CERTIFICATE OF AUTHENTICITY

THIS IS TO CERTIFY THAT THE FOLLOWING ELECTRONIC RECORDS ARE TRUE AND ACCURATE REPRODUCTIONS OF THE ORIGINAL RECORDS OF JAMES CITY COUNTY GENERAL SERVICES DEPARTMENT- STORMWATER DIVISION; WERE SCANNED IN THE REGULAR COURSE OF BUSINESS PURSUANT TO GUIDELINES ESTABLISHED BY THE LIBRARY OF VIRGINIA AND ARCHIVES; AND HAVE BEEN VERIFIED IN THE CUSTODY OF THE INDIVIDUAL LISTED BELOW.

BMP NUMBER: **DC009**

DATE VERIFIED: **May 22, 2012**

QUALITY ASSURANCE TECHNICIAN: **Leah Hardenbergh**

Leah Hardenbergh

LOCATION: WILLIAMSBURG, VIRGINIA

Stormwater Division

MEMORANDUM

DATE: March 10, 2010

TO: Michael J. Gillis, Virginia Correctional Enterprises Document Management Services

FROM: Jo Anna Ripley, Stormwater

PO: 270712

RE: Files Approved for Scanning

General File ID or BMP ID: DC009

PIN: 0340100003D

Subdivision, Tract, Business or Owner Name (if known): Williamsburg Christian Retreat

Property Description: Church Retreat Center

Site Address: 9275 Barnes Road

(For internal use only) **Box** 10 **Drawer:** 6

Agreements: (in file as of scan date) **N** **Book or Doc#:** **Page:**

Comments

DC-009

Contents for Stormwater Management Facilities As-built Files

Each file is to contain:

1. As-built plan
2. Completed construction certification
3. Construction Plan
4. Design Calculations
5. Watershed Map
6. Maintenance Agreement
7. Correspondence with owners
8. Inspection Records
9. Enforcement Actions

COPY

COUNTY OF JAMES CITY, VIRGINIA

DECLARATION OF COVENANTS
INSPECTION/MAINTENANCE OF DRAINAGE SYSTEM

THIS DECLARATION, made this 29 day of SEPTEMBER, 20 08, between WILLIAMSBURG CHRISTIAN RETREAT ASSOCIATION and all successors in interest, ("COVENANTOR(S)"), owner(s) of the following property:

Parcel Identification Number: 0340100003D
Legal Description: PT RACEFIELD PARD
Project or Subdivision Name: WILLIAMSBURG CHRISTIAN RETREAT CENTER YOUTH FACILITY
Document No.
OR Deed Book 351, Page No. 704,
and the County of James City, Virginia ("COUNTY.")

WITNESSETH:

I (We), the COVENANTOR(S), with full authority to execute deeds, mortgages, other covenants, and all rights, titles and interests in the property described above, do hereby covenant with the COUNTY as follows:

1. The COVENANTOR(S) shall provide maintenance for the drainage system including any runoff control facilities, conveyance systems and associated easements, hereinafter referred to as the "SYSTEM," located on and serving the above-described property to ensure that the SYSTEM is and remains in proper working condition in accordance with approved design standards, and with the law and applicable executive regulations. The SYSTEM shall not include any elements located within any Virginia Department of Transportation rights-of-way.

2. If necessary, the COVENANTOR(S) shall levy regular or special assessments against all present or subsequent owners of property served by the SYSTEM to ensure that the SYSTEM is properly maintained.

3. The COVENANTOR(S) shall provide and maintain perpetual access from public right-of-ways to the SYSTEM for the COUNTY, its agent and its contractor.

4. The COVENANTOR(S) shall grant the COUNTY, its agent and its contractor a right of entry to the SYSTEM for the purpose of inspecting, monitoring, operating, installing, constructing, reconstructing, maintaining or repairing the SYSTEM.

5. If, after reasonable notice by the COUNTY, the COVENANTOR(S) shall fail to maintain the SYSTEM in accordance with the approved design standards and with the law and applicable executive regulations, the COUNTY may perform all necessary repair or maintenance work, and the COUNTY may assess the COVENANTOR(S) and/or all property served by the SYSTEM for the cost of the work and any applicable penalties.

Instrument # 080024520
Recorded on Oct. 3, 2008

Return to:
County Attorney's Office
James City County
101-C Mounts Bay Road
Williamsburg, VA 23185

6. The COVENANTOR(S) shall indemnify and save the COUNTY harmless from any and all claims for damages to persons or property arising from the installation, construction, maintenance, repair, operation or use of the SYSTEM.

7. The COVENANTOR(s) shall promptly notify the COUNTY when the COVENANTOR(S) legally transfers any of the COVENANTOR(S)' responsibilities for the SYSTEM. The COVENANTOR(S)' shall supply the COUNTY with a copy of any document of transfer, executed by both parties.

8. The covenants contained herein shall run with the land and shall bind the COVENANTOR(S) and the COVENANTOR(S)' heirs, executors, administrators, successors and assignees, and shall bind all present and subsequent owners of property served by the SYSTEM.

9. This COVENANT shall be recorded in the County Land Records.

IN WITNESS WHEREOF, the COVENANTOR(S) have executed this DECLARATION OF COVENANTS as of the date first above written.

COVENANTOR(S)

Robert W. Briscoe

Signature

ROBERT W. BRISCOE EXECUTIVE DIRECTOR

Print Name and Title

ACKNOWLEDGMENT

COMMONWEALTH OF VIRGINIA
CITY/COUNTY OF James City, to wit:

I hereby certify that on this 29 day of Sept, 2008, before the subscribed, a Notary Public for the Commonwealth of Virginia, personally appeared Robert W Briscoe and did acknowledge the foregoing instrument to be his/her A
ct.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 29 day of September, 2008.

[SEAL]

Melanie J. Davis

Notary Public

Notary Registration Number: 7014335

My Commission expires: 12/31/2010

COVENANTOR(S)

_____
Signature

_____
Print Name and Title

ACKNOWLEDGMENT

COMMONWEALTH OF VIRGINIA
CITY/COUNTY OF _____, to wit:

I hereby certify that on this _____ day of _____, 20____, before the subscribed, a Notary Public for the Commonwealth of Virginia, personally appeared _____ and did acknowledge the foregoing instrument to be his/her Act.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this _____ day of _____, 20____.

[SEAL]

_____
Notary Public

Notary Registration Number: _____

My Commission expires: _____

Approved as to form:

Adam Kinsman
County Attorney

This Declaration of Covenants prepared by:

Name: Robert W. Briscoe

Print Name: ROBERT W. BRISCOE

Title: EXECUTIVE DIRECTOR

Address: 9275 BARNES RD.
TOANO, VA, 23168

Phone Number: (757) 566-2256

(drainage1.pre)

NOV 07 2012

James City County, Virginia
Environmental Division

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: Williamsburg Christian Retreat Center, Youth Facility
Structure/BMP Name: Extended Dry Detention Basin, Timber Weir Wall Outlet
Project Location: 9275 Barnes Road, Toano, VA 23168
BMP Location: LAT: 37°25'27.41"N, LONG: 76°51'22.89"W
County Plan No.: SP - 0054 - 2011

Project Type: ☐ Residential ☐ Business ☐ Commercial ☐ Office ☐ Institutional ☐ Industrial ☐ Public ☐ Roadway ☑ Other NON PROFIT

Tax Map/Parcel No.: 3-4 / 1-3D
BMP ID Code (if known): NC009
Zoning District:: A-1
Land Use: Recreation (church camp)
Site Area (sf or acres): 149.8 ACRES

Brief Description of Stormwater Management/BMP Facility:

Roughly 300 LF of stormwater drainage pipe with three drop inlets routed to an extended dry detention basin with a pressure treated timber weir wall outlet structure. The drainage area for the extended dry detention basin is about 3.8 acres.

Nearest Visible Landmark to SWM/BMP Facility: Phase 1 commonc and cabins

Nearest Vertical Ground Control (if known):
☐ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☑ Arbitrary ☐ Other
Station Number or Name: Iron Rod Set
Datum or Reference Elevation: 91.59
Control Description: Set from tennis court spot elevation
Control Location from Subject Facility: Benchmark located inside road loop

Section 2 - Stormwater Management / BMP Facility Construction Information:

PreConstruction Meeting Held for Construction of SWM/BMP Facility: ☑ Yes ☐ No ☐ Unknown
Approx. Construction Start Date for SWM/BMP Facility: April 2009
Facility Monitored by County Representative during Construction: ☑ Yes ☐ No ☐ Unknown
Name of Site Work Contractor Who Constructed Facility: George Nice & Sons
Name of Professional Firm Who Routinely Monitored Construction: Engineering Consulting Services, Ltd.
Date of Completion for SWM/BMP Facility: June 2009
Date of Record Drawing/Construction Certification Submittal: August 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 Environmental 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: Williamsburg Christian Retreat Association, Inc.
Mailing Address: 9275 Barnes Road, Toano, VA 23168

Business Phone: (757) 566-2256 Fax: (757) 566-4875
Contact Person: Bob Briscoe Title: Executive Director

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: Terra Engineering and Land Solutions, PC
Mailing Address: 2374 Stuarts Draft Highway, Stuarts Draft, VA 24477

Business Phone: (540) 337-4591
Fax: (540) 337-5291
Responsible Plan Preparer: Steve Driver
Title: President
Plan Name: Williamsburg Christian Retreat Center Site Plan Amendment
Firm's Project No. 0716
Plan Date: March 19, 2012
Sheet No.'s Applicable to SWM/BMP Facility: 2.2.2 / 3.0.0 / 7.0.0 / ____ / ____

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

Name: George Nice & Sons, Inc.
Mailing Address: 129 Industrial Blvd., Toano, VA 23168

Business Phone: (757) 565-2885
Fax: (757) 565-1526
Contact Person: Ray Nice
Site Foreman/Supervisor: Bobby Nice
Specialty Subcontractors & 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: Terra Engineering and Land Solutions
Mailing Address: 2374 Stuarts Draft Highway
Stuarts Draft, VA 24477
Business Phone: (540) 337-4591
Fax: (540) 337-5291

Name: Steve Driver
Title: President
Signature:
Date: 9-6-12

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 with the provisions of the approved design plan, specifications and stormwater management plan, except as specifically noted.

