURING CONSTRUCTION ACTIVITIES.
 - THE GENERAL CONTRACTOR IS RESPONSIBLE FOR DAILY AND PERIODIC INSPECTIONS OF EROSION CONTROL MEASURES. DAMAGED MEASURES SHALL BE REPAIRED IMMEDIATELY. EROSION AND SEDIMENT CONTROL MEASURES WITH EVIDENCE OF FAILURE SHALL BE REPLACED, REPAIRED OR REINFORCED WITH SUPPLEMENTAL MEASURES.
 - THE GENERAL CONTRACTOR SHALL MAINTAIN AND BE ACTIVE IN MAINTAINING ANY LOGS OF EARTHMOVING ACTIVITY IN ACCORDANCE WITH THE CONDITIONS OF THE VIRGINIA STORMWATER MANAGEMENT PERMIT (VSWMP) AND THE STORMWATER PREVENTION POLLUTION PLAN (SWPPP).
 - AFTER EVERY RAINFALL EVENT OF 0.1 INCH OR MORE, THE GENERAL CONTRACTOR SHALL INSPECT THE SITE IMMEDIATELY (OR THE NEXT WORK DAY IF RAINFALL OCCURS AT NIGHT OR DURING A NON-WORKING DAY) FOR FAILURES IN THE EROSION CONTROL MEASURES, OR TO MAINTAIN INSTALLED EROSION CONTROL MEASURES.
 - PRIOR TO ANY CONSTRUCTION ACTIVITY, THE GENERAL CONTRACTOR SHALL HAVE ALL AREAS OF TREE REMOVAL WELL MARKED. INDIVIDUAL TREES OR PERIMETER TREE LINES TO REMAIN SHALL BE INDICATED WITH TREE PROTECTION MEASURES IN ACCORDANCE WITH VESCH.
 - THE GENERAL CONTRACTOR SHALL CONTRACT "MISS UTILITY" AND THE PROPERTY OWNER TO MARK FOR ANY UNDERGROUND INFRASTRUCTURE PRIOR TO GROUND DISTURBING ACTIVITIES.
 - THE GENERAL CONTRACTOR SHALL ARRANGE FOR A PRECONSTRUCTION MEETING WITH THE APPROPRIATE JAMES CITY COUNTY REPRESENTATIVES PRIOR TO DISTURBANCE OF ANY GROUND SURFACES.
 - UPON THE PRE-CONSTRUCTION MEETING, THE GENERAL CONTRACTOR SHALL HAVE PERIMETER EROSION AND SEDIMENT CONTROL MEASURES INSTALLED AND FUNCTIONAL. THESE MEASURES INCLUDE: SILT FENCING, CONSTRUCTION ENTRANCE, CHECK DAMS, CULVERT INLET PROTECTIONS, AND ADDITIONAL TREE PROTECTION MEASURES.
- PHASE 1:**
- NOTE: DURING PHASE 1 CONSTRUCTION, THE SOUTHERN HALF OF THE ENTRANCE TO EAGLE EYE AUTOMOTIVE DIRECTLY ACROSS FROM ADAMS ROAD SHALL REMAIN OPEN TO CUSTOMER TRAFFIC AT ALL TIMES. DURING CONSTRUCTION ELEMENTS NOT DIRECTLY LOCATED IN THE ENTRANCE TO EAGLE EYE AUTOMOTIVE (OUTLET PROTECTION, SS#1-1, #1-2, #1-3), THE ENTIRE ENTRANCE SHALL REMAIN OPEN TO CUSTOMER TRAFFIC.
 - THE GENERAL CONTRACTOR SHALL CLEAR THE SITE AS SHOWN IN THE PLANS.
 - THE CONTRACTOR SHALL INSTALL THE RIGID BOUNDARY BASIN OUTLET PROTECTION AND THE PROPOSED STORM SYSTEM STRUCTURES AND PIPES FROM STRUCTURE #1-1 TO STRUCTURE #1-3.
 - THE CONTRACTOR SHALL FINE GRADE ALL DENuded AREAS, AND SHALL DISTRIBUTE TOPSOIL ACROSS ALL REMAINING DENuded AREAS TO A DEPTH OF 4-INCHES MINIMUM. THE GENERAL CONTRACTOR SHALL SEED THE SITE WITH APPROPRIATE SEEDING. THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR WATERING AND MAINTAINING SEEDING UNTIL THE SEEDING PROVIDE A WORK PERMANENT GROUND COVER.
 - THE CONTRACTOR SHALL SAWCUT EXISTING PAVEMENT AND INSTALL 52 LF OF THE 42" RCP FROM STORM SYSTEM STRUCTURE #1-3 TO #1-4. TRENCHING TO BE TERMINATED BEFORE INTERFERING WITH ENTRANCE TO EAGLE EYE AUTOMOTIVE, APPROXIMATELY 46 LF FROM EXISTING EDGE OF PAVEMENT (SEE PLANS).
 - THE TRENCH SHALL BE STABILIZED AND SHORED TO ALLOW FOR CONSTRUCTION OF THE REMAINING 24 LF OF 42" RCP DURING PHASE 2.
 - THE CONTRACTOR SHALL FILL TRENCH AND PROVIDE PAVEMENT PATCH THAT WILL SERVE AS THE ENTRANCE TO EAGLE EYE AUTOMOTIVE DURING PHASE 2 OF CONSTRUCTION. CONTRACTOR SHALL ENSURE THAT 42" RCP IS LEFT EXPOSED TO ALLOW CONNECTION DURING INSTALLATION OF REMAINING 42" PIPE DURING PHASE 2.
- PHASE 2:**
- NOTE: DURING PHASE 2 CONSTRUCTION, THE NORTHERN HALF OF THE ENTRANCE TO EAGLE EYE AUTOMOTIVE DIRECTLY ACROSS FROM ADAMS ROAD SHALL REMAIN OPEN TO CUSTOMER TRAFFIC. CONTRACTOR SHALL ENSURE THAT THIS PORTION OF ENTRANCE REMAINS OPEN DURING ALL CONSTRUCTION ACTIVITIES.
 - THE CONTRACTOR SHALL INSTALL REMAINING 24 LF OF 42" RCP FROM STORM SYSTEM STRUCTURE #1-3 TO #1-4 AND STORM SYSTEM STRUCTURE #1-4 (60" MANHOLE).
 - THE CONTRACTOR SHALL FILL TRENCH AND PROVIDE PAVEMENT PATCH OVER REMAINING STORM PIPE.
 - UPON COMPLETION OF THE WORK AND WITHIN 30 DAYS OF FINAL SITE STABILIZATION, THE GENERAL CONTRACTOR SHALL REMOVE ALL EROSION AND SEDIMENT MEASURES FROM THE SITE UPON APPROVAL OF THE REPRESENTATIVE OF JAMES CITY COUNTY.
 - THIS IS A GENERALIZED SEQUENCE OF CONSTRUCTION, AND MAY BE AMENDED WITH NOTICE TO THE OWNER AND JAMES CITY COUNTY REPRESENTATIVE SO LONG AS THE INTENT OF THE WORK REMAINS UNCHANGED.

NOTES:
 1. IS-1 INLET SHAPING TO BE PROVIDED FOR SS#1-2 AND SS#1-3.
 2. FENCES AND LANDSCAPING SHALL BE REMOVED WITH CARE AND REPLACED UPON COMPLETION OF CONSTRUCTION ACTIVITIES.

EROSION AND SEDIMENTATION CONTROL LEGEND

- (SF) SILT FENCE (SPEC. 3.05)
- (CIP) CULVERT INLET PROTECTION (SPEC. 3.08-1 WITH STONE COMBINATION INSTEAD OF SILT FENCE)
- (RR) RIP RAP (SPEC. 3.19)
- (CD) ROCK CHECK DAM (SPEC. 3.20)
- (PS) PERMANENT SEEDING (SPEC. 3.32)
- (EC-3) TREATMENT 2 SOIL STABILIZATION MATTING (SPEC. 3.36)
- (DC) DUST CONTROL (SPEC. 3.39)

NOTE: SEE VIRGINIA EROSION & SEDIMENT CONTROL HANDBOOK FOR EROSION CONTROL SPECIFICATIONS (SPEC.) AND DETAILS.



Revised By	Date	Description



6548 Old Towne Road, Suite 1
 Williamsburg, Virginia 23188
 Phone: (757) 763-0040
 Fax: (757) 763-5894
 www.ades.com

ADES
 CONSULTING ENGINEERS
 Hampton Roads | Central Virginia | Middle Peninsula

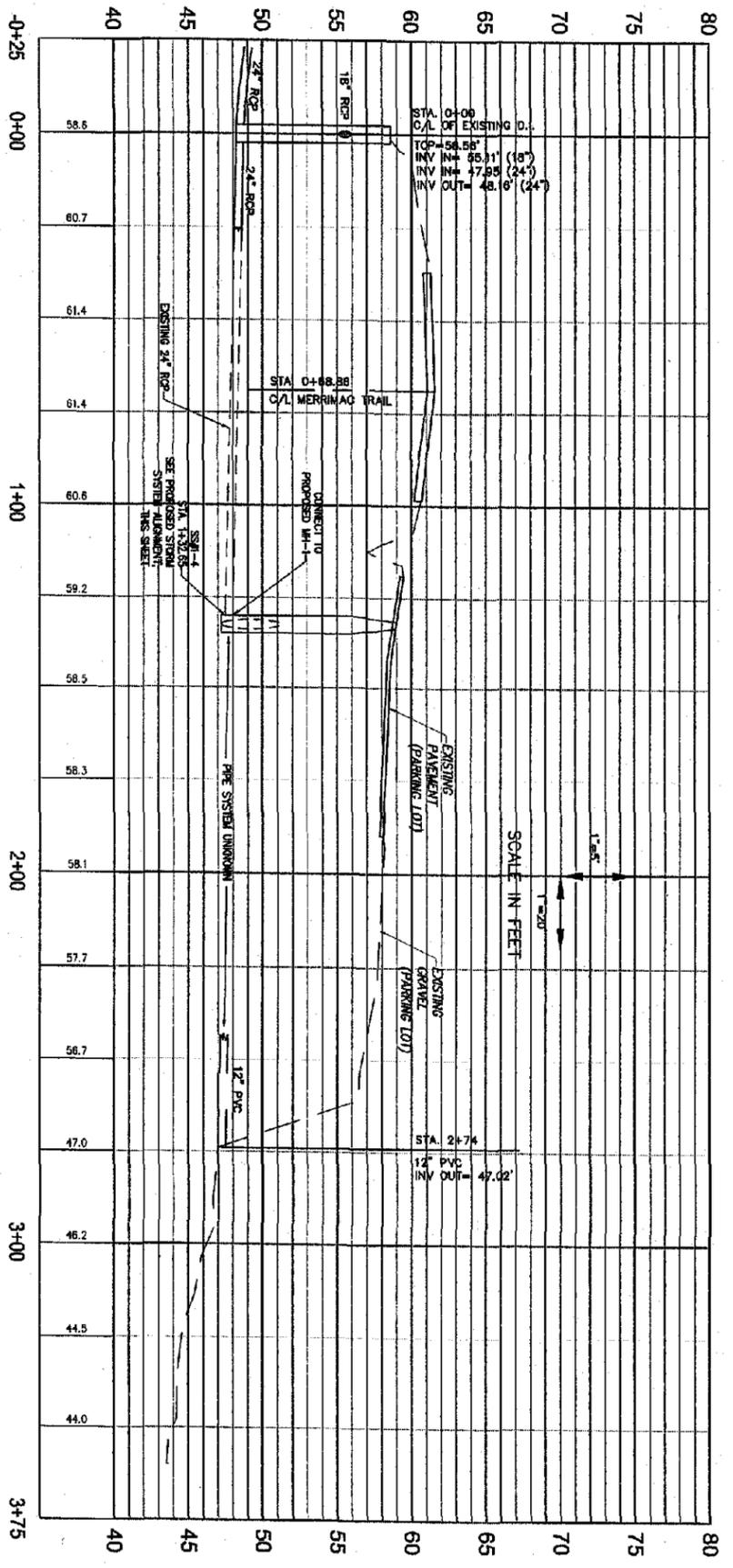
MERRIMAC TRAIL
 DRAINAGE IMPROVEMENTS

DISTRICT: JAMES CITY COUNTY, VIRGINIA

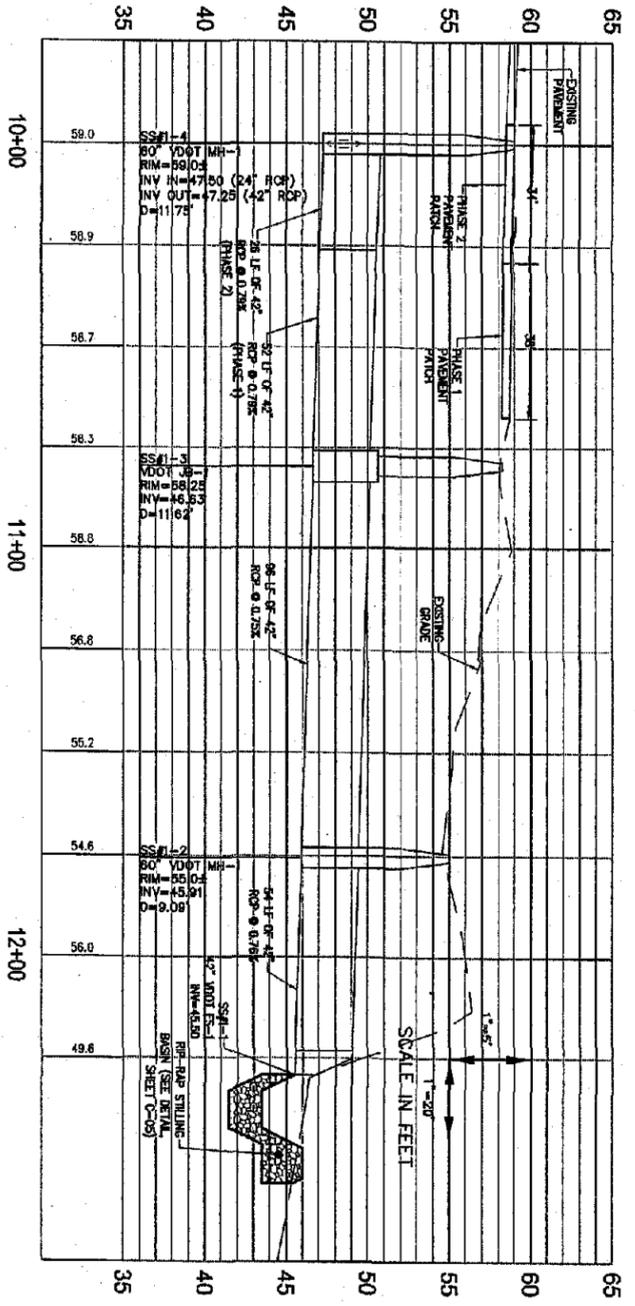
Project Contacts: VMB
 Project Number: 9901-E-27
 Scale: 1"=20' Date: 3/14/11

Sheet Title:
GRADING, DRAINAGE, AND SITE PLAN

Sheet Number:
C-03



EXISTING STORM SYSTEM ALIGNMENT



PROPOSED STORM SYSTEM ALIGNMENT

Rev.	Date	Description	Reviewed By



AES
CONSULTING ENGINEERS
5048 Old Towne Road, Suite 1
Williamsburg, Virginia 23108
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Fax: (757) 230-8664
www.aesva.com
Hampton Roads | Central Virginia | Middle Peninsula

MERRIMAC TRAIL
DRAINAGE IMPROVEMENTS
DISTRICT JAMES CITY COUNTY VIRGINIA

Sheet Number: **C-04**
Project District: VAB
Project Number: 2007-527
Scale: 1"=20'
Date: 3/14/11
Notes & Details

**JAMES CITY COUNTY ENVIRONMENTAL DIVISION
STANDARD EROSION AND SEDIMENT CONTROL NOTES
REVISED OCTOBER 1, 2009**

THE FOLLOWING STANDARD EROSION AND SEDIMENT CONTROL (ES&S) NOTES SHALL BECOME PART OF APPROVED EROSION AND SEDIMENT CONTROL PLANS FOR ALL PLAN OF DEVELOPMENT PROJECTS IN JAMES CITY COUNTY, VIRGINIA.

- ALL THE PROVISIONS OF VIRGINIA EROSION AND SEDIMENT CONTROL LAW AND REGULATIONS, MINIMUM STANDARDS, HANDBOOKS, AND TECHNICAL BULLETINS AS PUBLISHED BY THE VIRGINIA SOIL & WATER CONSERVATION BOARD AND/OR THE VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION, DIVISION OF SOIL & WATER CONSERVATION SHALL APPLY TO THE PROJECT.
- MINIMUM STANDARDS # 1 THROUGH # 19 OF THE VIRGINIA EROSION AND SEDIMENT CONTROL REGULATIONS (#VACS0-30-40) SHALL APPLY TO THE PROJECT.
- THE OWNER OR APPLICANT SHALL BE RESPONSIBLE TO REGISTER FOR COVERAGE UNDER THE GENERAL PERMIT FOR DISCHARGE OF STORMWATER FROM CONSTRUCTION ACTIVITIES, IN ACCORDANCE WITH CURRENT REQUIREMENTS OF THE VIRGINIA STORMWATER MANAGEMENT PROGRAM (VSWMP) AND THE VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION.
- THE OWNER OR APPLICANT SHALL PROVIDE THE NAME OF AN INDIVIDUAL HOLDING A VALID RESPONSIBLE LAND DISTURBER (RLD) CERTIFICATE OF COMPETENCE WHO WILL BE RESPONSIBLE FOR THE LAND-DISTURBING ACTIVITY PRIOR TO ENGAGING IN THE LAND-DISTURBING ACTIVITY. THIS WILL BE NECESSARY PRIOR TO ISSUANCE OF A LAND-DISTURBING PERMIT FOR THE PROJECT. THE RLD IS REQUIRED TO ATTEND THE PRECONSTRUCTION CONFERENCE FOR THE PROJECT.
- THE CONTRACTOR IS RESPONSIBLE TO CONTACT MISS UTILITY (DIAL 811 IN VA OR 1-800-552-7001) PRIOR TO ANY UTILITY OR SITE WORK EXCAVATIONS.
- ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE PLANNED, DESIGNED, IMPLEMENTED, INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE PROVISIONS OF THE LATEST EDITION OF THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK (VESCH). THE CONTRACTOR SHALL MAINTAIN, INSPECT AND REPAIR ALL EROSION AND SEDIMENT CONTROL MEASURES AS NEEDED THROUGHOUT THE LIFE OF THE PROJECT TO ENSURE CONTINUED ACCEPTABLE PERFORMANCE.
- A PRECONSTRUCTION CONFERENCE (MEETING) SHALL BE HELD ON SITE BETWEEN THE COUNTY ENVIRONMENTAL DIVISION, THE OWNER/APPLICANT, THE RESPONSIBLE LAND-DISTURBER (RLD), THE CONTRACTOR AND OTHER RESPONSIBLE AGENCIES, AS APPLICABLE, PRIOR TO ISSUANCE OF A LAND-DISTURBING PERMIT. THE OWNER OR APPLICANT IS REQUIRED TO COORDINATE SCHEDULING OF THE PRECONSTRUCTION CONFERENCE BETWEEN ALL APPLICABLE PARTIES. THE CONTRACTOR SHALL SUBMIT A SEQUENCE OF CONSTRUCTION TO THE COUNTY ENVIRONMENTAL DIVISION FOR REVIEW AND APPROVAL PRIOR TO THE PRECONSTRUCTION MEETING.
- ALL PERIMETER EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CONSTRUCTED AS A FIRST STEP IN ANY LAND-DISTURBING ACTIVITY AND SHALL BE MADE FUNCTIONAL BEFORE UPSLOPE LAND DISTURBANCE TAKES PLACE.
- ADDITIONAL SAFETY FENCE OR DUST CONTROL MEASURES, IN ACCORDANCE WITH THE PROVISIONS OF MINIMUM STANDARDS & SPECS. 3.01 AND 3.39 OF THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK (VESCH), MAY BE REQUIRED TO BE IMPLEMENTED IN ADDITION TO THAT SHOWN ON THE APPROVED PLAN IN ORDER TO ENSURE ADEQUATE PROTECTION OF THE HEALTH, SAFETY AND WELFARE OF THE PUBLIC OR IF SITE CONDITIONS CHANGE, BECOME APPARENT OR ALTER SIGNIFICANTLY FOLLOWING THE DATE OF PLAN APPROVAL. CONSTRUCTION OF EROSION AND SEDIMENT CONTROL MEASURES FROM THE APPROVED PLAN.
- OFF-SITE WASTE OR BORROW AREAS SHALL BE APPROVED BY THE COUNTY ENVIRONMENTAL DIVISION PRIOR TO THE IMPORT OF ANY BORROW OR EXPORT OF ANY WASTE TO OR FROM THE PROJECT SITE.
- CULVERT AND STORM DRAIN INLET PROTECTIONS, IN ACCORDANCE WITH THE PROVISIONS OF MINIMUM STANDARDS & SPECS. 3.07 & 3.08 OF THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK (VESCH), MAY BE REMOVED AT THE DISCRETION OF THE ASSIGNED COUNTY ENVIRONMENTAL DIVISION INSPECTOR SHOULD PLACEMENT OF THE MEASURE RESULT IN EXCESSIVE ROAD FLOODING OR TRAFFIC HAZARD OR RESULT IN THE REDIRECTION OF DRAINAGE ONTO OR TOWARD EXISTING LOTS, DRIVEWAYS OR STRUCTURES. DECISIONS SHALL BE MADE ON A CASE-BY-CASE BASIS BASED ON FIELD SITUATIONS ENCOUNTERED.
- DRAINAGE FACILITIES SHALL BE INSTALLED AND FUNCTIONAL WITHIN 30 DAYS FOLLOWING COMPLETION OF ROUGH GRADING AT ANY POINT WITHIN THE PROJECT.
- NO MORE THAN 300 FEET OF TRENCH MAY BE OPEN AT ONE TIME FOR UNDERGROUND UTILITY LINES, INCLUDING STORM WATER CONVEYANCES. ALL OTHER PROVISIONS OF MINIMUM STANDARD # 16 OF THE VIRGINIA EROSION AND SEDIMENT CONTROL REGULATIONS APPLY.
- IF DISTURBED AREA STABILIZATION IS TO BE ACCOMPLISHED DURING THE MONTHS OF DECEMBER, JANUARY OR FEBRUARY, STABILIZATION SHALL CONSIST OF MULCHING IN ACCORDANCE WITH MINIMUM STANDARD & SPEC. 3.35 OF THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK (VESCH). SEEDING WILL THEN TAKE PLACE AS SOON AS THE SEASON PERMITS.
- THE TERM SEEDING, FINAL VEGETATIVE COVER OR STABILIZATION ON THE APPROVED PLAN SHALL MEAN THE SUCCESSFUL GERMINATION AND ESTABLISHMENT OF A STABLE GRASS COVER FROM A PROPERLY PREPARED SEEDBED, IN ACCORDANCE WITH MINIMUM STANDARDS & SPECS. 3.28 THROUGH 3.37 OF THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK (VESCH), AS APPLICABLE. IRRIGATION, IF NECESSARY, SHALL COMPLY WITH ALL APPLICABLE OUTDOOR WATER USE RESTRICTIONS OF THE JAMES CITY SERVICE AUTHORITY.
- TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL NOT BE REMOVED UNTIL ALL DISTURBED AREAS ARE STABILIZED. REMOVAL SHALL NOT OCCUR WITHOUT AUTHORIZATION BY THE COUNTY ENVIRONMENTAL DIVISION. DISTURBANCES ASSOCIATED WITH THE REMOVAL OF TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE PROPERLY STABILIZED.
- NO SEDIMENT TRAP OR SEDIMENT BASIN SHALL BE REMOVED UNTIL A) AT LEAST 75 PERCENT OF THE SINGLE-FAMILY LOTS WITHIN THE DRAINAGE AREA TO THE TRAP OR BASIN HAVE BEEN SOLD TO A THIRD PARTY FOR THE CONSTRUCTION OF HOMES (UNRELATED TO THE DEVELOPER); AND/OR, B) 60 PERCENT OF THE SINGLE-FAMILY LOTS WITHIN THE DRAINAGE AREA TO THE TRAP OR BASIN ARE COMPLETED AND STABILIZED. A BULK SALE OF THE LOTS TO ANOTHER BUILDER DOES NOT SATISFY THIS PROVISION. SEDIMENT TRAPS AND SEDIMENT BASINS SHALL NOT BE REMOVED WITHOUT AUTHORIZATION OF THE COUNTY ENVIRONMENTAL DIVISION.
- APPLICABLE PROVISIONS OF THE COUNTY BMP MANUAL (JAMES CITY COUNTY GUIDELINES FOR DESIGN AND CONSTRUCTION OF STORMWATER MANAGEMENT BMPs) AND THE VIRGINIA STORMWATER MANAGEMENT HANDBOOK (VSMH) APPLY TO THE PROJECT.
- DESIGN AND CONSTRUCTION OF PRIVATE-TYPE STORM DRAINAGE SYSTEMS, OUTSIDE VDOT RIGHT-OF-WAY, SHALL BE PERFORMED IN ACCORDANCE WITH THE CURRENT VERSION OF THE JAMES CITY COUNTY ENVIRONMENTAL DIVISION, STORMWATER DRAINAGE CONVEYANCE SYSTEMS (NON-BMP RELATED), GENERAL DESIGN AND CONSTRUCTION GUIDELINES.
- RECORD DRAWINGS (ASBUILTS) AND CONSTRUCTION CERTIFICATIONS ARE REQUIRED FOR ALL STORMWATER FACILITIES INCLUDING STORMWATER MANAGEMENT BMP FACILITIES AND STORM DRAINAGE CONVEYANCE SYSTEMS. RECORD DRAWINGS AND CONSTRUCTION CERTIFICATIONS MUST MEET ESTABLISHED PROGRAM REQUIREMENTS OF BOTH THE COUNTY ENVIRONMENTAL AND STORMWATER DIVISIONS.
- ALL STORMWATER FACILITIES INCLUDING BMPs, STORM DRAINAGE PIPES, STORMWATER CONVEYANCES, INLETS, MANHOLES, OUTFALLS AND ROADSIDE AND OTHER OPEN CHANNELS SHALL BE INSPECTED BY THE COUNTY STORMWATER DIVISION AND GEOTECHNICAL ENGINEER IN ACCORDANCE WITH ESTABLISHED COUNTY STORMWATER DIVISION PROGRAM REQUIREMENTS.

MINIMUM CARE LAWN COMMERCIAL OR RESIDENTIAL -KENTUCKY 31 OR TURF-TYPE TALL FESCUE OR -COMMON BERMUUDA GRASS **	TOTAL LBS PER ACRE
	175-200 LBS.
GENERAL SLOPE (3:1 OR LESS) -KENTUCKY 31 FESCUE -RED TOP GRASS -SEASONAL NURSE CROP *	128 LBS. 2 LBS. 20 LBS. 150 LBS.
LOW MAINTENANCE SLOPE (STEEPER THAN 3:1) -KENTUCKY 31 TALL FESCUE -COMMON BERMUODAGRASS ** -RED TOP GRASS -SEASONAL NURSE CROP * -SERICEA LESPEDEZA **	93-108 LBS. 0-15 LBS 2 LBS. 20 LBS. 20 LBS. 150 LBS.

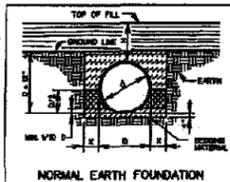
* USE SEASONAL CROP IN ACCORDANCE WITH SEEDING DATES AS STATED BELOW:
FEBRUARY, MARCH THROUGH APRIL.....ANNUAL RYE
MAY 1ST THROUGH AUGUST.....FOXTAIL MILLET
SEPTEMBER, OCTOBER THROUGH NOVEMBER 15TH.....ANNUAL RYE
NOVEMBER 16TH THROUGH JANUARY.....WINTER RYE

** MAY THROUGH OCTOBER, USE HULLED SEED. ALL OTHER SEEDING PERIODS, USE UNHULLED SEED. WEEPING LOVEGRASS MAY BE ADDED TO ANY SLOPE OR LOW-MAINTENANCE MIX DURING WARMER SEEDING PERIODS; ADD 10-20 LBS./ACRE IN MIXES.