Construction Certification

Firm Name: Terra Engineering and Land Solutions
Mailing Address: 2374 Stuarts Draft Highway
Stuarts Draft, VA 24477
Business Phone: (540) 337-4591
Fax: (540) 337-5291

Name: Steve Driver
Title: President
Signature:
Date: 9-6-12

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 design plan, specifications and stormwater management plan, except as specifically noted.

THE AS-BUILT DOES NOT MATCH THE ORIGINAL SITE PLAN, BUT HAS BEEN DEMONSTRATED TO WORK WITH REVISED CALCULATIONS.

COMMONWEALTH OF VIRGINIA
STEVEN L. DRIVER
NO. 019933
PROFESSIONAL ENGINEER

(Seal)
Virginia Registered Professional Engineer
or Certified Land Surveyor
9-6-12

COMMONWEALTH OF VIRGINIA
STEVEN L. DRIVER
NO. 019933
PROFESSIONAL ENGINEER

(Seal)
Virginia Registered
Professional Engineer
9-6-12

Section 5 - Record Drawing and Construction Certification Requirements and Instructions:

☑ PreConstruction Meeting - Provides an opportunity to review SWM / BMP facility construction, maintenance and operation plans and address any questions regarding construction and/or monitoring of the structure. The design engineer, certifying professionals (if different), Owner/Applicant, Contractor and County representative(s) are encouraged to attend the preconstruction meeting. Advanced notice to the Environmental Division is requested. Usually, this requirement can be met simultaneously with Erosion and Sediment Control preconstruction meetings held for the project.

☑ A fully completed ***STORMWATER MANAGEMENT / BMP FACILITIES, RECORD DRAWING and CONSTRUCTION CERTIFICATION FORM*** and ***RECORD DRAWING CHECKLIST***. All applicable sections shall be completed in their entirety and certification statements signed and sealed by the registered professional responsible for individual record drawing and/or construction certification.

☑ The Record Drawing shall be prepared by a Registered Professional Engineer or Certified Land Surveyor for the drainage system of the project including any Best Management Practices.

☑ Construction Certification. Construction of Stormwater Management / BMP facilities which contain impoundments, embankments and related engineered appurtenances including subgrade preparation, compacted soils, structural fills, liners, geosynthetics, filters, seepage controls, cutoffs, toe drains, hydraulic flow control structures, etc. shall be visually observed and monitored by a Registered Professional Engineer or his/her authorized representative. The Engineer must certify that the structure, embankment and associated appurtenances were built in accordance with the approved design plan, specifications and stormwater management plan and standard accepted construction practice and shall submit a written certification and/or drawings to the Environmental Division as required. Soil and compaction test reports, concrete test reports, inspection reports, logs and other required construction material or installation documentation may be required by the Environmental Division to substantiate the certification, if specifically requested. The Engineer shall have the authority and responsibility to make minor changes to the approved plan, in coordination with the assigned County inspector, in order to compensate for unsafe or unusual conditions encountered during construction such as those related to bedrock, soils, groundwater, topography, etc. as long as changes do not adversely affect the integrity of the structure(s). Major changes to the approved design plan or structure must be reviewed and approved by the original design professional and the James City County Environmental Division.

☑ Record Drawing and Construction Certifications are required within **thirty (30) days** of the completion of Stormwater Management / BMP facility construction. Submittals must be reviewed and accepted by James City County Environmental Division prior to final inspection, acceptance and bond/surety release.

Dual Purpose Facilities - Completion of construction also includes an interim stage for Stormwater Management / BMP facilities which serve dual purpose as temporary sediment basins during construction and as permanent stormwater management / BMP facilities following construction, once development and stabilization are substantially complete. For these dual purpose facilities, construction certification is required once the temporary sediment basin phase of construction is complete. Final record drawing and construction certification of additional permanent components is required once permanent facility construction is complete.

Interim Construction Certification is required for those dual purpose embankment-type facilities that are generally ten (10) feet or greater in dam height (*) and may not be converted, modified or begin function as a permanent SWM / BMP structure for a period generally ranging from six (6) to eighteen (18) months or more from issuance of a Land Disturbance permit for construction.

Interim or final record drawing and construction certifications are not required for temporary sediment basins which are designed and constructed in accordance with current minimum standards and specifications for temporary sediment basins per the Virginia Erosion and Sediment Control Handbook (VESCH); have a temporary service life of less than eighteen (18) months; and will be removed completely once associated disturbed areas are stabilized, unless a distinct hazard to the public's health, safety and welfare is determined by the Environmental Division due to the size or presence of the structure or due to evidence of improper construction.

(*Note: Dam Height as referenced above is generally defined as the vertical distance from the natural bed of the stream or waterway at the downstream toe of the embankment to the top of the embankment structure in accordance with 4VAC50-20-30, Virginia Impoundment Structure Regulations and the Virginia Dam Safety Program.)

☑ Record Drawings shall provide, at a minimum, all information as shown within these requirements and the attached **RECORD DRAWING CHECKLIST** specific to the type of SWM/BMP facility being constructed. Other additional record data may be formally requested by the James City County Environmental Division. *(Note: Refer to the current edition of the James City County Guidelines for Design and Construction of Stormwater Management BMP's manual for a complete list of acceptable BMP's. Currently there are over 20 acceptable water quality type BMP's accepted by the County.)*

☑ Record Drawings shall consist of blue/black line prints and a reproducible (mylar, sepia, diazo, etc.) set of the approved stormwater management plan including applicable plan views, profiles, sections, details, maintenance plans, etc. as related to the subject SWM / BMP facility. The set shall indicate **"RECORD DRAWING "** in large text in the lower right hand corner of each sheet with record elevations, dimensions and data drawn in a clearly annotated format and/or boxed beside design values. Approved design plan values, dimensions and data shall not be removed or erased. Drawing sheet revision blocks shall be modified as required to indicate record drawing status. Elevations to the nearest 0.1' are sufficiently accurate except where higher accuracy is needed to show positive drainage. Certification statements as shown in Section 4 of the Record Drawing and Construction Certification Form, ***or similar forms thereof***, and professional signatures and seals, with dates matching that of the record drawing status in the revision or title block, are also required on all associated record drawing plans, prints or reproducibles.

☑ Submission Requirements. Initial and subsequent submissions for review shall consist of a minimum of one (1) blue/black line set for record drawings and one copy of the construction certification documents with appropriate transmittal. Under certain circumstances, it is understood that the record drawing and construction certification submissions may be performed by different professional firms. Therefore, record drawing submission may be in advance of construction certification or vice versa. Upon approval and prior to release of bond/surety, final submission shall include one (1) reproducible set of the record drawings, one (1) blue/black line set of the record drawings and one (1) copy of the construction certification. Also for current and/or future incorporation into the County BMP database and GIS system, it is requested that the record drawings also be submitted to the Environmental Division on a diskette or CD-ROM in an acceptable electronic file format such as *.dxf, *.dwg, etc. or in a standard scanned and readable format. The electronic file requirement can be discussed and coordinated with Environmental Division staff at the time of final submission.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

I. Methods and Presentation: *(Required for all Stormwater Management / BMP facilities.)*

XX 1. All constructed facilities meet approved design plans, unless otherwise shown. Record information or deviations from approved design plan shown in clearly annotated format and/or boxed beside design values.

XX 2. Elevations to the nearest 0.1' unless higher accuracy is needed to show positive drainage.

XX 3. All plan sheets labeled with "RECORD DRAWING" in large text in lower right hand corner (Approved County Plan Number and BMP ID Code can be included if known).

XX 4. All plan sheet revision blocks modified to indicate date and record drawing status.

XX 5. All plan sheets have certification statements and certifying professional's signature and seal.

II. Minimum Standards: *(Required for all Stormwater Management / BMP facilities, as applicable.)*

XX 1. All requirements of Section I (Methods and Presentation) apply to this section.

XX 2. Plan Views: Show general location, arrangement and dimensions. Location and alignment shall generally match approved design plans.

N/A 3. Profile or elevations along top or berm of the facility. At a minimum, elevations are required at each end, at intervals not to exceed 50 feet and where low spots may be present. Top of embankment or berm elevations must be no less than design elevation plus any settlement allowances.

N/A 4. Top widths, berm widths and embankment side slopes.

XX 5. Show length, width and depth of facility or grading, contours or spot elevations as required to verify permanent pool and design storage volumes were met or were reasonably close to the approved design. Evaluation of as-built grading, contours, spot elevations, or cross-sections, may be necessary by the professional to ensure approved design configurations, depths and volumes were closely maintained. If grading or elevations are significantly different from the approved plan, the Environmental Division shall be contacted immediately to determine whether the variation is acceptable or whether further evidence will be required. Facilities which do not closely resemble approved plan grades, elevations or configurations may require regrading by the Contractor; check volumetric computations; and/or a check hydraulic routing to ensure approved design water surface elevations, discharges or freeboard were closely maintained.

XX 6. Cross-section of the embankment through the principal spillway or outlet barrel. Must extend at least 100 ft. downstream of the pipe outlet or to recorded site property line, whichever is closer. Proper correlation is required between principal spillway (control structure) crest, emergency spillway crest, orifice and weirs and the top of the dam or facility. All elevations and dimensions must reasonably match the design plan or be sequentially relative to each other and the facility must reflect the required design storage volume(s) and/or design depth.

XX 7. Profile or elevations along the entire centerline of the emergency spillway. Emergency spillway may be steeper, but no flatter or narrower than design.

XX 8. Elevation of the principal spillway crest or outlet crest of the structure.

N/A 9. Primary control structure (riser) diameter or dimensions, height, type of material and base size. Indicate provisions for access that are present such as steps, ladders, etc.

XX 10. Dimensions, locations and elevations of outlet orifices, weirs, slots and drains.

N/A 11. Type and size of anti-vortex and trash rack device. Height, diameter, dimensions, bar spacings (if applicable) and elevations relative to the principal spillway crest. Indicate if lockable hatch is present or not.

XX 12. Type, location, size and number of anti-seep collars or documentation of other methods utilized for seepage control. **May need to obtain this information during construction.**

N/A 13. Top of impervious core embankment, core trench limits and elevation of cut-off trench bottom. **May need to obtain this information during construction.**

N/A 14. Elevation of the principal spillway barrel (outlet pipe) inlet and outlet invert.

N/A 15. Outlet barrel diameter, length, slope, type and thickness class of material and type of flared end sections, headwall or endwall.

XX 16. Outfall protection dimension, type and depth of rock and if underlain filter fabric is present.

XX 17. BMP interior and periphery landscaping zones conform with arrangements and requirements of the approved design plan.

XX 18. Maintenance plan taken from approved design plan transposed onto record drawing set.

N/A 19. Fencing location and type, if applicable to facility.

XX 20. BMP vicinity properly cleaned of stockpiles and construction debris.

XX 21. No visual signs of erosion or channel degradation immediately downstream of facility.

N/A 22. Any other information formally requested by the Environmental Division specific to the constructed SWM/BMP facility.

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

III. Group A - Wet Ponds *(Includes A-1 Small Wet Ponds; A-2 Wet Ponds; A-3 Wet Ext Det Ponds.)*

_____ A1. All requirements of Section II, Minimum Standards, apply to Group A facilities.

_____ A2. Principal spillway consists of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

_____ A3. Sediment forebays or pretreatment devices provided at inlets to pond. Generally 4 to 6 ft. deep.

_____ A4. Access for maintenance and equipment is provided to the forebay(s). Access corridors are at least 12 ft. wide, have a maximum slope of 15 percent and are adequately stabilized to withstand heavy equipment or vehicle use.

_____ A5. Adequate fixed vertical sediment depth markers installed in the forebay(s) for future sediment monitoring purposes.

_____ A6. Pond liner (if required) provided. Either clay liners, polyliners, bentonite liners or use of chemical soil additives based on requirements of the approved plan.

_____ A7. Minimum 6 percent slope safety bench extending a minimum of 15 feet outward from normal pool edge and/or an aquatic bench extending a minimum of 10 feet inward from the normal shoreline with a maximum depth of 12 inches below the normal pool elevation, if applicable, per the approved design plans. (Note: Safety benches may be waived if pond side slopes are no steeper than 4H:1V).

_____ A8. No trees are present within a zone 15 feet around the embankment toe and 25 feet from the principal spillway structure.

_____ A9. Wet permanent pool, typically 3 to 6 feet deep, is provided and maintains level within facility.

_____ A10. Low flow orifice has a non-clogging mechanism.

_____ A11. A pond drain pipe with valve was provided.

_____ A12. Pond side slopes are not steeper than 3H:1V, unless approved plan allowed for steeper slope.

_____ A13. End walls above barrels (outlet pipe) greater than 48 inch in diameter are fenced to prevent a fall hazard.

THIS SHEET
N/A

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

IV. Group B - Wetlands *(Includes B-1 Shallow Marsh; B-2 Ext Det Shallow Wetlands; B-3 Pond Wetland System and B-4 Pocket Wetland)*

_____ B1. Same requirements as Group A Wet Ponds.

_____ B2. Minimum 2:1 length to width flow path provided across the facility.

_____ B3. Micropool provided at or around outlet from BMP (generally 3 to 6 ft. deep).

_____ B4. Wetland type landscaping provided in accordance with approved plan. Includes correct pondscaping zones, plant species, planting arrangements, wetland beds, etc. Wetland plants include 5 to 7 emergent wetland species. Individual plants at 18 inches on center in clumps.

_____ B5. Adequate wetland buffer provided (Typically 25 ft. outward from maximum design water surface elevation and 15 ft. setback to structures).

_____ B6. No more than one-half (½) of the wetland surface area is planted.

_____ B7. Topsoil or wetland mulch provided to support vigorous growth of wetland plants.

_____ B8. Planting zones staked or flagged in field and locations subsequently established by appropriate field surveying methods for record drawing presentation.

THIS SHEET
N/A

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

V. Group C - Infiltration Practices

(Includes C-1 Infiltration Trench; C-2 Infiltration Trench; C-3 Infiltration Basin; and C-4 Infiltration Basin)

_____ C1. All requirements of Section II, Minimum Standards, apply to Group C facilities as applicable.

_____ C2. Facility is not located on fill slopes or on natural ground in excess of six (6) percent.

_____ C3. Pretreatment devices provided prior to entry into the infiltration facility. Acceptable pretreatment devices include sediment forebays, sediment basins, sediment traps, sump pits or inlets, grass channels, plunge pools or other acceptable measures.

_____ C4. Three (3) or more of the following pretreatment devices provided to protect long term integrity of structure: grass channel; grass filter strip; bottom sand layer; upper filter fabric layer; use of washed bank run gravel aggregate.

_____ C5. Sides of infiltration practice lined with filter fabric.

_____ C6. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

_____ C7. Stabilization and acceptable vegetative cover established over contributing drainage area prior to conveyance of stormwater to the facility.

_____ C8. Minimum one hundred (100) foot separation horizontally from any known water supply well and minimum one hundred (100) foot separation upslope from any building.

_____ C9. Minimum twenty-five (25) foot separation down gradient from any structure.

_____ C10. Stormwater outfalls provided for overflow associated with larger design storms.

_____ C11. No visual signs of erosion or channel degradation immediately downstream of facility.

_____ C12. Facility does not currently cause any apparent surface or subsurface water problems to downgrade properties.

_____ C13. Observation well provided.

_____ C14. Adequate, direct access provided to the facility for future maintenance, operation and inspection.

THIS SHEET
N/A

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

VI. Group D - Filtering Systems *(Includes D-1 Bioretention Cells; D-2 Surface Sand Filters; D-3 Underground Sand Filters; D-4 Perimeter Sand Filters; D-5 Organic Filters; and D-6 Pocket Sand Filters)*

_____ D1. All requirements of Section II, Minimum Standards, apply to Group D facilities.

_____ D2. Sediment pretreatment devices provided.

_____ D3. For D-1 BMPs (Bioretention Cells), pretreatment consisting of a grass filter strip below level spreader (deflector); a gravel diaphragm; and mulch and planting soil layers were provided.

_____ D4. For D-1 BMPs (Bioretention Cells), plantings consist of native plant species; vegetation provided was based on zones of hydric tolerances; trees and understory of shrubs and herbaceous materials were provided; woody vegetation is absent from inflow locations; and trees are located around facility perimeter.

_____ D5. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

_____ D6. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed .

_____ D7. Filtering system is off-line from storm drainage conveyance system.

_____ D8. Overflow outlet has adequate erosion protection.

_____ D9. Deflector, diversion, flow splitter or regulator structure provided to divert the water quality volume to the filtering structure.

_____ D10. Minimum four (4) inch perforated underdrain provided in a clean aggregate envelope layer beneath the facility.

_____ D11. Minimum fifty (50) foot separation from any slope fifteen (15) percent or greater. Minimum one hundred (100) foot separation horizontally from any known water supply well. Minimum one hundred (100) foot separation upslope and twenty-five (25) foot separation downslope from any building.

_____ D12. Stabilization and acceptable vegetative cover established over contributing drainage area prior to conveyance of stormwater to the facility.

_____ D13. No visual signs of erosion or channel degradation immediately downstream of facility.

_____ D14. Adequate, direct access provided to the pretreatment area and/or filter bed for future maintenance.

THIS SHEET

N/A

STORMWATER MANAGEMENT / BMP FACILITIES
AS-BUILT PLAN CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

VII. Group E - Open Channel Systems *(Includes E-1 Wet Swales (Check Dams); E-2 Dry Swales;and E-3 Biofilters)*

XX E1. All requirements of Section II, Minimum Standards, apply to Group E facilities as applicable.

XX E2. Open channel system has constructed longitudinal slope of less than four (4) percent.

XX E3. No visual signs of erosion in the open channel system's soil and/or vegetative cover.

XX E4. Open channel side slopes are no steeper than 2H:1V at any location. Preferred channel sideslope is 3H:1V or flatter.

XX E5. No visual signs of ponding are present at any location in the open channel system, except at rock check dam locations for E-1 systems (Wet Swales).

N/A E6. For E-2 BMPs (Dry Swales), an underdrain system was provided.

N/A E7. Treated timber or rock check dams provided as pretreatment devices for the open channel system.

N/A E8. Gravel diaphragm provided in areas where lateral sheet flow from impervious surfaces are directly connected to the open channel system.

XX E9. Grass cover/stabilization in the open channel system appears adaptable to the specific soils and hydric conditions for the site and along the channel system.

XX E10. Open channel system areas with grass covers higher than four (4) to six (6) inches were properly mowed.

XX E11. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

XX E12. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

N/A E13. For E-3 BMPs (Biofilters), the bottom width is six (6) feet maximum at any location.

N/A E14. For E-3 BMPs (Biofilters), sideslopes are 3H:1V maximum at any location.

N/A E15. For E-3 BMPs (Biofilters), the constructed channel slope is less than or equal to three (3) percent at any location.

N/A E16. For E-3 BMPs (Biofilters), the constructed grass channel is approximately equivalent to the constructed roadway length.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

VIII. Group F - Extended Dry Detention *(Includes F-1 Timber Walls; and F-2 Dry Extended Detention with Forebay)*

XX F1. All requirements of Section II, Minimum Standards, apply to Group F facilities.

XX F2. Basin bottom has positive slope and drainage from all basin inflow points to the riser (or outflow) location.

XX F3. Timber wall BMP used in intermittent stream only. (ie. Prohibited in perennial streams.)

XX F4. Forebay provided approximately 20 ft. upstream of the facility. Forebays generally 4 to 6 feet in depth.

XX F5. A reverse slope pipe, vertical stand pipe or mini-barrel and riser was provided to prevent clogging.

N/A F6. Principal spillway and outlet barrel provided consisting of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

N/A F7. Mini-barrel and riser, if used, contains a removable trash rack to reduce clogging.

XX F8. Low flow orifice, if used, has a minimum diameter of three (3) inches or two (2) inches if internal orifice control was utilized and a small, cage type external trash rack.