PS
VA DSHIC
PG II - 304

SITE SPECIFIC SEEDING MIXTURES FOR COASTAL PLAIN AREA

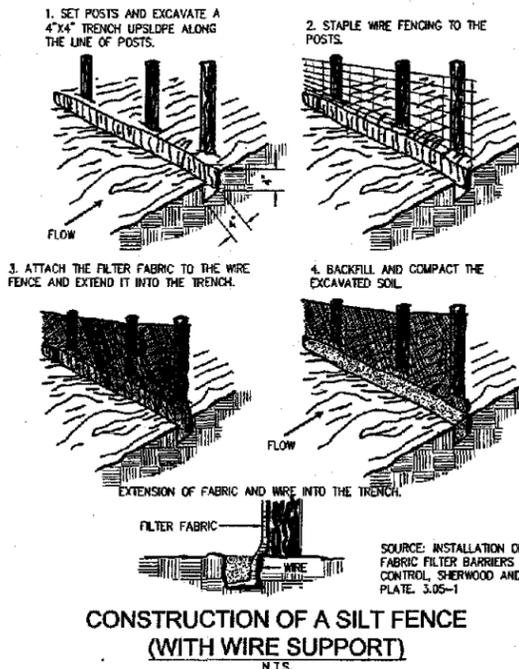
NO PROJECTION OF PIPE ABOVE GROUND LINE



- SEEDING MATERIAL IN ACCORDANCE WITH SPECIFICATIONS
- CLASS 2 SANDFILL MATERIAL IN ACCORDANCE WITH SPECIFICATIONS
- REGULAR SANDFILL MATERIAL IN ACCORDANCE WITH SPECIFICATIONS
- EMBANKMENT

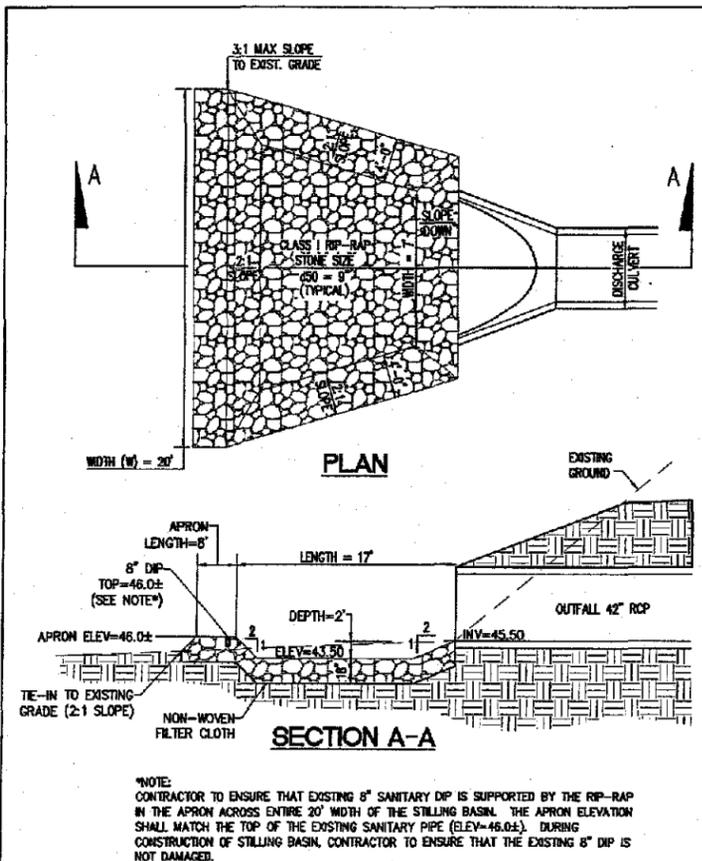
NOTES:
FOR PLASTIC PIPE THE LIMITS OF THE CLASS 2 SANDFILL MATERIAL SHALL BE EXTENDED TO 2" ABOVE THE TOP OF THE PIPE.
FOR GENERAL NOTES ON PIPE BEDDING, SEE INSTALLATION OF PIPE GUIDELINES AND STORM WATERS GENERAL NOTES ON SHEET 02.02.
EMBANKMENT SHALL BE CONFORMANT WITH THE SPECIFICATIONS FOR EMBANKMENT FOR ANY DEVIATION OF EROSION AND SEDIMENT CONTROL MEASURES FROM THE APPROVED PLAN.

VDOT ROAD AND BRIDGE CONSTRUCTION SHEET 1 OF 3 02.02	INSTALLATION OF PIPE CULVERTS AND STORM SEWERS CIRC. PIPE BEDDING AND BACKFILL - METHOD "A" VIRGINIA DEPARTMENT OF TRANSPORTATION	SECTION REFERENCE 302 303
---	---	---------------------------------



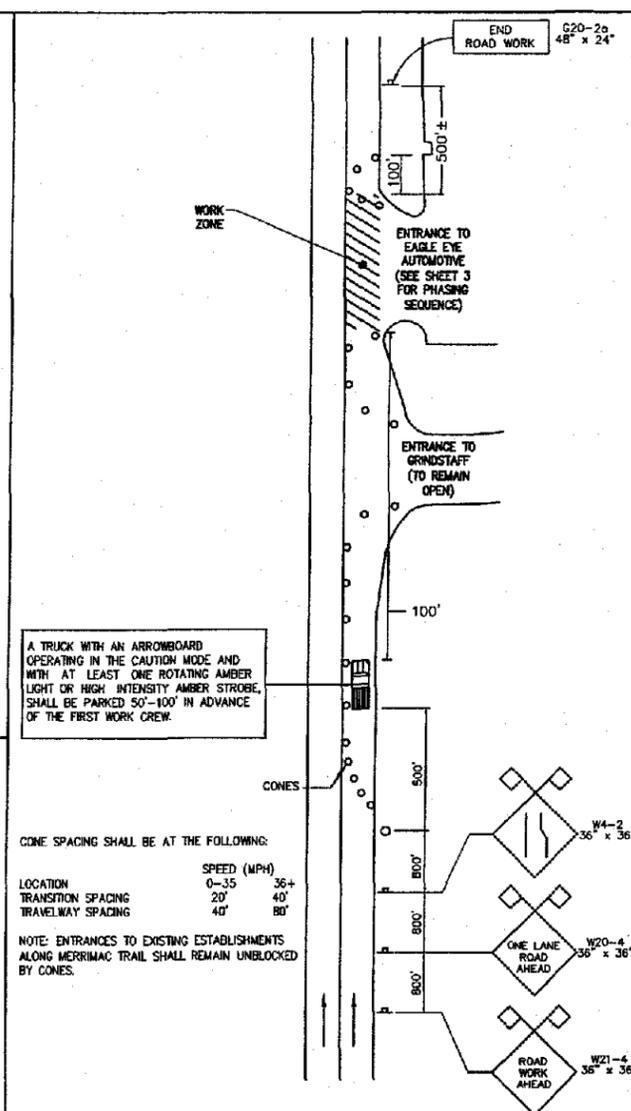
**CONSTRUCTION OF A SILT FENCE
(WITH WIRE SUPPORT)**

SOURCE: INSTALLATION OF STRAW AND FABRIC FILTER BARRIERS FOR SEDIMENT CONTROL, SHERWOOD AND WYANT PLATE. 3.05-1



*NOTE:
CONTRACTOR TO ENSURE THAT EXISTING 8\"/>

STILLING BASIN DETAIL
NOT TO SCALE



A TRUCK WITH AN ARROWBOARD OPERATING IN THE CAUTION MODE AND WITH AT LEAST ONE ROTATING AMBER LIGHT OR HIGH INTENSITY AMBER STROBE, SHALL BE PARKED 50'-100' IN ADVANCE OF THE FIRST WORK CREW.

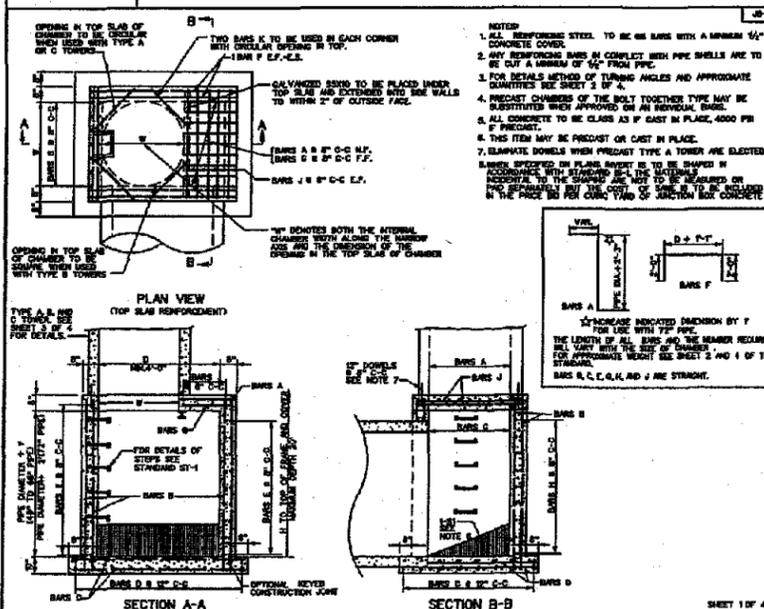
CONE SPACING SHALL BE AT THE FOLLOWING:

LOCATION	SPEED (MPH)	TRANSITION SPACING	TRAVELWAY SPACING
	0-35	36'	
	36-40	20'	40'
	40-80		80'

NOTE: ENTRANCES TO EXISTING ESTABLISHMENTS ALONG MERRIMAC TRAIL SHALL REMAIN UNBLOCKED BY CONES.

NOTE:
REFER TO PAGE 6-110 OF THE VIRGINIA WORK AREA PROTECTION MANUAL FOR NOTES REGARDING TRAFFIC CONTROL.

TRAFFIC CONTROL SIGNAGE DETAIL



JUNCTION BOX CHAMBER DETAILS FOR 48\"/>

MAXIMUM DEPTH (H) = 20'

NO.	DESCRIPTION	DATE



ABS
CONSULTING ENGINEERS
Hempden Road | Centra Virginia | Middle Peninsula
6205 Olds Truss Road, Suite 1
Westminster, Virginia 23188
Tel: (703) 235-6884
www.abs-engineers.com

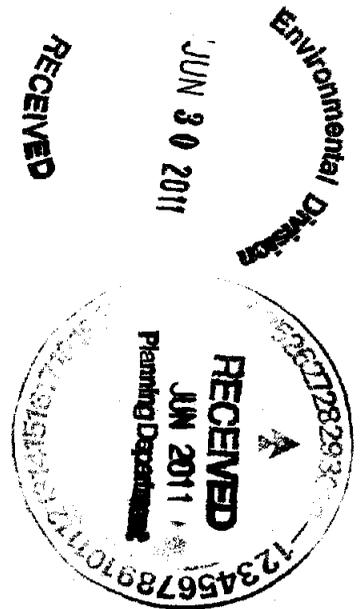
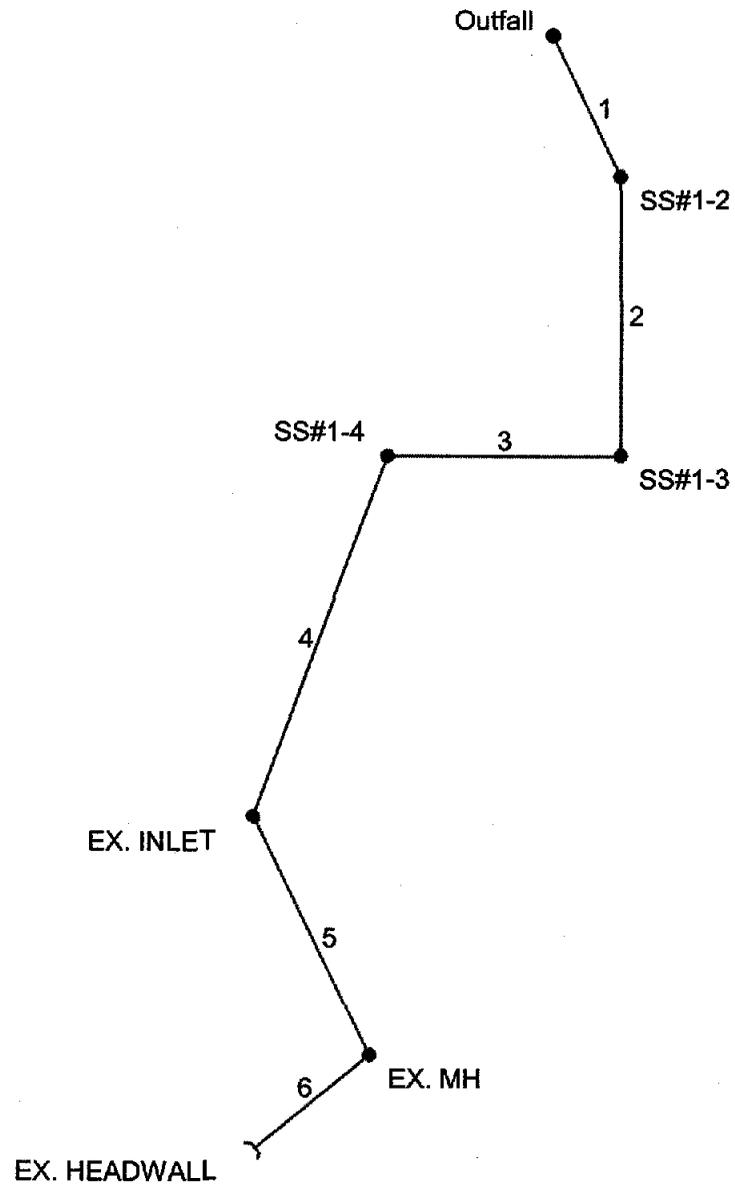
MERRIMAC TRAIL
DRAINAGE IMPROVEMENTS
DISTRICT
JAMES CITY COUNTY, VIRGINIA

Project Contacts: VMS
Project Number: 9801-E-27
Scale: 1\"/>

Sheet Title:
NOTES & DETAILS

Sheet Number:
C-05

Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2009 Plan



Project File: 9801-E-27_Storm System Design.stm

Number of lines: 6

Date: 06-10-2011

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	1-2 TO 1-1	82.81	42	Cir	54.000	45.50	45.91	0.759	48.79	49.01	0.00	49.01	End	Manhole
2	1-3 TO 1-2	82.81	42	Cir	96.000	45.91	46.63	0.750	49.01	49.42	0.00	49.42	1	Manhole
3	1-4 TO 1-3	82.81	42	Cir	78.000	46.63	47.25	0.795	49.42	50.04	0.00	50.04	2	Manhole
4	EX. INLET TO 1-4	82.81	24	Cir	132.000	47.50	47.95	0.341	50.04*	67.74*	0.00	67.74	3	Grate
5	EX MH TO EX. INLET	44.40	24	Cir	91.000	47.95	49.89	2.132	67.74*	71.25*	0.00	71.25	4	Manhole
6	EX. HEADWALL TO EX. MH	44.40	30	Cir	50.000	49.89	53.05	6.320	71.25*	71.83*	0.00	71.83	5	OpenHeadwall

Project File: 9801-E-27_Storm System Design.stm

Number of lines: 6

Run Date: 06-10-2011

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

DRAINAGE CALCULATIONS
FOR
MERRIMAC TRAIL DRAINAGE IMPROVEMENTS

SITE:

James City County

SUBMITTED TO:

Environmental Division
James City County

Prepared By:

AES Consulting Engineers
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188

March 25, 2011

AES Project No. 9801-E-27

Stormwater Management Report.doc



APR 04 2011

RECEIVED

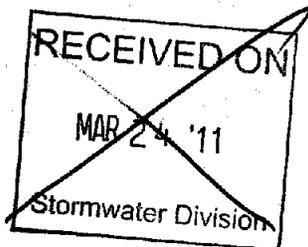
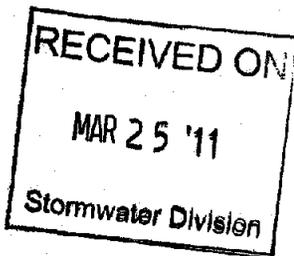


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-Drainage Area SCS Calculations.....	3
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-Stilling Basin Design.....	18

STORM WATER NARRATIVE

PROJECT DESCRIPTION

This project consists of improvement to an existing storm system that collects runoff from the northeast side of Merrimac Trail and conveys it behind Eagle Eye Automotive. Additional outfall protection is provided at the outfall of the proposed storm system.