XX F9. Timbers properly reinforced or concrete footing provided if soil conditions were prohibitive.

XX F10. Timber wall cross members extended to a minimum depth of two (2) feet below ground elevation.

XX F11. Protection against erosion and scour from the low flow orifice and weir-flow trajectory provided.

XX F12. Stilling basin or standard outlet protection provided at principal spillway outlet.

XX F13. Adequate, direct access provided to the facility. Access corridor to facility is at least ten (10) feet wide, slope is less than twenty (20) percent and appropriate stabilization provided for equipment and vehicle use. Access extends to forebay, standpipe and timber wall, as applicable.

XX F14. No visual signs of undercutting of timber walls or clogging of the low orifice were present.

XX F15. No visual signs of erosion or channel degradation immediately downstream of facility.

XX F16. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

IX. Group G - Open Spaces *(Includes All Open Space Types G-1; G-2; and G-3)*

_____ G1. All requirements of Section II, Minimum Standards, apply to Group G facilities as applicable.

_____ G2. Constructed impervious areas appear to conform with locations indicated on the approved plan and appear less than sixty (60) percent impervious in accordance with the requirements of the James City County Chesapeake Bay Preservation Ordinance.

_____ G3. Dedicated open space areas are in undisturbed common areas, conservation easements or are protected by other enforceable instruments that ensures perpetual protection.

_____ G4. Provisions included to clearly specify how the natural vegetated areas utilized as dedicated open space will be managed and field identified (marked).

_____ G5. Adequate protection measures were implemented during construction to protect the defined dedicated open space areas.

_____ G6. Dedicated open space areas were not disturbed during construction (ie. cleared, grubbed or graded).

THIS SHEET
N/A

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

X. Storm Drainage Systems (Associated with BMP's Only)

(Includes all incidental stormwater drainage conveyance systems associated with SWM/BMP facilities such as onsite or offsite storm drains, open channels, inlets, manholes, junctions, outlet protections, deflectors, etc. These facilities are external to the treatment function of, but are directly associated with drainage to and/or from a constructed SWM/BMP facility. The intent of this portion of the certification is to accurately identify the type and quantity of inflow or outflow points associated with the facility for future reference. The Professional may use his/her own discretion to determine inclusive facilities to meet the intent of this section. As a general rule, storm drainage systems would include incidental facilities to the nearest access structure upslope or downslope from the normal physical limits of the facility or 800 feet of storm drainage conveyance system length, whichever is less.)

XX SD1. All requirements of Section II, Minimum Standards, apply to Storm Drainage Systems.

XX SD2. Horizontal location of all pipe and structures relative to the SWM/BMP facility.

XX SD3. Type, top elevation and invert elevation of all access type structures (inlets, manholes, etc.).

XX SD4. Material type, size or diameter, class, invert elevations, lengths and slopes for all pipe segments.

XX SD5. Class, length, width and depth of riprap and outlet protections or dimensions of special energy dissipation structures.

XII. Other Systems

N/A

(Includes any non-typical, specialty, manufactured or innovative stormwater management/BMP practices or systems generally accepted for use as or in conjunction with other acceptable stormwater management / BMP practices. Requires evidence of prior satisfactory industry use and prior Environmental Division approval, waiver or exception .)

____ O1. All requirements of Section II, Minimum Standards, apply to this section.

____ O2. Certification criteria to be determined on a case-by-case basis by the Environmental Division specific to the proposed SWM/BMP facility.

XIII. References

(The James City County Record Drawing and Construction Certification Forms and Checklists for Stormwater Management / BMP facilities were developed using the following sources and references.)

- ❒ Baltimore County, Maryland Soil Conservation District, As-Built Stormwater Management Pond Checklist.
- ❒ James City County, Virginia, Guidelines for Design and Construction of Stormwater Management BMP's (October 1999).
- ❒ James City County, Virginia, Stormwater Detention/Retention Basin Design Checklist and Erosion and Sediment Control and Stormwater Management Design Plan Checklists.
- ❒ James City County Stormwater Policy Framework, Final Report of the James City County BMP Policy Project, October 1998, The Center for Watershed Protection.
- ❒ Prince Georges County, Maryland, As-Built Requirements Retention or Detention Pond/Basin.
- ❒ Prince William County, Virginia, Stormwater Management Fact Sheet.
- ❒ Stafford County, Virginia, As-Built Plan Checklist.
- ❒ Stormwater Management Design Manual, NRCS Maryland Code No. 378, Pond Standards and Specifications.
- ❒ USEPA/Watershed Management Institute, Stormwater Management Inspection Forms.
- ❒ Virginia Impounding Structure Regulations (Dam Safety), Department of Conservation & Recreation, 1997.
- ❒ Virginia Erosion and Sediment Control Handbook, Third Edition 1992, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation.
- ❒ Virginia Stormwater Management Handbook, 1999 edition, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation.

File: Shared\SWMProg\BMP\Certif\RDCC_fillable.wpd

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

Project Name: WILLIAMSBURG CHRISTIAN RETREAT CENTER
County Plan No.: SP-12-069
Stormwater Management Facility: DRY POND
BMP Phase #: ☐ I ☐ II ☑ III
☑ Information Package Received. Date/By:
☑ Completeness Check:
- ☑ Record Drawing Date/By: 9/6/12 - S. DRIVER
- ☑ Construction Certification Date/By: 9/6/12 - S. DRIVER
- ☑ RD/CC Standard Forms (Required for all BMPs after Feb 1st 2001Only)
- ☑ Insp/Maint Agreement # / Date: 0800024520 - 10/3/08
- ☑ BMP Maintenance Plan Location: AS BUILT DRAWINGS
- ☐ Other:

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

☑ Assign **County BMP ID Code #**: Code: DC009
☑ 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: 8/1/12 BEM / MPM
☑ Record Drawing (RD) Review Date: 8/1/12 BEM
☑ Construction Certification (CC) Review Date: 8/1/12 BEM
☑ Actions:
- ☐ No comments.
- ☑ Comments. Letter Forwarded. Date: 8/2/12
- ☑ Record Drawing (RD) N/A
- ☑ Construction Certification (CC) N/A
- ☑ Construction-Related (CR)
- ☐ Site Issues (SI)
- ☐ Other :

☑ Second Submission: N/A
☑ Reinspection (if necessary): 1/29/13
☑ 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.

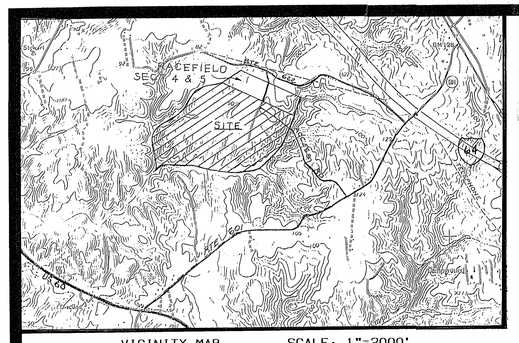
Final Sign-Off

Inspector: MPM Date: 1/29/13

Chief Engineer: Date:

*** See separate checklist, if needed.

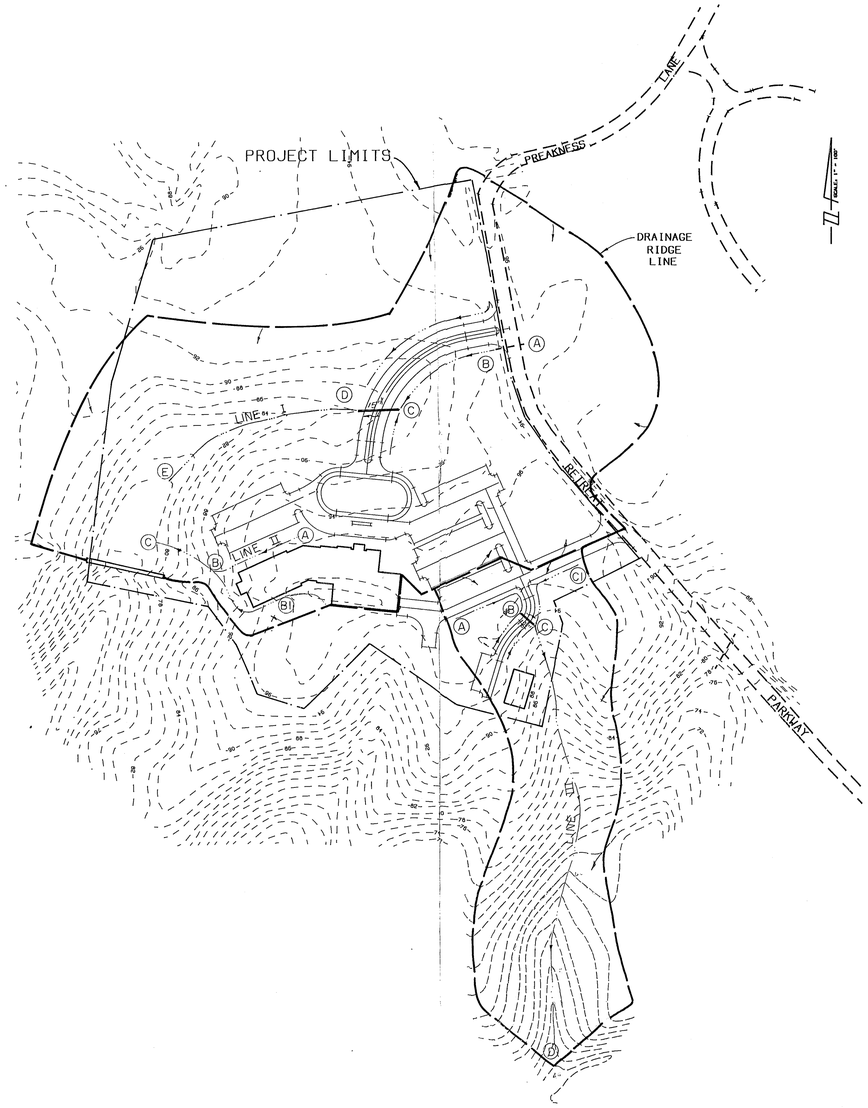
AF 52482A



VICINITY MAP SCALE: 1"=2000'

WILLIAMSBURG CHRISTIAN RETREAT CENTER

JAMES CITY COUNTY, VIRGINIA



SHEET INDEX

1. COVER SHEET
2. SITE PLAN
3. LANDSCAPE PLAN
4. DETAILS
5. EROSION AND SEDIMENT CONTROL DETAILS AND NOTES

NOTES

1. ALL UTILITIES TO BE UNDERGROUND.
2. ALL ROADS AND UTILITIES TO BE MAINTAINED BY OWNER.
3. STREET/PARKING LIGHTING IS NOT TO EXCEED 30 FT. IN HEIGHT.
4. ALL CLEARING AND GRUBBING IN DRAINFIELD AREAS IS TO BE DONE UNDER THE SUPERVISION OF THE SEPTIC SYSTEM ENGINEERS. SUITABLE SOIL CONDITIONS MUST BE MAINTAINED.
5. WASTEWATER TREATMENT AND WATER SYSTEM DESIGN BY:
   RICKMOND ENGINEERING, INC.
   1643-C MERRIMAC TRAIL
   WILLIAMSBURG, VIRGINIA 23185
   (804) 229-1776

LAND USE SUMMARY

1. ZONING OF SITE: A-1
2. TAX MAP: (3-4) PARCEL: (1-3D)
3. AREA TABULATIONS:
   PROJECT AREA = 392,040 SQ.FT. - 9.0 AC. - 100%
   BUILDING AREA = 15,539 SQ.FT. - 0.36 AC. - 4%
   OPEN AREA = 321,727 SQ.FT. - 7.39 AC. - 82%
   PAVED & GRAVEL AREA = 54,538 SQ.FT. - 1.25 AC. - 14%
4. MAXIMUM BUILDING HEIGHT: 24 FT.
5. BUILDING CONSTRUCTION: MASONRY
6. PARKING PROVIDED:
   (85) - 9½' X 18' STANDARD SPACES
   (4) - 8½' X 18' W/(2) 5' RAMPS HANDICAP SPACES
   89 - TOTAL
7. PARKING REQUIRED:
   (24) RENTAL UNITS (MAIN LODGE) @ (1) SPACE/UNIT = 24
   (87) PERSON CAPACITY MEETING ROOMS @ (1) SPACE/(5) PERSONS = 18
   (125) PERSON CAPACITY BANQUET ROOM @ (1) SPACE/(5) PERSONS = 32
   (6) RENTAL UNITS (CABINS) @ (1) SPACE/UNIT = 6
   TOTAL = 80

OWNER/DEVELOPER:

WILLIAMSBURG CHRISTIAN RETREAT CTR. ASSOC., INC.
9275 BARNES ROAD
TOANO, VIRGINIA 23168

PROPERTY ADDRESS:

9275 BARNES ROAD
TOANO, VIRGINIA 23168

COUNTY OF JAMES CITY
SITE PLAN

		DATE
Re:		
Appr:		
Fire Dr:	GSW/RPA	11/10/90
Health:	JHS/RPA	8/14/90
Highw:	FWH/RPA	8/10/90
Plan:	[illegible]	10/10/90
Pub.:	DBC/RPA	8/9/90
Zonin:	[illegible]	10/10/90
JCCA:	ATG/RPA	10/10/90
Other		
Other		

RECEIVED OCT 1990 PLANNING DEPARTMENT

SP-42-90

REVISIONS

No.	Date	Description

All construction or land development activities shall be subject to the requirements of the Chesapeake Bay Preservation Area Designation and Management Regulations (VR-173-02-01) and any local ordinances adopted pursuant thereto. These regulations and ordinances may place additional requirements on lots recorded after September 30, 1989, and may limit development of lots. Owners should familiarize themselves with the regulations and ordinances and are encouraged to contact the James City County Director of Code Compliance for more information.

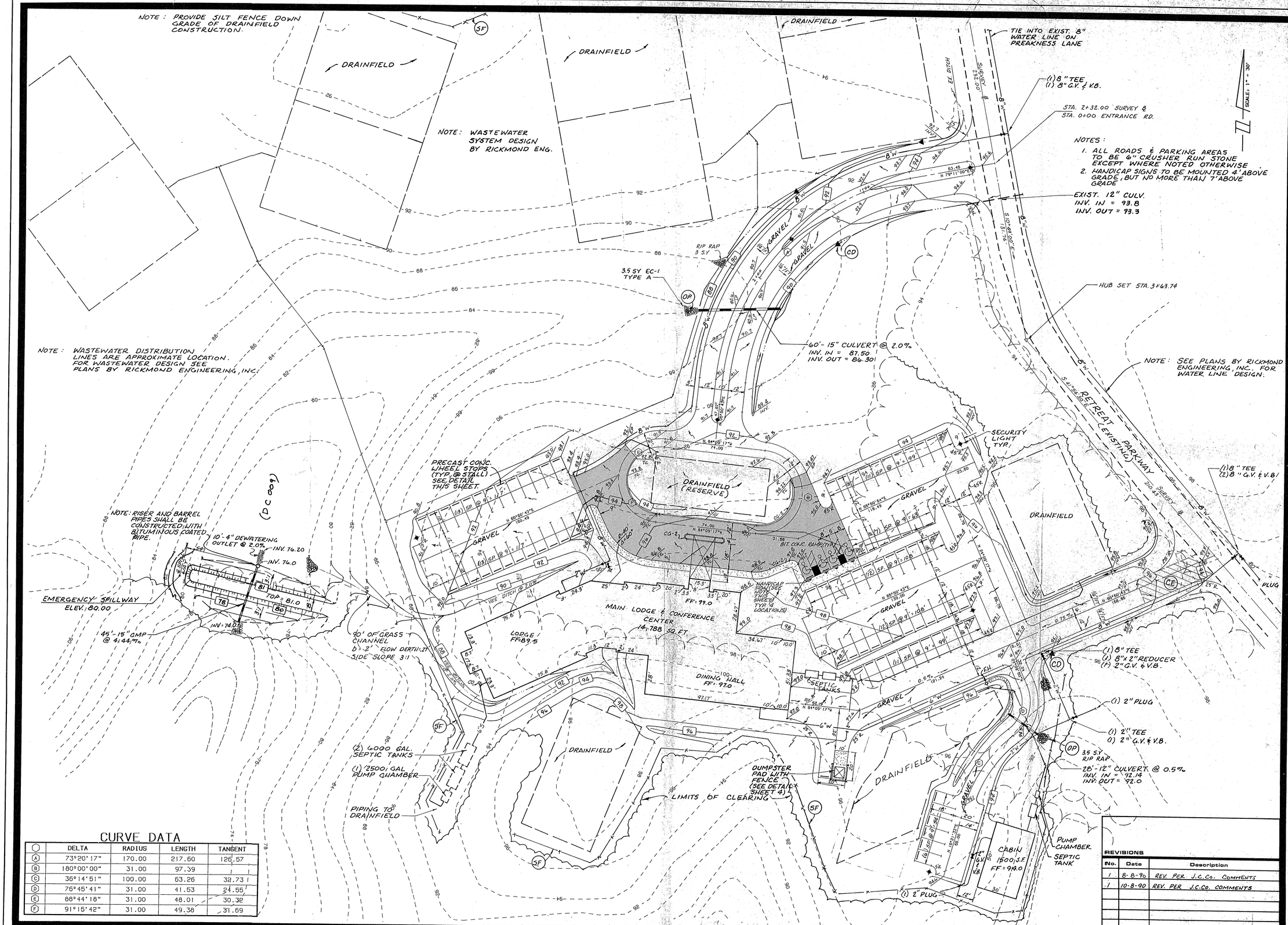
ENGINEERS · ARCHITECTS · SURVEYORS
INTERIOR DESIGNERS · PLANNERS
P.O. BOX 197 WILLIAMSBURG, VIRGINIA 23187 (804) 253-0673 (804) 874-5015

WILLIAMSBURG CHRISTIAN RETREAT CENTER
MAIN LODGE & CONFERENCE CENTER
STONEHOUSE DISTRICT JAMES CITY COUNTY, VIRGINIA

SCALE 1" = 100'
DESIGNED TCS
DRAWN TCS
CHECKED LMP
DATE 5-2-90
COMMISSION NO. 1900050
SHEET 1 OF 5

DC 009

AF 52482A



CURVE DATA

	DELTA	RADIUS	LENGTH	TANGENT
A	73°20'17"	170.00	217.60	126.57
B	180°00'00"	31.00	97.39	
C	36°14'51"	100.00	63.26	32.73
D	76°45'41"	31.00	41.53	24.55
E	88°44'18"	31.00	48.01	30.32
F	91°15'42"	31.00	49.38	31.69

REVISIONS

No.	Date	Description
1	8-8-90	REV. PER J.C.Co. COMMENTS
1	10-8-90	REV. PER J.C.Co. COMMENTS

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INTERIOR DESIGNERS · PLANNERS
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SITE PLAN

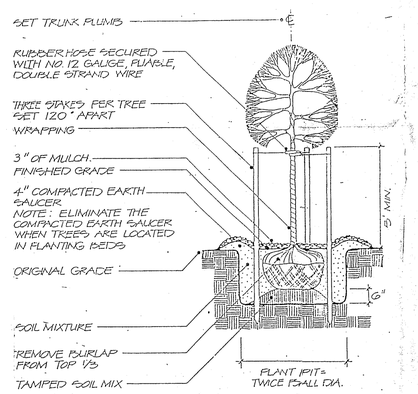
WILLIAMSBURG CHRISTIAN RETREAT CENTER
MAIN LODGE & CONFERENCE CENTER
STONEHOUSE DISTRICT JAMES CITY COUNTY, VIRGINIA