EXISTING SITE CONDITIONS

A 24" concrete pipe exits the grate inlet on the east side of Merrimac Trail, crosses the road, runs underneath the eagle eye parking lot, and eventually outfalls into a ravine behind Eagle Eye Automotive. At some undetermined point in the line, the pipe size is reduced to 12"

ADJACENT PROPERTIES

The project is bordered to the east by Merrimac Trail, to the west by the CSX railroad, to the North by the Grindstaff Virginia property, and to the south by Eagle Eye Automotive.

SOILS

The project area consists of 15E-Emporia Complex and 37-Urban Land with slopes ranging from 0 to 25 percent.

CRITICAL EROSION AREAS

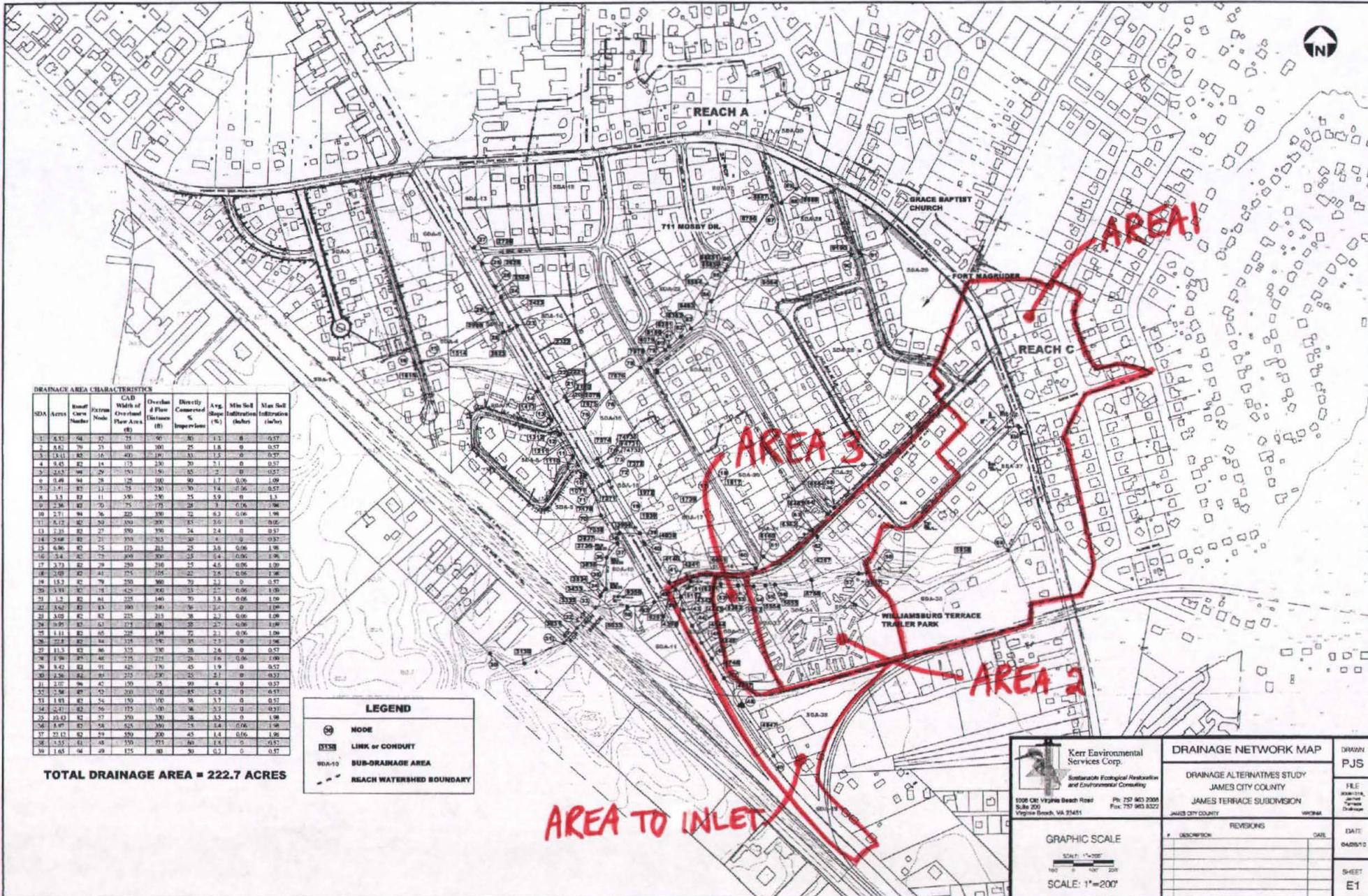
There are areas of 25% slope impact at the proposed outfall of the storm system. This amount to 0.024 acres or 9.2% of the total disturbed area.

STORMWATER MANAGEMENT & WATER QUALITY

The proposed storm system was designed to pass the 25-year storm volume for its contributing drainage area. The total drainage area is shown on the Drainage Network Map provided by Kerr Environmental and included in this calculation package. A hydraflow routing was performed taking into account storage provided upstream of the storm system, and the 25-year flow for the proposed storm system was found to be 82.81 cubic feet per second. The storm system and the stilling basin outlet protection have been sized based on this value.

RESULTS & CONCLUSIONS

The resizing and rerouting of the storm system should alleviate upstream flooding problems as well as providing opportunity for future improvements. If VDOT ever decides to replace the existing 24" concrete pipe crossing Merrimac Trail with a larger pipe, opportunity is available for them to connect into the proposed storm system.



Drainage Area Characteristics

SDA	Acres	Basin Area Number	From Node	CAD Width of Overland Flow Area (ft)	Overland Flow Distance (ft)	Directly Connected % Impervious	Avg. Slope (%)	Min Sd (Inches)	Max Sd (Inches)
1	4.32	84	25	75	90	80	1.3	0	0.57
2	4.85	79	23	101	101	25	1.8	0	0.57
3	13.11	82	16	401	191	33	1.5	0	0.57
4	5.45	82	14	175	230	20	3.1	0	0.57
5	2.23	86	29	150	150	85	2.7	0	0.57
6	3.68	84	28	126	100	90	1.7	0.06	1.09
7	2.41	82	12	75	230	30	1.4	0.06	0.57
8	3.3	82	11	380	530	55	5.9	0	1.3
9	2.36	87	50	75	175	28	1.1	0.06	1.09
10	2.71	84	26	225	330	22	4.3	0.06	1.09
11	7.12	82	50	380	290	25	5.0	0	0.06
13	7.33	82	27	380	330	24	2.4	0	0.57
14	2.68	82	21	300	325	30	1	0	0.57
15	6.96	82	25	175	212	25	3.5	0.06	1.09
16	5.4	82	17	400	300	25	1.4	0.06	1.09
17	3.73	82	29	280	330	35	4.5	0.06	1.09
18	7.09	82	41	175	125	22	2.8	0.06	1.09
19	15.3	82	79	350	300	30	2.2	0	0.57
20	3.81	82	32	425	300	33	2.2	0.06	1.09
21	1.2	82	61	325	140	30	3.8	0.06	1.09
22	1.62	82	63	380	240	30	2.4	0	1.09
23	3.09	82	62	225	213	30	2.2	0.06	1.09
24	0.95	82	62	175	80	25	2.2	0.06	1.09
25	1.11	82	65	240	138	22	2.1	0.06	1.09
26	2.8	82	64	125	130	35	2.3	0	1.09
27	11.3	82	86	325	330	28	2.6	0	0.57
28	1.96	82	48	225	225	28	1.6	0.06	1.09
29	8.42	82	71	425	170	45	1.9	0	0.57
30	2.26	82	61	225	230	25	2.1	0	0.57
31	2.02	86	47	150	25	99	1	0	0.57
32	2.94	82	52	210	110	48	3.8	0	0.57
33	1.91	82	54	150	100	38	3.7	0	0.57
34	2.41	82	56	175	100	38	3.3	0	0.57
35	10.42	82	57	350	330	38	3.3	0	1.09
36	1.07	82	58	225	300	25	1.4	0.06	1.09
37	22.12	82	59	350	290	45	1.4	0.06	1.09
38	1.53	82	48	350	225	40	1.4	0	0.57
39	1.05	84	29	125	80	30	0.2	0	0.57

TOTAL DRAINAGE AREA = 222.7 ACRES

LEGEND

- NODE
- LINK or CONDUIT
- SUB-DRAINAGE AREA
- WATERSHED BOUNDARY

AREA TO INLET

Kerr Environmental Services Corp.
 Sustainable Ecological Remediation and Environmental Consulting
 1008 Old Virginia Beach Road, Suite 200, Virginia Beach, VA 23461
 Ph: 757 963 2009, Fax: 757 963 8322

DRAINAGE NETWORK MAP

DRAINAGE ALTERNATIVES STUDY
 JAMES CITY COUNTY
 JAMES TERRACE SUBDIVISION
 JAMES CITY COUNTY

DRAWN: PJS
 FILE: 0008-016, 010000
 DATE: 04/05/10
 SHEET: E1

#	DESCRIPTION	REVISIONS	DATE

GRAPHIC SCALE
 SCALE: 1"=200'
 SCALE: 1"=200'

Merrimac Trail Storm Improvements
CALCULATION FOR SCS HYDROGRAPH GENERATION AND CHANNEL PROTECTION
FOR AREA 1

Project No. 9801-E-27
 5-Oct-10
 Revision Date

II. POST-DEVELOPMENT CONDITIONS TO POINT OF CONCERN (for total site)

- A. Post-Development Drainage Area to Point of Concern = **41.09 Acres**
 B. Post-development Land Use, Soil Classification and Calculation of Composite Curve Number

	Soil Type	Soil Hydrologic Group	Post-Development Land Use	Area of Land Use (in Acres)	Curve Number for Land Use (CN)	Adjusted (CN)
1)						0
2)						0
3)						0
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
	Total Adjusted CN =					82
	Composite CN =					82

C. Post-Development Time of Concentration Calculations

- 1) Overland Flow (maximum 300 feet)
 - Surface description (table 5-7) **Dense Grass**
 - Manning's roughness coefficient, n (table 5-7) **0.24**
 - Length of overland flow, L **300 Feet**
 - 25-year 24-hour rainfall, P25 **6.4 inches**
 - Average slope of overland flow, s **0.02 feet per foot**
 - Travel time, $T_t = (0.007 \cdot (n \cdot L)^{0.8}) / (P^{0.5} \cdot s^{0.4})$ **0.41 hours**

 - 2) Shallow concentrated flow (maximum 300 feet)
 - Surface description, paved or unpaved **0 Feet**
 - Length of shallow concentrated flow, L **0 feet per foot**
 - Average slope of shallow concentrated flow, s **0.0 feet per second**
 - Average velocity, v **0.00 hours**
 - Travel time, $T_t = L / (3600 \cdot v)$

 - 3) Channel or Pipe Flow
 - Length of channel flow, L **160 Feet**
 - Average velocity of channel flow, v **2.2 feet per second**
 - Travel time, $T_t = L / (3600 \cdot v)$ **0.22 hours**
- Total Time of Concentration = **0.83 hours**
 or **38 minutes**

Merrimac Trail Storm Improvements
CALCULATION FOR SCS HYDROGRAPH GENERATION AND CHANNEL PROTECTION
FOR AREA 2

Project No. 9801-E-27

5-Oct-10

Revision Date

II. POST-DEVELOPMENT CONDITIONS TO POINT OF CONCERN (for total site)

A. Post-Development Drainage Area to Point of Concern =

14.77 Acres

B. Post-development Land Use, Soil Classification and Calculation of Composite Curve Number

	Soil Type	Soil Hydrologic Group	Post-Development Land Use	Area of Land Use (in Acres)	Curve Number for Land Use (CN)	Adjusted (CN)
1)						0
2)						0
3)						0
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0

Total Adjusted CN =

Composite CN =

82

C. Post-Development Time of Concentration Calculations

1) Overland Flow (maximum 300 feet)

Surface description (table 5-7)

Manning's roughness coefficient, n (table 5-7)

Length of overland flow, L

25-year 24-hour rainfall, P25

Average slope of overland flow, s

Travel time, $T_t = (0.007 * (n * L)^{0.8}) / (P^{2 * 0.5 * s^{0.4}})$

Dense grassland

0.24

300 Feet

6.4 inches

0.037 feet per foot

0.32 hours

2) Shallow concentrated flow (maximum 300 feet)

Surface description, paved or unpaved

Length of shallow concentrated flow, L

Average slope of shallow concentrated flow, s

Average velocity, v

Travel time, $T_t = L / (3600 * v)$

unpaved

250 Feet

0.07 feet per foot

4.5 feet per second

0.02 hours

3) Channel or Pipe Flow

Length of channel flow, L

Average velocity of channel flow, v

Travel time, $T_t = L / (3600 * v)$

400 Feet

2.5 feet per second

0.04 hours

Total Time of Concentration =

0.38 hours

or

23 minutes

Merrimac Trail Storm Improvements
CALCULATION FOR SCS HYDROGRAPH GENERATION AND CHANNEL PROTECTION
FOR AREA 3

Project No. 9801-E-27
 5-Oct-10
 Revision Date

II. POST-DEVELOPMENT CONDITIONS TO POINT OF CONCERN (for total site)

- A. Post-Development Drainage Area to Point of Concern = **2.66 Acres**
 B. Post-development Land Use, Soil Classification and Calculation of Composite Curve Number

	<u>Soil Type</u>	<u>Soil Hydrologic Group</u>	<u>Post-Development Land Use</u>	<u>Area of Land Use (in Acres)</u>	<u>Curve Number for Land Use (CN)</u>	<u>Adjusted (CN)</u>
1)						0
2)						0
3)						0
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0