SCALE 1" = 30'
DESIGNED TCS
DRAWN TCS
CHECKED LMP
DATE 5-2-90
COMMISSION NO. 1900050
SHEET 2 OF 5

AF 52482A

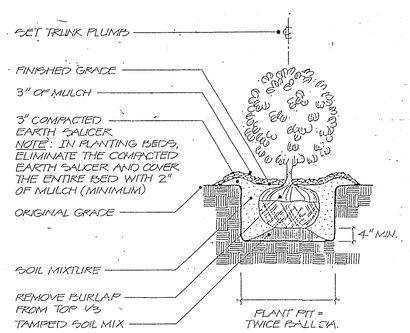
PLANT SCHEDULE

ABBR.	QUANTITY	SCIENTIFIC NAME	COMMON NAME	SIZE
SHRUBS:				
A	14	BERBERIS THUNBERGI 'ATROPURPUREA'	REDLEAVED JAPANESE BARBERRY	15" - 18" CONT. OR B&B
B	10	ILEX GLABRA	INKBERRY	18" - 24" CONT. OR B&B
C	16	ILEX GLABRA COMPACTA	DWARF INKBERRY	15" - 18" CONT. OR B&B
D	8	MYRICA PENSYLVANICA	NORTHERN BAYBERRY	3 - 4 FEET CONT. OR B&B
TREES:				
E	12	LAGERSTROEMIA INDICA 'REGAL RED'	REGAL RED CRAPE MYRTLE	5-6 FEET B&B MULTI-STEM
F	3	QUERCUS ALBA	WHITE OAK	1 1/2 - 2" CAL. B&B
G	6	QUERCUS DARLINGTONIA	DARLINGTON OAK	1 1/2 - 2" CAL. B&B



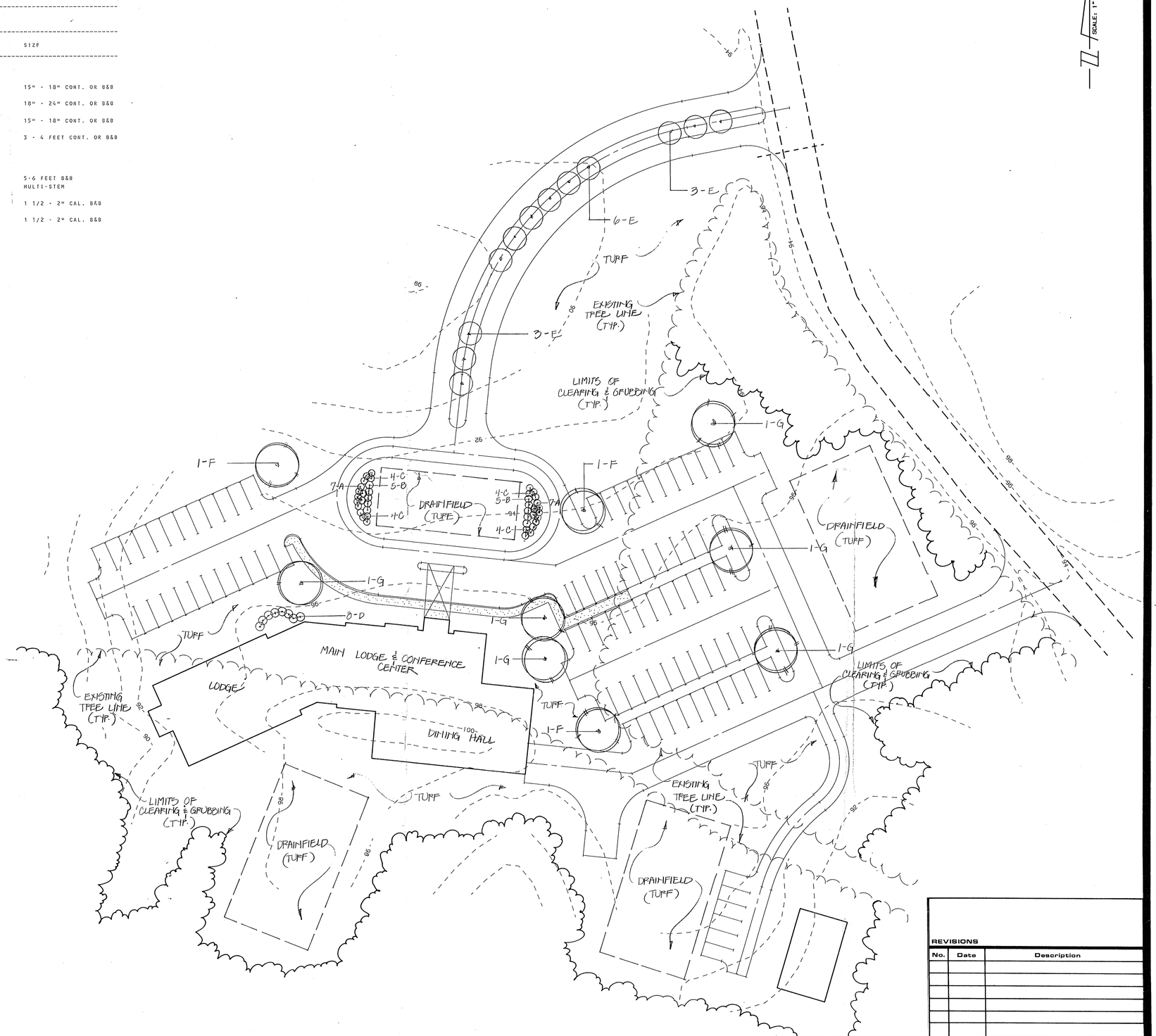
TREE PLANTING DETAIL

NTS



SHRUB PLANTING DETAIL

NTS



REVISIONS

No.	Date	Description

ENGINEERS · ARCHITECTS · SURVEYORS
INTERIOR DESIGNERS · PLANNERS

P.O. BOX 197 WILLIAMSBURG, VIRGINIA 23187 (804) 253-0673 (804) 874-5015

LANDSCAPE PLAN

WILLIAMSBURG CHRISTIAN RETREAT CENTER

MAIN LODGE & CONFERENCE CENTER

STONEHOUSE DISTRICT JAMES CITY COUNTY, VIRGINIA

SCALE 1" = 30'

DESIGNED M.E.H

DRAWN M.E.H.

CHECKED L.M.P.

DATE 5-2-90

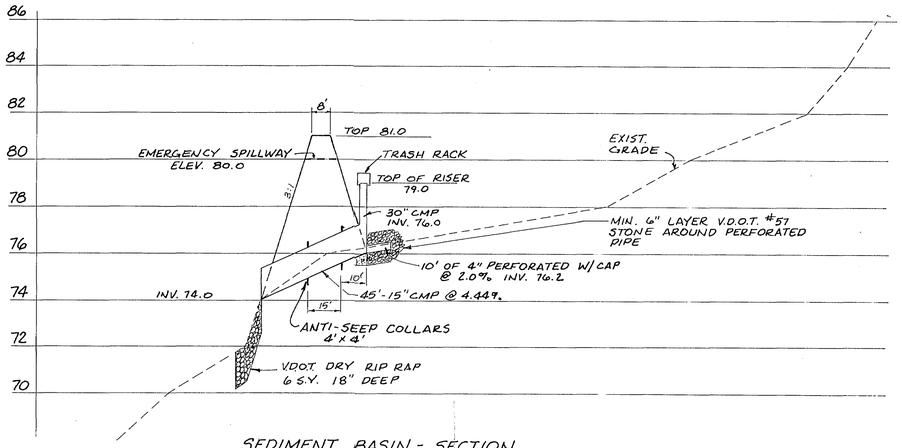
1900050
COMMISSION NO.

SHEET

3 OF 5

DC009_WILLIAMSBURG_CHRISTIAN_RETREAT - 006

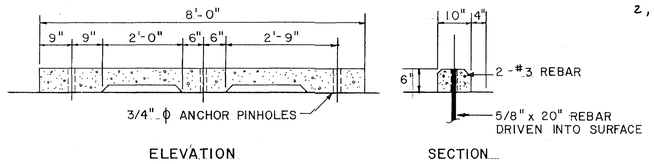
AF 52482A



SEDIMENT BASIN - SECTION

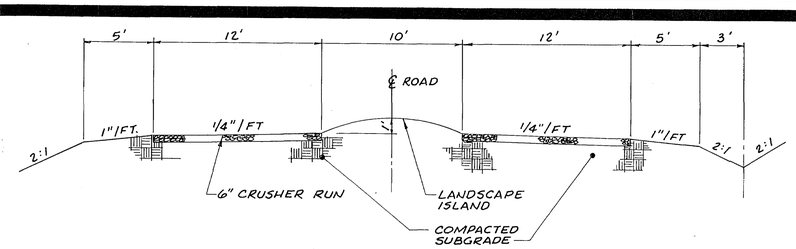
SCALE : 1" = 30' HORIZ.
1" = 3' VERT.

NOTE: EMBANKMENT & SPILLWAY CONSTRUCTION DETAILS & SPECIFICATIONS TO BE IN ACCORDANCE WITH THE 1980 VIRGINIA EROSION & SEDIMENT CONTROL HANDBOOK CHAPTER 2, SPEC. 1.26.



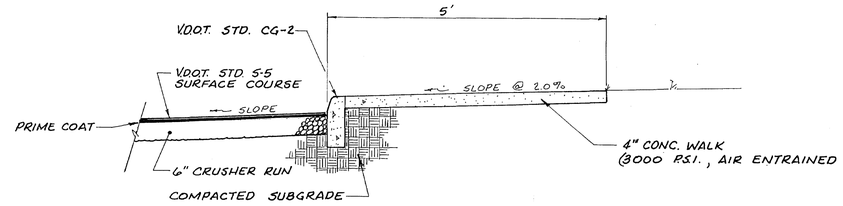
PRECAST CONCRETE WHEELSTOPS

N.T.S.



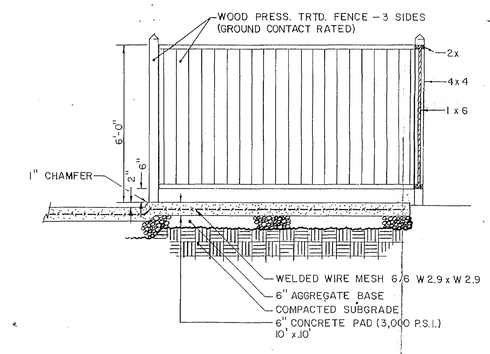
ENTRANCE ROAD SECTION

SCALE : 1" = 5'



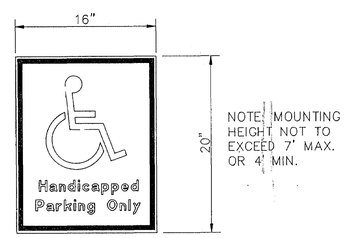
SIDEWALK & PAVEMENT SECTION

SCALE : 1" = 2'



DUMPSTER PAD / FENCE DETAIL

NOT TO SCALE



HANDICAPPED SIGN DETAIL

REVISIONS

No.	Date	Description

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INTERIOR DESIGNERS · PLANNERS
P.O. BOX 197 WILLIAMSBURG, VIRGINIA 23187 (804) 253-0673 (804) 874-5015

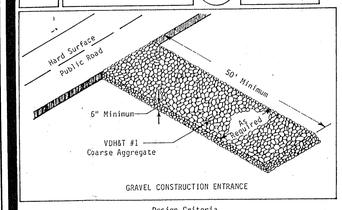
DETAILS

WILLIAMSBURG CHRISTIAN RETREAT CENTER
MAIN LODGE & CONFERENCE CENTER
STONEHOUSE DISTRICT JAMES CITY COUNTY, VIRGINIA

SCALE AS SHOWN
DESIGNED L.M.P.
DRAWN T.C.S.
CHECKED L.M.P.
DATE 5-2-90
1900050
COMMISSION NO.
SHEET
4 OF 5

DC009_WILLIAMSBURG_CHRISTIAN_RETREAT - 007

1.01 TEMPORARY GRAVEL CONSTRUCTION ENTRANCE (CE)



GRAVEL CONSTRUCTION ENTRANCE

Design Criteria

Aggregate Size

VDH&T aggregate No.1 (2-3-inch stone) should be used.

Entrance Dimensions

The aggregate layer must be at least 6 inches thick. It must extend the full width of the vehicular ingress and egress area. The length of the entrance must be at least 50 feet. (See Plate 1.01a).

Washing

If conditions on the site are such that the majority of the mud is not removed by the vehicles traveling over the gravel, then the tires of the vehicles must be washed before entering a public road. Wash water must be carried away from the entrance to a settling area to remove sediment. A wash rack may also be used to make washing more convenient and effective. (See Plate 1.01b).

Location

The entrance should be located to provide for maximum utility by all construction vehicles.

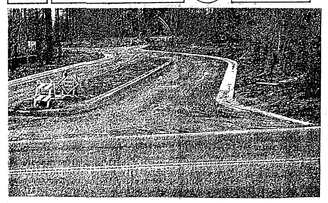
Construction Specifications

The area of the entrance should be cleared of all vegetation, roots, and other objectionable material. The gravel shall be placed to the specified dimensions. Any drainage facilities required because of washing should be constructed according to specifications. If wash racks are used, they should be installed according to manufacturer's specifications.

Maintenance

The entrance shall be maintained in a condition which will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with 2-inch stone, as conditions demand, and repair and/or cleanout of any structures used to trap sediment. All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately.

1.02 CONSTRUCTION ROAD STABILIZATION (CRS)



Permanent Roads and Parking Areas

Permanent roads and parking areas shall be designed and constructed in accordance with applicable Virginia Department of Highways and Transportation (VDH&T) or local criteria except that an initial base course of gravel of at least 6 inches shall be applied immediately following grading.

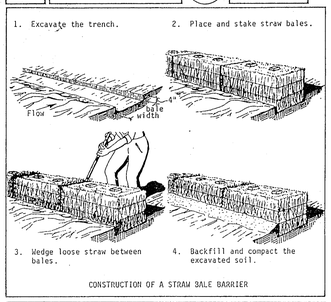
Vegetation

All roadside ditches, cuts, fills and disturbed areas adjacent to parking areas and roads shall be stabilized with appropriate temporary or permanent vegetation according to the applicable standards and specifications contained in this handbook.

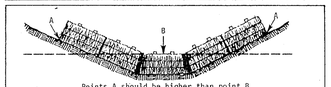
Maintenance

Both temporary and permanent roads and parking areas may require periodic top dressing with new gravel. Seeded areas adjacent to the roads and parking areas should be checked periodically to insure that a vigorous stand of vegetation is maintained. Roadside ditches and other drainage structures should be checked regularly to insure that they do not become clogged with silt or other debris.

1.05 STRAW BALE BARRIER (STB)



CONSTRUCTION OF A STRAW BALE BARRIER



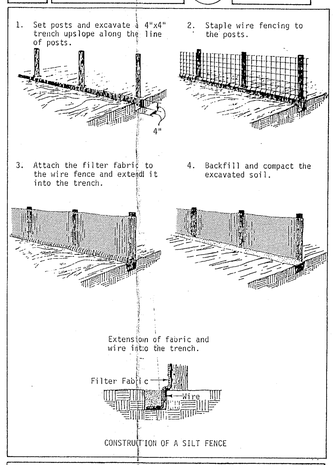
Points A should be higher than point B

PROPER PLACEMENT OF STRAW BALE BARRIER IN DRAINAGE WAY

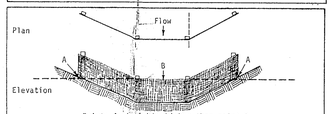
Maintenance

1. Straw bale barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall.
2. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales.
3. Necessary repairs to barriers or replacement of bales shall be accomplished promptly.
4. Sediment deposits should be removed after each rainfall. They must be removed when the level of deposition reaches approximately one-half the height of the barrier.
5. Any sediment deposits remaining in place after the straw bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.

1.06 SILT FENCE (SF)



CONSTRUCTION OF A SILT FENCE



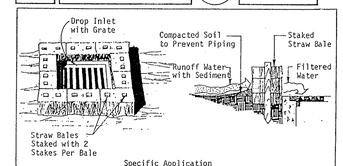
Points A should be higher than point B

PROPER PLACEMENT OF A FILTER BARRIER IN A DRAINAGE WAY

Maintenance

1. Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.
2. Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.
3. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.
4. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

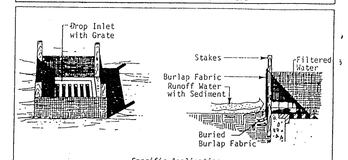
1.08 STORM DRAIN INLET PROTECTION (IP)



Specific Application

This method of inlet protection is applicable where the inlet drains a relatively flat area (slopes no greater than 5 percent) where sheet or overland flows (not exceeding 0.5 cfs) are typical. The method shall not apply to inlets receiving concentrated flows, such as in street or highway medians.

STRAW BALE DROP INLET SEDIMENT FILTER



Specific Application

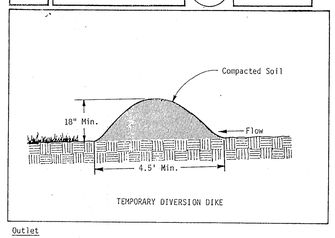
This method of inlet protection is applicable where the inlet drains a relatively flat area (slopes no greater than 5 percent) where sheet or overland flows (not exceeding 0.5 cfs) are typical. The method shall not apply to inlets receiving concentrated flows, such as in street or highway medians.

BURLAP DROP INLET SEDIMENT FILTER

Maintenance

1. The structure shall be inspected after each rain and repairs made as needed.
2. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to 1/2 the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.
3. Structures shall be removed and the area stabilized when the remaining drainage area has been properly stabilized.

1.15 TEMPORARY DIVERSION DIKE (DD)



TEMPORARY DIVERSION DIKE

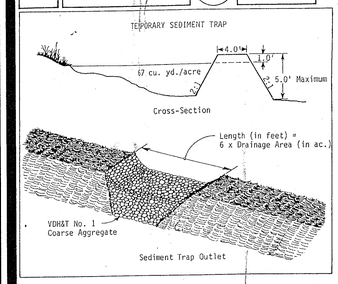
Outlet

1. The diverted runoff, if free of sediment, must be released through a stabilized outlet or channel.
2. Sediment-laden runoff must be diverted and released through a sediment trapping facility.

Construction Specifications

1. Whenever feasible, the dike should be built before construction begins on the project.
2. The dike should be adequately compacted to prevent failure.
3. Temporary or permanent seeding and mulch shall be applied to the dike within 15 days of construction.
4. The dike should be located to minimize damages by construction operations and traffic.

1.25 TEMPORARY SEDIMENT TRAP (ST)



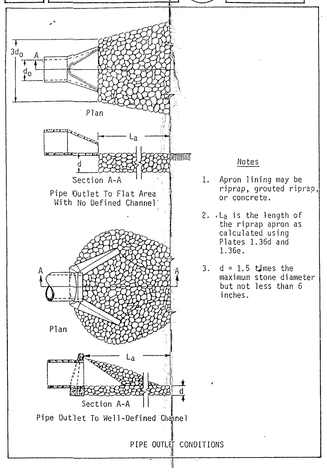
Construction Specifications

1. The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat. To facilitate cleanout, the pool area should be cleared.
2. Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment should be compacted in 8-inch layers by traversing with construction equipment.
3. The earthen embankment shall be seeded with temporary or permanent vegetation (see Std. & Spec. 1.65 and 1.66) within 15 days of construction.
4. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
5. The structure shall be removed and the area stabilized when the upslope drainage area has been stabilized.
6. All cut and fill slopes shall be 2:1 or flatter.

Maintenance

1. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to 1/2 the design volume of the trap. Sediment removed from the basin shall be deposited in a suitable area and in such a manner that it will not erode.
2. The structure should be checked regularly to insure that it is structurally sound and has not been damaged by erosion or construction equipment. The height of the outlet should be checked to insure that its center is at least one foot below the top of the embankment.

1.36 OUTLET PROTECTION (OP)



PIPE OUTLET CONDITIONS

Notes

1. Apron lining may be riprap, grouted riprap, or concrete.
2. La is the length of the riprap apron as calculated using Plates 1.36d and 1.36e.
3. d = 1.5 times the maximum stone diameter but not less than 6 inches.