Total Adjusted CN =
 Composite CN =

82

C. Post-Development Time of Concentration Calculations

- 1) Overland Flow (maximum 300 feet)
 - Surface description (table 5-7) **Dense grasses**
 - Manning's roughness coefficient, n (table 5-7) **0.24**
 - Length of overland flow, L **300 Feet**
 - 25-year 24-hour rainfall, P25 **6.4 inches**
 - Average slope of overland flow, s **0.042 feet per foot**
 - Travel time, $T_t = (0.007 * (n * L)^{0.8}) / (P^{2.0} * s^{0.4})$ **0.29 hours**
- 2) Shallow concentrated flow (maximum 300 feet)
 - Surface description, paved or unpaved **unpaved**
 - Length of shallow concentrated flow, L **300 Feet**
 - Average slope of shallow concentrated flow, s **0.06 feet per foot**
 - Average velocity, v **4.3 feet per second**
 - Travel time, $T_t = L / (3600 * v)$ **0.02 hours**
- 3) Channel or Pipe Flow
 - Length of channel flow, L **60 Feet**
 - Average velocity of channel flow, v **2.8 feet per second**
 - Travel time, $T_t = L / (3600 * v)$ **0.01 hours**

Total Time of Concentration =

0.32 hours
19 minutes

or

Hydraflow Table of Contents

25 - Year

Summary Report	1
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Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	108.53	2	736	528,433	---	---	---	Area 1 Drainage
2	Reservoir	45.08	2	764	528,428	1	72.29	216,634	Pond 1 Routed
4	SCS Runoff	73.34	2	726	255,527	---	---	---	Area 2
5	Combine	83.92	2	726	783,955	2, 4	---	---	Pond 1 Routed & Area 2
6	Reservoir	43.27	2	782	783,943	5	60.66	146,049	Pond 2 Routed
8	SCS Runoff	13.86	2	724	43,852	---	---	---	Area 3
9	Combine	44.40	2	780	827,794	6, 8	---	---	Pond 2 Routed & Area 3
11	SCS Runoff	38.41	2	730	157,243	---	---	---	SCS Area to Grate Inlet
Reach C Hydraflow Model.gpw					Return Period: 25 Year			Friday, Mar 25, 2011	

$$Q = \frac{(1 - 0.25)^3}{1 - 0.85}$$

$$S = \frac{1000}{0.01} - 10$$

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 25, 2011

Hyd. No. 1

$$Q = CiA$$

172

Area 1 Drainage

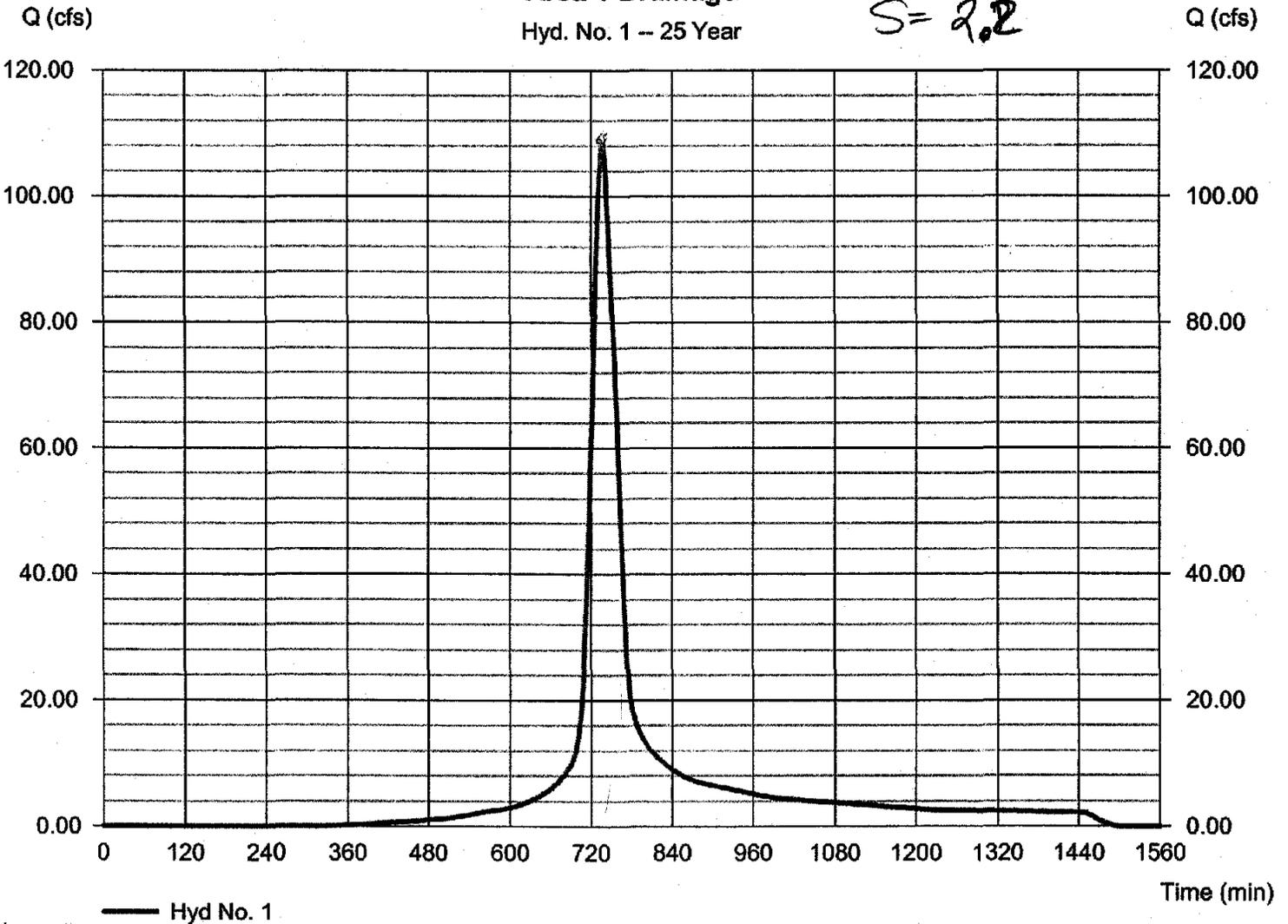
Hydrograph type = SCS Runoff
 Storm frequency = 25 yrs
 Time interval = 2 min
 Drainage area = 31.090 ac
 Basin Slope = 0.0 %
 Tc method = USER
 Total precip. = 6.75 in
 Storm duration = 24 hrs

Peak discharge = 108.53 cfs
 Time to peak = 736 min
 Hyd. volume = 528,433 cuft
 Curve number = 82 %
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 38.00 min
 Distribution = Type II
 Shape factor = 484

$$Q = \frac{(CiA - 0.25)^2}{C + 9.85} \quad q = 4.68 \text{ in} \quad S = \frac{CN}{1000} - 10$$

Area 1 Drainage
 Hyd. No. 1 -- 25 Year

$$S = 2.2$$



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 25, 2011

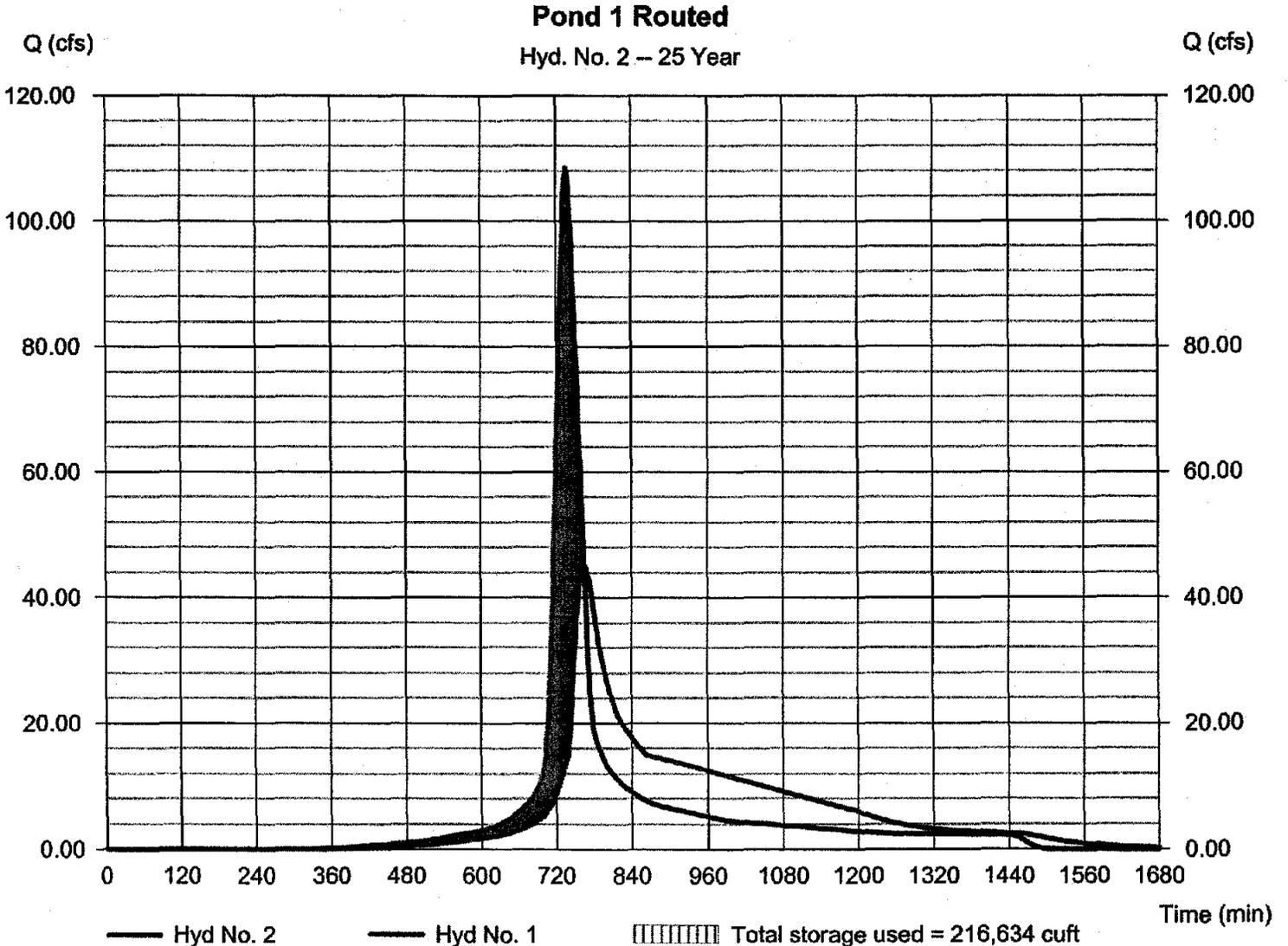
Hyd. No. 2

Pond 1 Routed

Hydrograph type = Reservoir
 Storm frequency = 25 yrs
 Time interval = 2 min
 Inflow hyd. No. = 1 - Area 1 Drainage
 Reservoir name = Pond 1

Peak discharge = 45.08 cfs
 Time to peak = 764 min
 Hyd. volume = 528,428 cuft
 Max. Elevation = 72.29 ft
 Max. Storage = 216,634 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 25, 2011

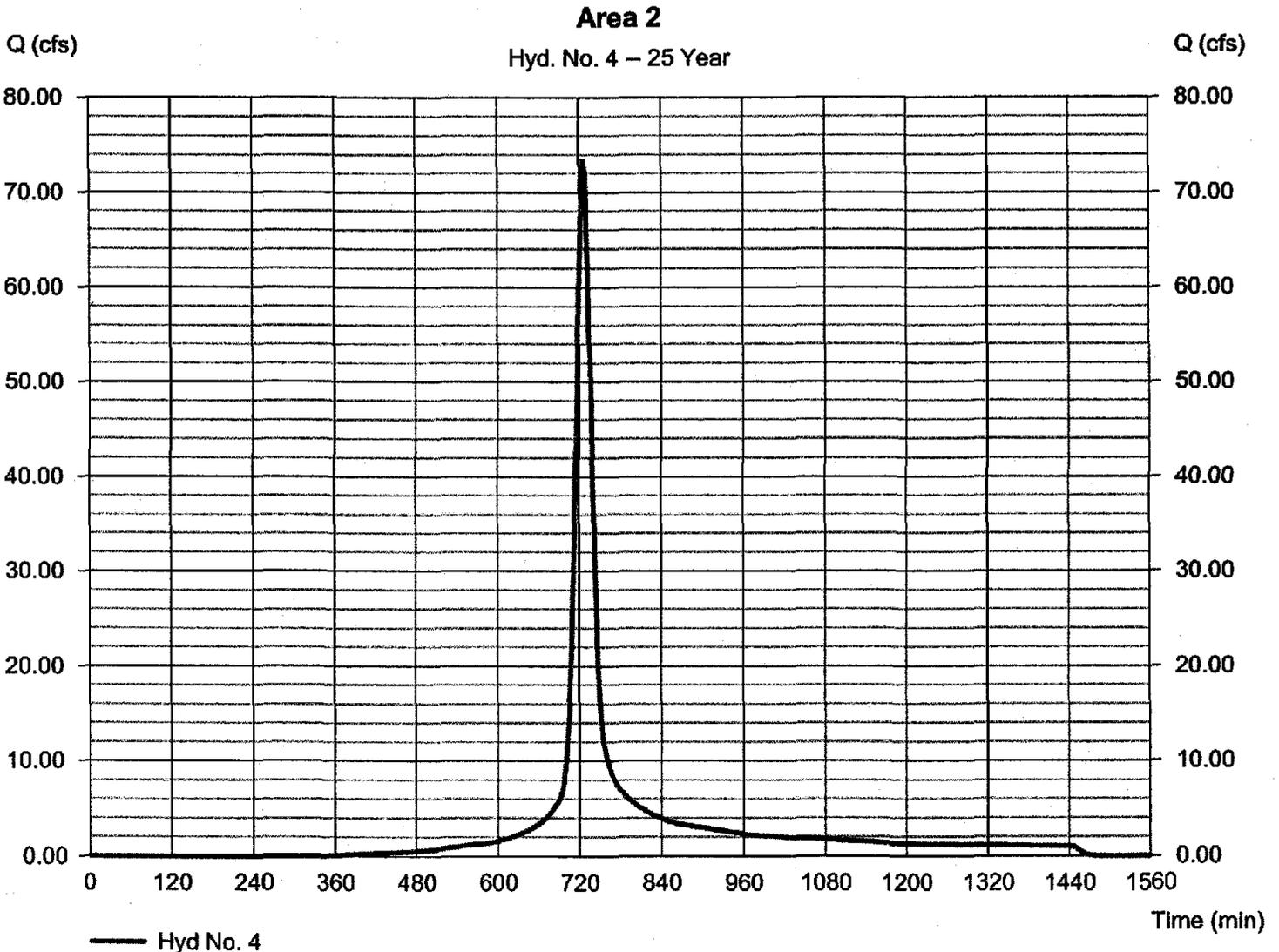
Hyd. No. 4

$$Q = C_i A = 0.82 \cdot 6.75 \cdot 14,770 = 81,75$$

Area 2

Hydrograph type = SCS Runoff
 Storm frequency = 25 yrs
 Time interval = 2 min
 Drainage area = 14,770 ac
 Basin Slope = 0.0 %
 Tc method = USER
 Total precip. = 6.75 in
 Storm duration = 24 hrs

Peak discharge = 73.34 cfs
 Time to peak = 726 min
 Hyd. volume = 255,527 cuft
 Curve number = 82
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 23.00 min
 Distribution = Type II
 Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

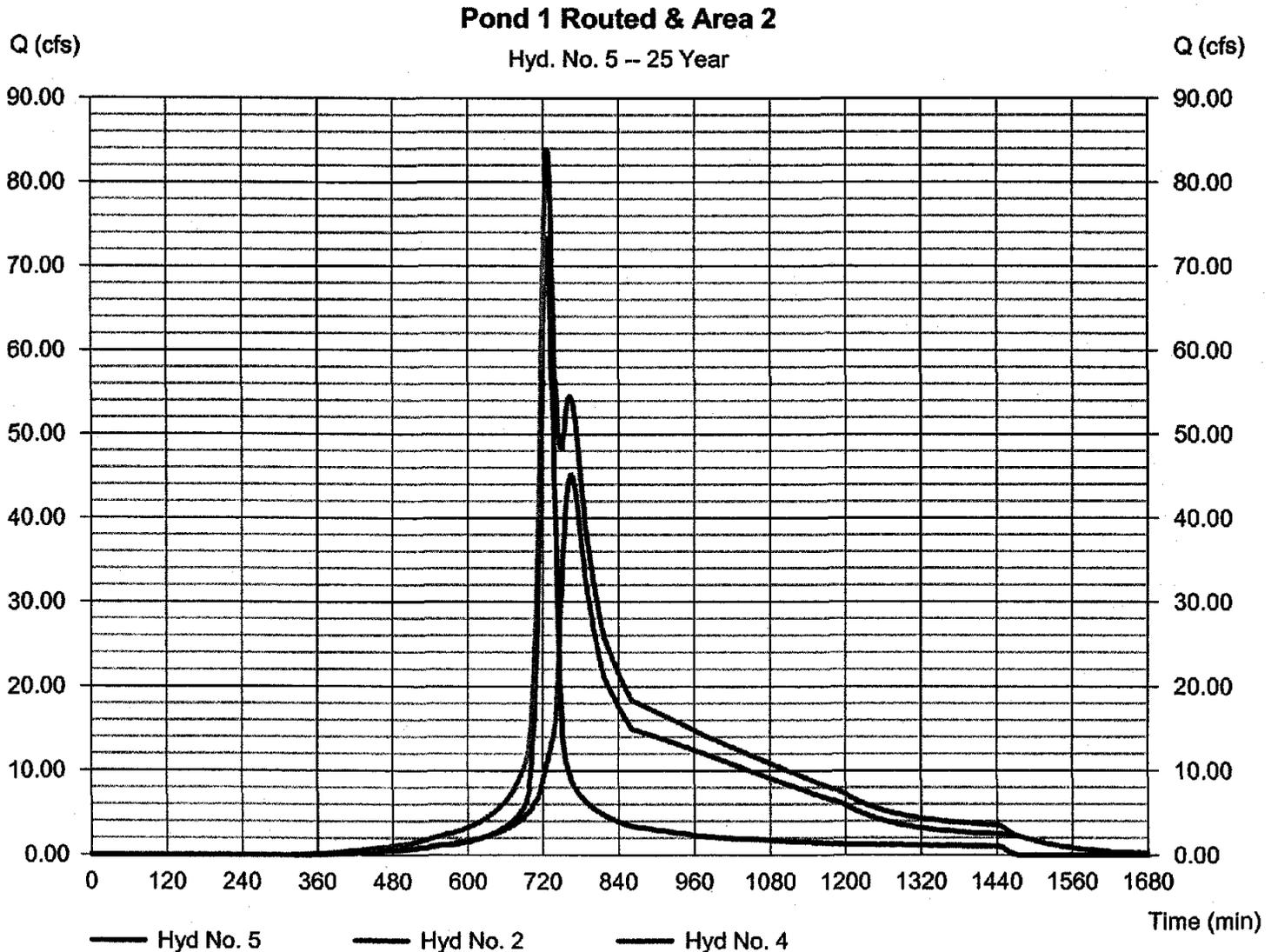
Friday, Mar 25, 2011

Hyd. No. 5

Pond 1 Routed & Area 2

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 2 min
Inflow hyds. = 2, 4

Peak discharge = 83.92 cfs
Time to peak = 726 min
Hyd. volume = 783,955 cuft
Contrib. drain. area = 14.770 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

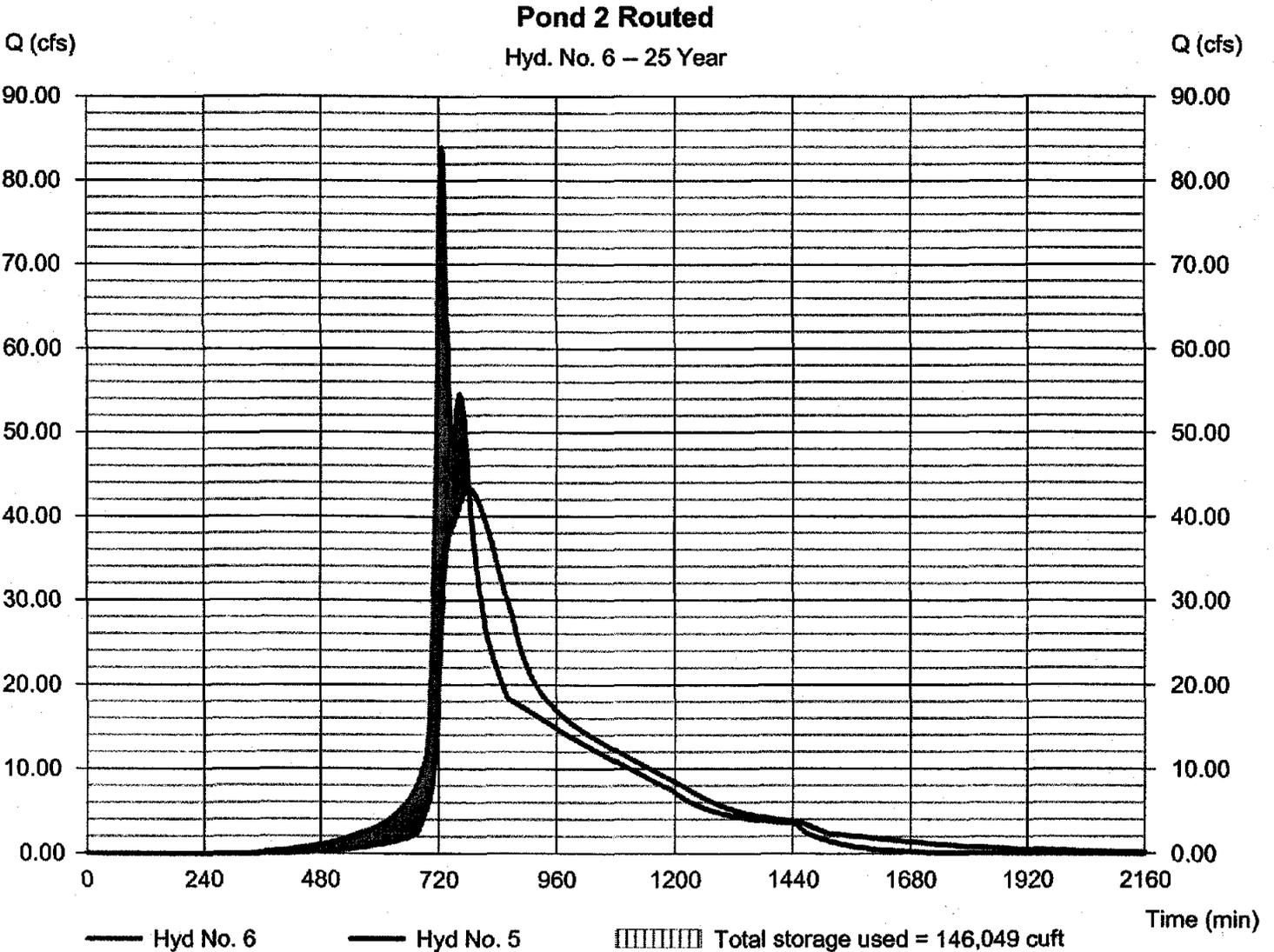
Friday, Mar 25, 2011

Hyd. No. 6

Pond 2 Routed

Hydrograph type	= Reservoir	Peak discharge	= 43.27 cfs
Storm frequency	= 25 yrs	Time to peak	= 782 min
Time interval	= 2 min	Hyd. volume	= 783,943 cuft
Inflow hyd. No.	= 5 - Pond 1 Routed & Area 2	Max. Elevation	= 60.66 ft
Reservoir name	= Pond 2	Max. Storage	= 146,049 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

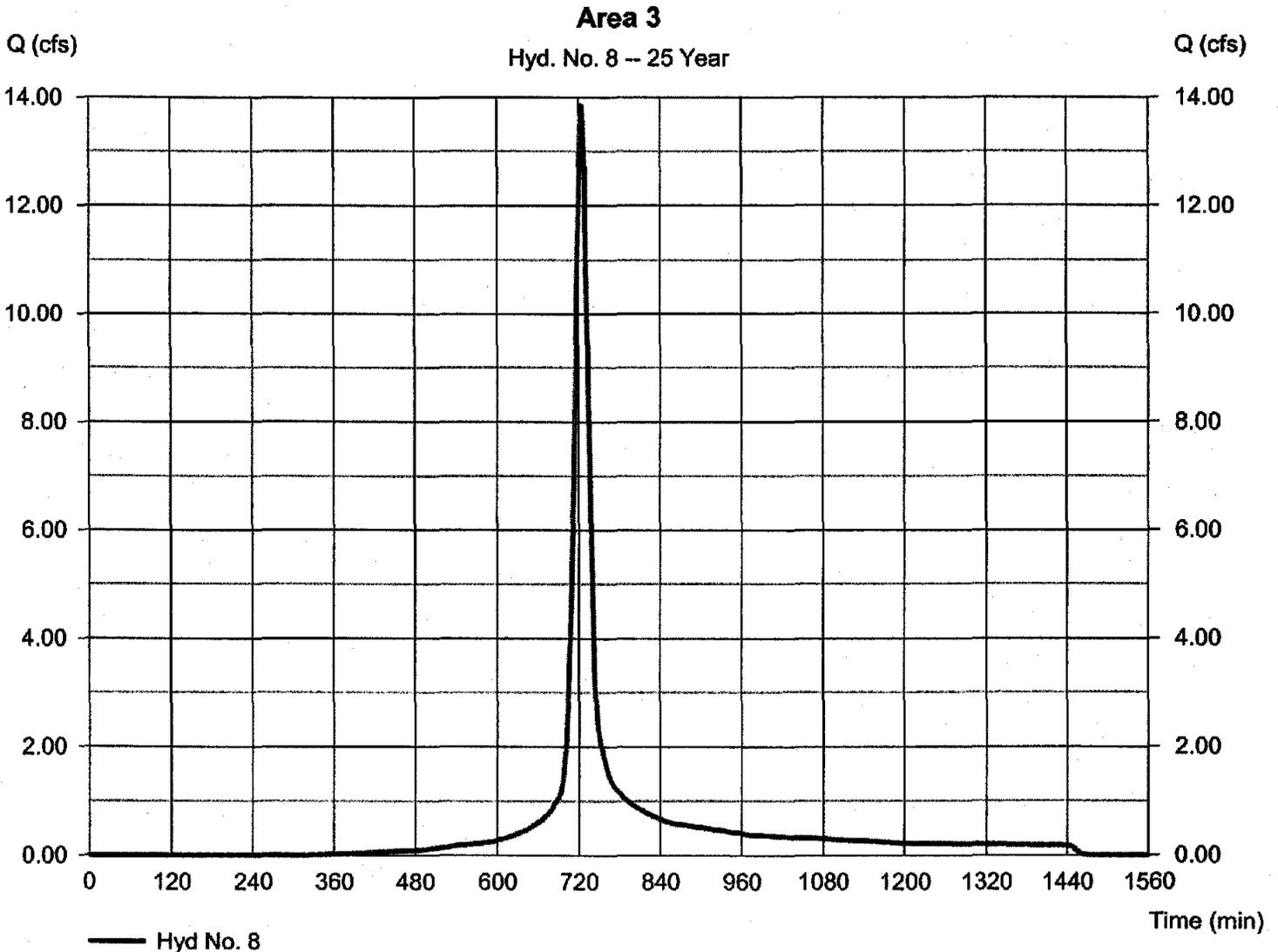
Friday, Mar 25, 2011

Hyd. No. 8

Area 3

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 2.580 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.75 in
Storm duration = 24 hrs

Peak discharge = 13.86 cfs
Time to peak = 724 min
Hyd. volume = 43,852 cuft
Curve number = 82
Hydraulic length = 0 ft
Time of conc. (Tc) = 19.00 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

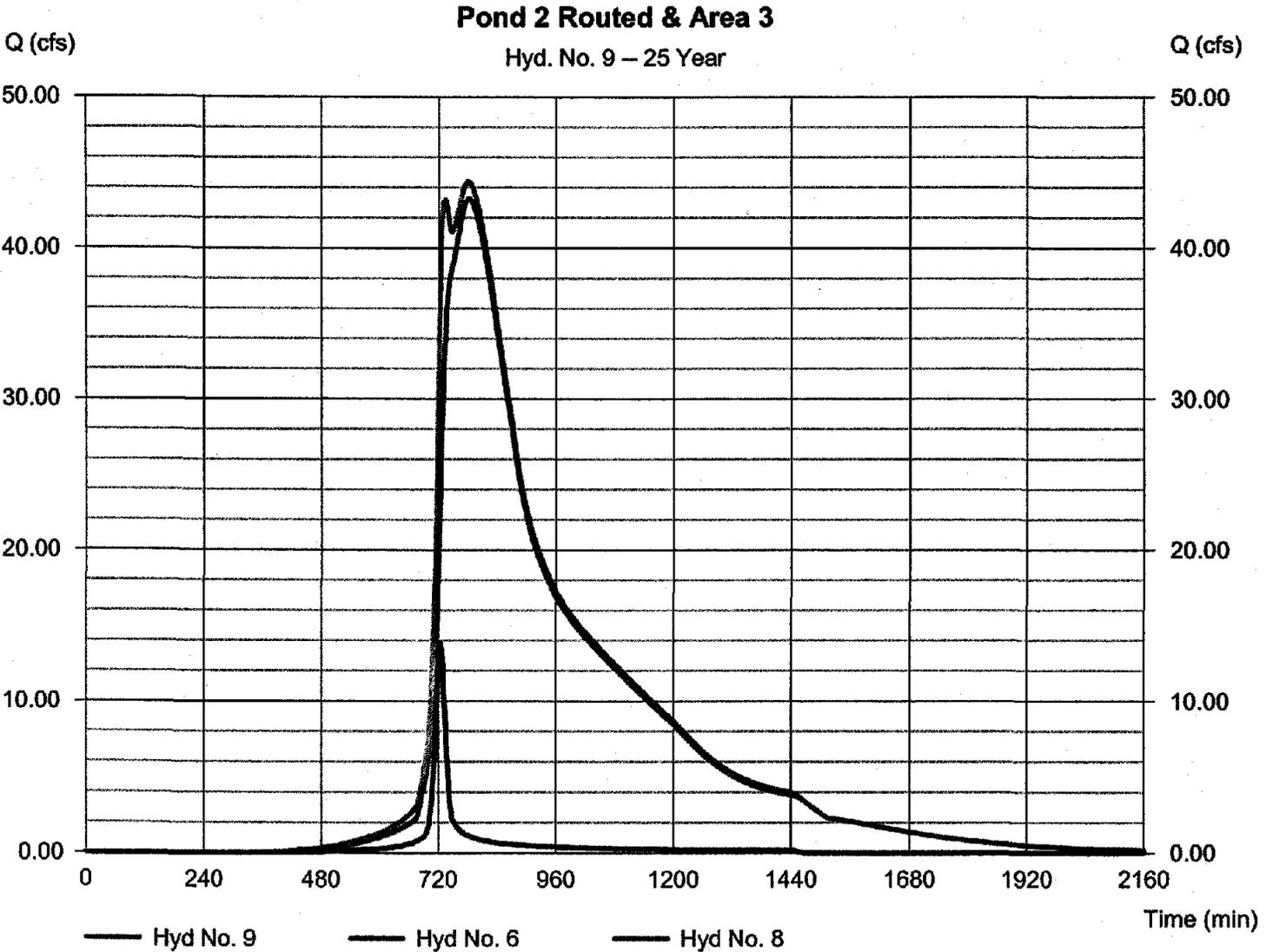
Friday, Mar 25, 2011

Hyd. No. 9

Pond 2 Routed & Area 3

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 2 min
Inflow hyds. = 6, 8

Peak discharge = 44.40 cfs
Time to peak = 780 min
Hyd. volume = 827,794 cuft
Contrib. drain. area = 2.580 ac



Hydrograph Report

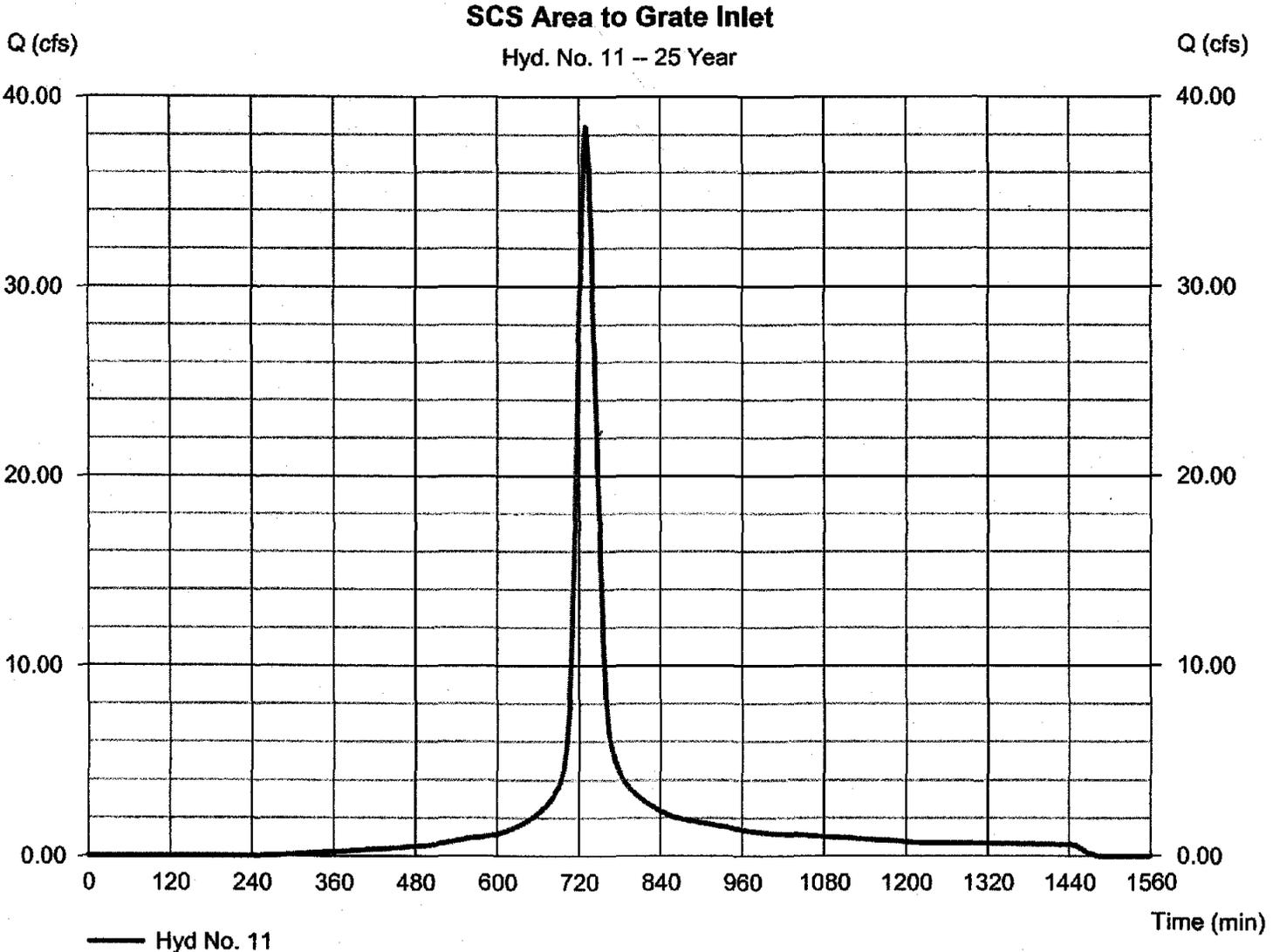
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 25, 2011

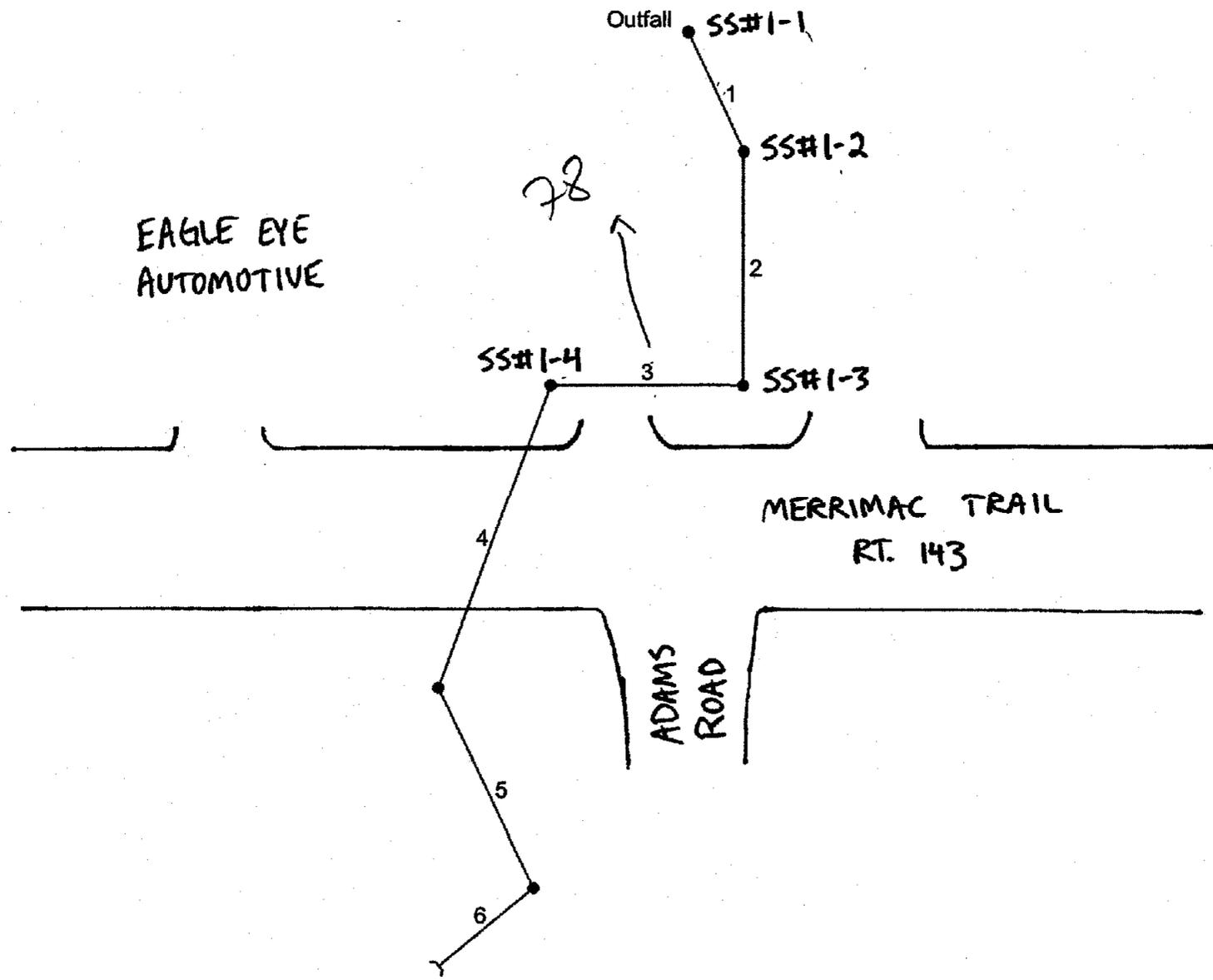
Hyd. No. 11

SCS Area to Grate Inlet

Hydrograph type	= SCS Runoff	Peak discharge	= 38.41 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 157,243 cuft
Drainage area	= 8.270 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 6.75 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2009 Plan



Storm Sewer Tabulation

Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (l) (in/hr)	Total flow (cfs)	Cap full. (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1-2	1-1	54.000	0.00	0.00	0.00	0.00	0.00	0.0	45.7	0.0	82.81	87.67	9.69	42	0.76	45.75	46.16	48.79	48.95	44.50	58.10	→ 55.0
1-3	1-2	96.000	0.00	0.00	0.00	0.00	0.00	0.0	44.9	0.0	82.81	87.43	10.06	42	0.75	46.16	46.88	48.95	49.67	58.10	0.00	→ 55.00
1-4	1-3	78.000	0.00	0.00	0.00	0.00	0.00	0.0	44.3	0.0	82.81	89.70	10.07	42	0.79	46.88	47.50	49.67	50.29	0.00	58.95	→ 59.00
4	3	132.000	0.00	0.00	0.00	0.00	0.00	30.0	43.2	0.0	82.81	13.21	26.36	24	0.34	47.50	47.95	50.29	67.99	58.95	58.56	
5	4	91.000	0.00	0.00	0.00	0.00	0.00	0.0	42.4	0.0	44.40	33.02	14.13	24	2.13	47.95	49.89	67.99	71.50	58.56	61.71	
6	5	50.000	0.00	0.00	0.00	0.00	0.00	42.0	42.0	0.0	44.40	103.1	9.05	30	6.32	49.89	53.05	71.50	72.08	61.71	53.05	→ 58.75

Project File: 9801-E-27_Storm System Design.stm

Number of lines: 6

Run Date: 03-25-2011

NOTES: Intensity = 143.72 / (Inlet time + 19.20) ^ 0.94; Return period = 10 Yrs. ; c = cir e = ellip b = box



Project: Merrimac Trail Drainage Improvements
 Project No.: 9801-E-27
 Subject: Riprap Basin
For Circular Culvert
 Date: 3/25/2011
 Calculated By: GVC

Hydraulic Design of Energy Dissipators for Culverts and Channels
 Hydraulic Engineering Circular No. 14, Third Edition
 U.S. Department of Transportation Federal Highway Administration - July 2006

Outfall Description: Storm System Outfall

Pipe Diameter (D) or (W_o) = 3.50 FT.

Flow (Q) = 82.81 CFS

Tailwater Depth (TW) = 1.20 FT.

Determine brink depth (y_o):

$$(K_u) \frac{Q}{D^{2.5}} = (1) \frac{82.81}{22.92} = 3.61$$

$$\frac{TW}{D} = \frac{1.20}{3.50} = 0.34$$

$$y_o / D = \underline{0.65} \quad \text{From Figure 3.4}$$

$$y_o = \frac{y_o}{D} \times D = 0.65 \times 3.50 = 2.28 \text{ FT.}$$

Determine culvert outlet velocity (V_o):

$$\frac{TW}{y_o} = \frac{1.20}{2.28} = 0.527$$

$$A / D^2 = \underline{0.5405} \quad \text{From Table B.2 where } y_o / D = d / D$$

$$A = A / D^2 \times D^2 = 0.5405 \times 12.25 = 6.62 \text{ SF}$$

$$V_o = Q \div A = 82.8 \div 6.62 = 12.5 \text{ FT/S}$$

Determine Froude number (Fr):

$$y_e = (A / 2)^{1/2} = 1.82 \text{ FT.}$$

$$Fr = V_o / [(32.2)(y_e)]^{1/2} = 1.63$$

Try $d_{50} / y_e = \underline{0.40}$ $d_{50} = 0.40 \times 1.82 = 0.73 \text{ FT. or } 8.7 \text{ IN.}$

Tailwater Parameter, C_o	Equation 10.2
$TW / y_e = 1.20 + 1.82 = 0.66$	
$TW / y_e < 0.75$	$C_o = 1.4$
$0.75 < TW / y_e < 1.0$	$C_o = 4.0 (TW / y_e) - 1.6$
	$= 4.0 (0.66) - 1.6 = 1.04$
$1.0 < TW / y_e$	$C_o = 2.4$

$h_s / y_e = 0.86 (d_{50} / y_e)^{-0.55} (Fr) - C_o$ Equation 10.1

$h_s / y_e = 0.86 (0.40)^{-0.55} (1.63) - \underline{1.40}$

$h_s / y_e = 0.926$

$h_s = 0.926 \times 1.82 = 1.68 \text{ FT.}$

Check

$h_s / d_{50} = 2.32 \geq 2 \text{ OK}$

$d_{50} / y_e = 0.40 \geq 0.1 \text{ OK}$

Riprap Basin Size

Length of Dissipator Pool

$L_s = 10 \times h_s = 16.8 \text{ FT.}$

or $L_s = 3 \times W_o = 10.5 \text{ FT.}$

Use Larger Value $L_s = \underline{16.8 \text{ FT.}}$

Total Length

$L_B = 15 \times h_s = 25.3 \text{ FT.}$

or $L_B = 4 \times W_o = 14.0 \text{ FT.}$

Use Larger Value $L_B = 25.3 \text{ FT.}$

Width of Apron

$W_B = W_o + 2(L_B/3) = 20.3 \text{ FT.}$

Length of Apron

$L_A = L_B - L_s = 25.3 - 16.8 = 8.4 \text{ FT.}$

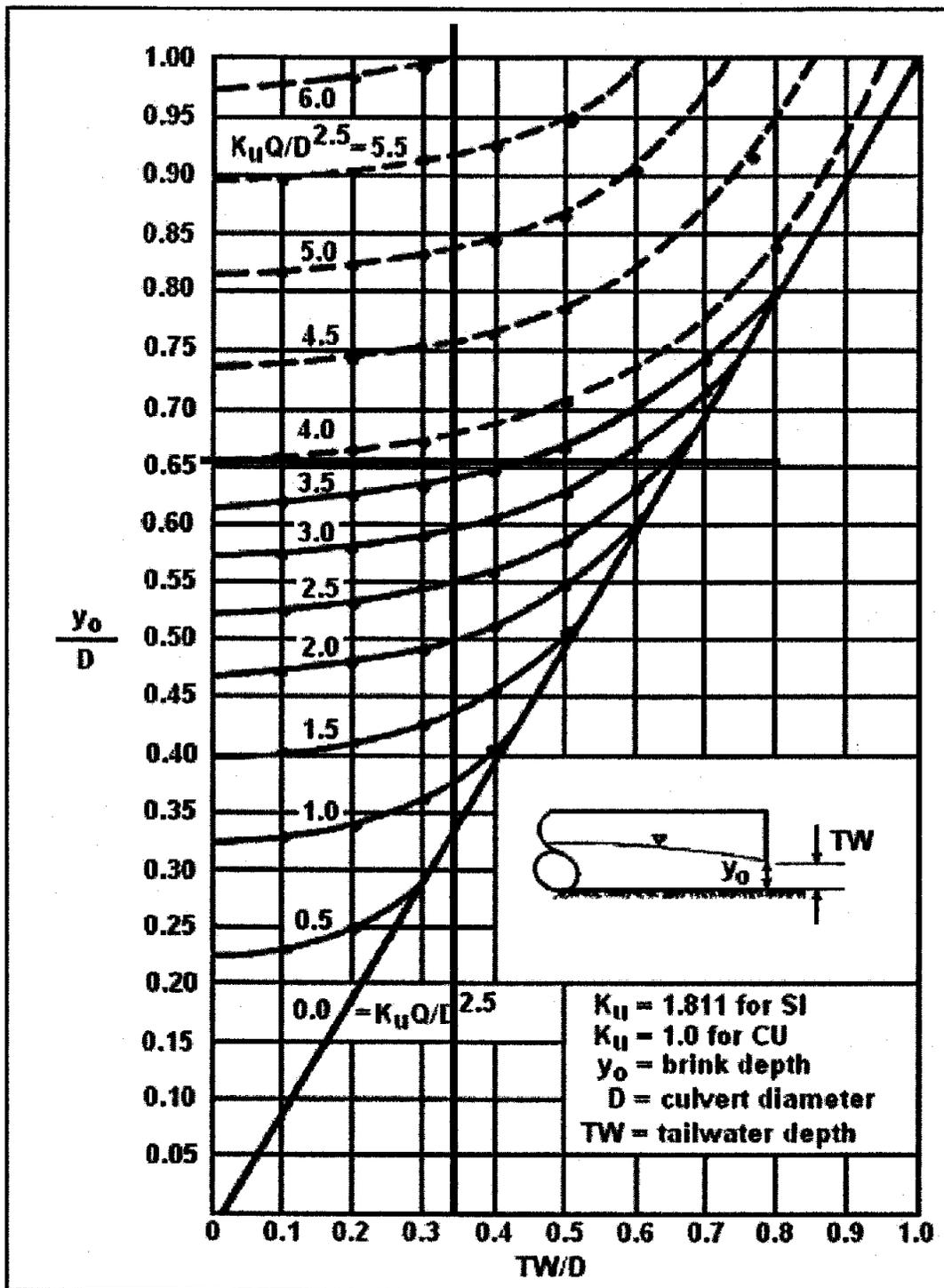


Figure 3.4. Dimensionless Rating Curves for the Outlets of Circular Culverts on Horizontal and Mild Slopes (Simons, 1970)

Table B.2. Uniform Flow in Circular Sections Flowing Partly Full

y/D	A/D ²	R/D	$\frac{(\alpha Qn)}{(D^{3/2} S^{1/2})}$	$\frac{(\alpha Qn)}{(y^{3/2} S^{1/2})}$	y/D	A/D ²	R/D	$\frac{(\alpha Qn)}{(D^{3/2} S^{1/2})}$	$\frac{(\alpha Qn)}{(y^{3/2} S^{1/2})}$
0.01	0.0013	0.0066	0.00007	15.04	0.51	0.4027	0.2531	0.239	1.442
0.02	0.0037	0.0132	0.00031	10.57	0.52	0.4127	0.2562	0.247	0.415
0.03	0.0069	0.0197	0.00074	8.56	0.53	0.4227	0.2592	0.255	1.388
0.04	0.0105	0.0262	0.00138	7.38	0.54	0.4327	0.2621	0.263	1.362
0.05	0.0147	0.0325	0.00222	6.55	0.55	0.4426	0.2649	0.271	1.336
0.06	0.0192	0.0389	0.00328	5.95	0.56	0.4526	0.2676	0.279	1.311
0.07	0.0294	0.0451	0.00455	5.47	0.57	0.4626	0.2703	0.287	1.286
0.08	0.0350	0.0513	0.00604	5.09	0.58	0.4724	0.2728	0.295	1.262
0.09	0.0378	0.0575	0.00775	4.76	0.59	0.4822	0.2753	0.303	1.238
0.10	0.0409	0.0635	0.0097	4.49	0.60	0.4920	0.2776	0.311	1.215
0.11	0.0470	0.0695	0.0118	4.25	0.61	0.5018	0.2799	0.319	1.192
0.12	0.0534	0.0755	0.0142	4.04	0.62	0.5115	0.2821	0.327	1.170
0.13	0.0600	0.0813	0.0167	3.86	0.63	0.5212	0.2842	0.335	1.148
0.14	0.0668	0.0871	0.0195	3.69	0.64	0.5308	0.2862	0.343	1.126
0.15	0.0739	0.0929	0.0225	3.54	0.65	0.5405	0.2988	0.350	1.105
0.16	0.0811	0.0985	0.0257	3.41	0.66	0.5499	0.2900	0.358	1.084
0.17	0.0885	0.1042	0.0291	3.28	0.67	0.5594	0.2917	0.366	1.064
0.18	0.0961	0.1097	0.0327	3.17	0.68	0.5687	0.2933	0.373	1.044
0.19	0.0139	0.1152	0.0365	3.06	0.69	0.5780	0.2948	0.380	1.024
0.20	0.1118	0.1208	0.0406	2.96	0.70	0.5872	0.2962	0.388	1.004
0.21	0.1199	0.1259	0.0448	2.87	0.71	0.5964	0.2975	0.395	0.985
0.22	0.1281	0.1312	0.0492	2.79	0.72	0.6054	0.2987	0.402	0.965
0.23	0.1365	0.1364	0.0537	2.71	0.73	0.6143	0.2998	0.409	0.947
0.24	0.1449	0.1416	0.0585	2.63	0.74	0.6231	0.3008	0.416	0.928
0.25	0.1535	0.1466	0.0634	2.56	0.75	0.6319	0.3042	0.422	0.910
0.26	0.1623	0.1516	0.0686	2.49	0.76	0.6405	0.3043	0.429	0.891
0.27	0.1711	0.1566	0.0739	2.42	0.77	0.6489	0.3043	0.435	0.873
0.28	0.1800	0.1614	0.0793	2.36	0.78	0.6573	0.3041	0.441	0.856
0.29	0.1890	0.1662	0.0849	2.30	0.79	0.6655	0.3039	0.447	0.838
0.30	0.1982	0.1709	0.0907	2.25	0.80	0.6736	0.3042	0.453	0.821
0.31	0.2074	0.1756	0.0966	2.20	0.81	0.6815	0.3043	0.458	0.804
0.32	0.2167	0.1802	0.1027	2.14	0.82	0.6893	0.3043	0.463	0.787
0.33	0.2260	0.1847	0.1089	2.09	0.83	0.6969	0.3041	0.468	0.770
0.34	0.2355	0.1891	0.1153	2.05	0.84	0.7043	0.3038	0.473	0.753
0.35	0.2450	0.1935	0.1218	2.00	0.85	0.7115	0.3033	0.453	0.736
0.36	0.2546	0.1978	0.1284	1.958	0.86	0.7186	0.3026	0.458	0.720
0.37	0.2642	0.2020	0.1351	1.915	0.87	0.7254	0.3018	0.485	0.703
0.38	0.2739	0.2062	0.1420	1.875	0.88	0.7320	0.3007	0.488	0.687
0.39	0.2836	0.2102	0.1490	1.835	0.89	0.7384	0.2995	0.491	0.670
0.40	0.2934	0.2142	0.1561	1.797	0.90	0.7445	0.2980	0.494	0.654
0.41	0.3032	0.2182	0.1633	1.760	0.91	0.7504	0.2963	0.496	0.637
0.42	0.3130	0.2220	0.1705	1.724	0.92	0.7560	0.2944	0.497	0.621
0.43	0.3229	0.2258	0.1779	1.689	0.93	0.7612	0.2921	0.498	0.604
0.44	0.3328	0.2295	0.1854	1.655	0.94	0.7662	0.2895	0.498	0.588
0.45	0.3428	0.2331	0.1929	1.622	0.95	0.7707	0.2865	0.498	0.571
0.46	0.3527	0.2366	0.201	1.590	0.96	0.7749	0.2829	0.496	0.553
0.47	0.3627	0.2401	0.208	1.559	0.97	0.7785	0.2787	0.494	0.535
0.48	0.3727	0.2435	0.216	1.530	0.98	0.7817	0.2735	0.489	0.517
0.49	0.3827	0.2468	0.224	1.500	0.99	0.7841	0.2666	0.483	0.496
0.50	0.3927	0.2500	0.232	1.471	1.00	0.7854	0.2500	0.463	0.463

y = depth of flow, m (ft)

D = diameter of pipe, m (ft)

A = area of flow, m² (ft²)

R = hydraulic radius, m (ft)

Source: USBR (1974)

Q = discharge by Manning's Equation, m³/s (ft³/s)

n = Manning's coefficient

S = channel bottom and water surface slope

α = units conversion = 1.49 for SI, 1 for CU

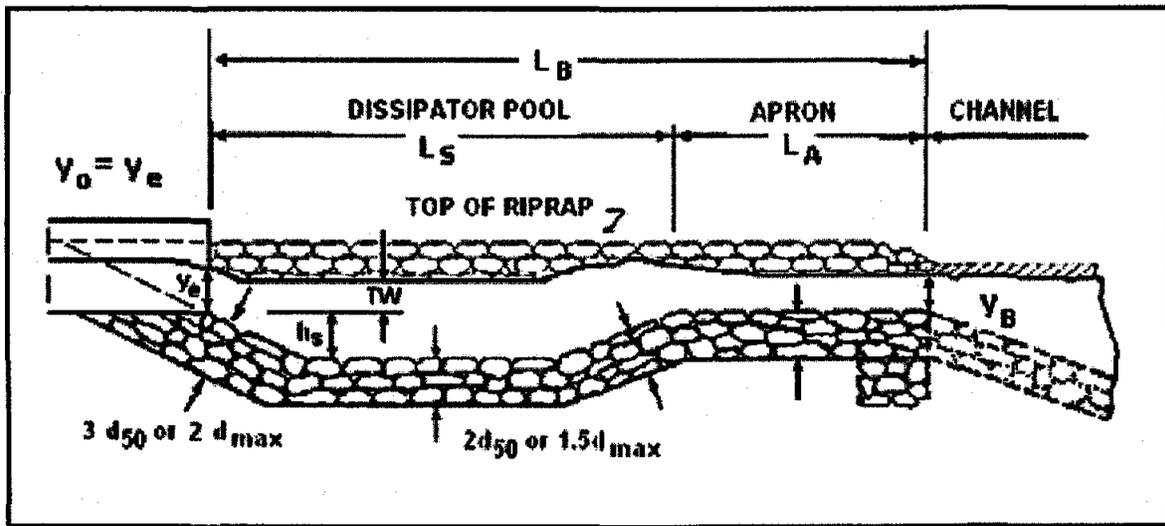


Figure 10.1. Profile of Riprap Basin

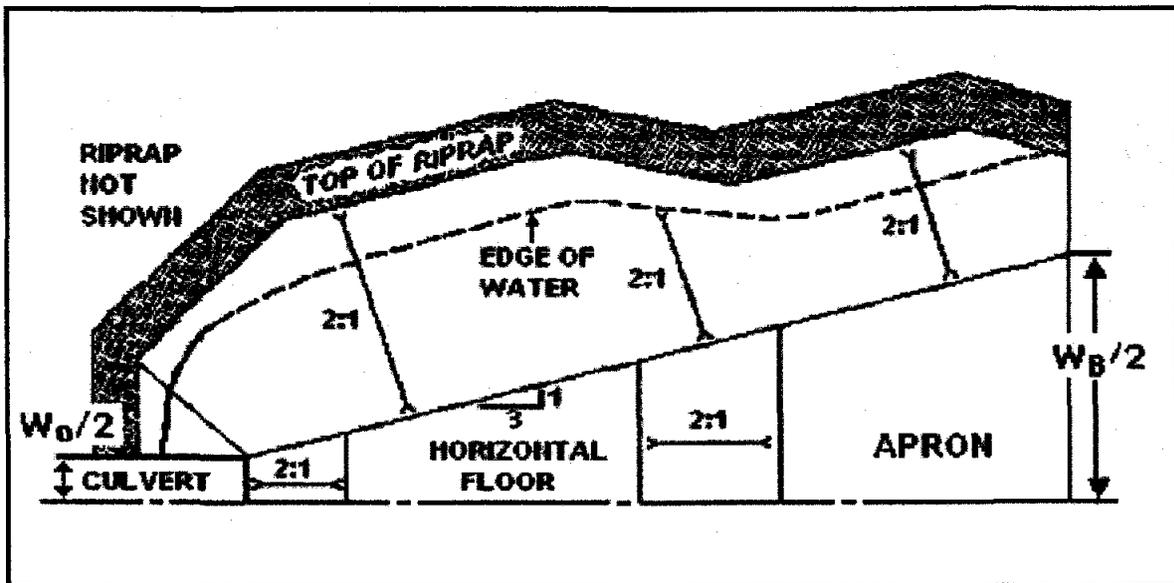


Figure 10.2. Half Plan of Riprap Basin