1.37 RIPRAP (RR)

Construction Specifications

Subgrade Preparation: The subgrade for the riprap or filter shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density approximating that of the surrounding undisturbed material. Brush, trees, stumps and other objectionable material shall be removed.

Filter Blanket: Placement of the filter blanket should be done immediately after slope preparation. For granular filters the stone should be spread in a uniform layer to the specified depth. Where more than one layer of filter material is used, the layers should be spread so that there is minimal mixing of the layers.

For plastic filter cloths, the cloth should be placed directly on the prepared slope. The edges of the sheets should overlap by at least 12 inches. Anchor pins, 15 inches long, should be spaced every 3 feet along the overlap. The upper and lower ends of the cloth should be buried a minimum of 12 inches deep. Care should be taken not to damage the cloth when placing the riprap. If damage occurs, that sheet should be removed and replaced. For large stone (12 inches or greater), a 4-inch layer of gravel may be necessary to prevent damage to the cloth.

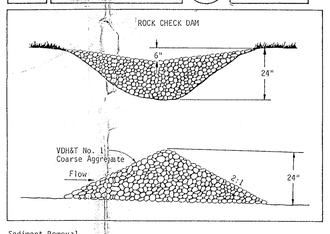
Stone Placement: Placement of riprap should follow immediately after placement of the filter. The riprap should be placed so that it produces a dense well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry, controlled dumping of successive loads during final placing, or by a combination of these methods. The riprap should be placed to its full thickness in one operation. The riprap should not be placed in layers. The riprap should not be placed by dumping into chutes or similar methods which are likely to cause segregation of the various stone sizes. Care should be taken not to dislodge the underlying material when placing the stones.

The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve the required grades and a good distribution of stone sizes. Final thickness of the riprap blanket should be within plus or minus 1/4 of the specified thickness.

Maintenance

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or dislodged any of the stone. If repairs are needed, they should be accomplished immediately.

1.38 CHECK DAMS (CD)



Sediment Removal

While this practice is not intended to be used primarily for sediment trapping, some sediment will accumulate behind the check dams. Sediment should be removed from behind the check dams when it has accumulated to one half of the original height of the dam.

Removal

Check dams must be removed when their useful life has been completed. In temporary ditches and swales, check dams should be removed and the ditch filled in when it is no longer needed. In permanent structures, check dams should be removed when a permanent lining can be installed. In the case of grass-lined ditches, check dams should be removed when the grass has matured sufficiently to protect the ditch or swale. The area beneath the check dams should be seeded and mulched immediately after they are removed.

Maintenance

Check dams should be checked for sediment accumulation after each significant rainfall. Sediment should be removed when it reaches one half of the original height or before.

Regular inspections should be made to insure that the center of the dam is lower than the edges. Erosion caused by high flows around the edges of the dam should be corrected immediately.

EROSION AND SEDIMENT CONTROL NOTES

THE PURPOSE OF THE EROSION CONTROL MEASURES SHOWN ON THESE PLANS SHALL BE TO PRECLUDE THE TRANSPORT OF ALL WATERBORNE SEDIMENTS RESULTING FROM CONSTRUCTION ACTIVITIES FROM ENTERING ONTO ADJACENT PROPERTIES OR STATE WATERS. IF FIELD INSPECTION REVEALS THE INADEQUACY OF THE PLAN TO CONFINE SEDIMENT TO THE PROJECT SITE, APPROPRIATE MODIFICATIONS WILL BE MADE TO CORRECT ANY PLAN DEFICIENCIES.

1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE "VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK". THE CONTRACTOR SHALL BE THOROUGHLY FAMILIAR WITH ALL APPLICABLE MEASURES CONTAINED THEREIN WHICH MAY BE PERTINENT TO THIS PROJECT.
2. ALL POINTS OF CONSTRUCTION INGRESS AND EGRESS SHALL BE PROTECTED BY A TEMPORARY CONSTRUCTION ENTRANCE TO PREVENT TRACKING OF MUD ONTO PUBLIC RIGHT-OF-WAYS. AN ENTRANCE PERMIT FROM VDOT IS REQUIRED PRIOR TO ANY CONSTRUCTION ACTIVITIES WITHIN STATE RIGHT-OF-WAYS.
3. SEDIMENT BASINS AND TRAPS, PERIMETER DIKES, SEDIMENT BARRIERS AND OTHER MEASURES INTENDED TO TRAP SEDIMENT ON-SITE MUST BE CONSTRUCTED AS A FIRST STEP IN GRADING AND BE MADE FUNCTIONAL BEFORE UPSLOPE LAND DISTURBANCE TAKES PLACE. EARTHEN STRUCTURES SUCH AS DAMS, DIKES, AND DIVERSIONS MUST BE SEEDED AND MULCHED WITHIN 15 DAYS OF INSTALLATION. AN ON-SITE PRE-CONSTRUCTION MEETING WILL BE HELD BETWEEN THE OFFICE OF CODE COMPLIANCE AND THE CONTRACTOR TO IDENTIFY THOSE MEASURES TO BE INITIALLY INSTALLED.
4. MAINTENANCE OF ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE ACCOMPLISHED IN ACCORDANCE WITH THE "VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK". MAINTENANCE WILL INCLUDE THE REPAIR OF MEASURES DAMAGED BY ANY SUBCONTRACTOR INCLUDING THOSE OF THE PUBLIC UTILITY COMPANIES. AT THE PRE-CONSTRUCTION MEETING, THE CONTRACTOR WILL SUPPLY CODE COMPLIANCE WITH THE NAME OF THE INDIVIDUAL WHO WILL BE RESPONSIBLE FOR ENSURING MAINTENANCE OF INSTALLED MEASURES ON A DAILY BASIS.
5. SURFACE FLOWS OVER CUT AND FILL SLOPES SHALL BE CONTROLLED BY EITHER REDIRECTING FLOWS FROM TRANSVERSING THE SLOPES OR BY INSTALLING MECHANICAL DEVICES TO SAFELY LOWER WATER DOWNSLOPE WITHOUT CAUSING EROSION. A TEMPORARY FILL DIVERSION (STD. & SPEC. 1.16) SHALL BE INSTALLED PRIOR TO THE END OF EACH WORKING DAY.
6. SEDIMENT CONTROL MEASURES MAY REQUIRE MINOR FIELD ADJUSTMENTS AT TIME OF CONSTRUCTION TO INSURE THEIR INTENDED PURPOSE IS ACCOMPLISHED. OFFICE OF CODE COMPLIANCE APPROVAL WILL BE REQUIRED FOR OTHER DEVIATIONS FROM THE APPROVED PLANS.
7. THE CONTRACTOR SHALL STRIP AND PILE TOPSOIL AT THE LOCATIONS SHOWN ON THIS PLAN OR AS DIRECTED BY THE ENGINEER. SILT FENCE SHALL BE PLACED AT THE TOE OF THE STOCKPILE AFTER STRIPPING OF TOPSOIL IS COMPLETE.
8. THE CONTRACTOR SHALL COMPLETE DRAINAGE FACILITIES WITHIN 30 DAYS AFTER FOLLOWING COMPLETION OF ROUGH GRADING AT ANY POINT WITHIN THE PROJECT. THE INSTALLATION OF DRAINAGE FACILITIES SHALL TAKE PRECEDENCE OVER ALL UNDERGROUND UTILITIES. OUTFALL DITCHES FROM DRAINAGE STRUCTURES SHALL BE STABILIZED IMMEDIATELY AFTER CONSTRUCTION OF SAME. THIS INCLUDES INSTALLATION OF EROSION CONTROL STONE WHERE REQUIRED. ANY DRAINAGE OUTFALLS REQUIRED FOR A STREET MUST BE COMPLETED BEFORE STREET GRADING BEGINS.
9. PERMANENT OR TEMPORARY SOIL STABILIZATION MUST BE APPLIED TO ALL DENUDED AREAS WITHIN 15 DAYS AFTER FINAL GRADE IS REACHED ON ANY PORTION OF THE SITE. SOIL STABILIZATION MUST ALSO BE APPLIED TO DENUDED AREAS WHICH MAY NOT BE AT FINAL GRADE BUT WILL REMAIN DORMANT (UNDISTURBED) FOR LONGER THAN 30 DAYS. SOIL STABILIZATION MEASURES INCLUDE VEGETATIVE ESTABLISHMENT, MULCHING AND THE EARLY APPLICATION OF GRAVEL BASE MATERIAL ON AREAS TO BE PAVED.
10. NO MORE THAN 300' OF SANITARY SEWER, STORM SEWER, OR WATERLINES ARE TO BE OPEN AT ONE TIME. FOLLOWING INSTALLATION OF ANY PORTION OF THESE ITEMS, ALL DISTURBED AREAS ARE TO BE IMMEDIATELY STABILIZED (I.E., THE SAME DAY).
11. IF DISTURBED AREA STABILIZATION IS TO BE ACCOMPLISHED DURING THE MONTHS OF DECEMBER, JANUARY, OR FEBRUARY, STABILIZATION SHALL CONSIST OF MULCHING IN ACCORDANCE WITH SPECIFICATION 1.75. SEEDING WILL THEN TAKE PLACE AS SOON AS THE SEASON PERMITS.
12. THE TERM SEEDING, FINAL VEGETATIVE COVER OR STABILIZATION, ON THIS PLAN SHALL MEAN THE SUCCESSFUL GERMINATION AND ESTABLISHMENT OF A STABLE GRASS COVER FROM A PROPERLY PREPARED SEEDBED CONTAINING THE SPECIFIED AMOUNTS OF SEED, LIME, AND FERTILIZER IN ACCORDANCE WITH SPECIFICATION 1.66, PERMANENT SEEDING. IRRIGATION SHALL BE REQUIRED AS NECESSARY TO ENSURE ESTABLISHMENT OF GRASS COVER.
13. ALL SLOPES STEEPER THAN 3:1 SHALL REQUIRE THE USE OF EROSION CONTROL BLANKETS SUCH AS EXCELSIOR BLANKETS TO AID IN THE ESTABLISHMENT OF A VEGETATIVE COVER. INSTALLATION SHALL BE IN ACCORDANCE WITH SPECIFICATION 1.75, MULCHING AND MANUFACTURER'S INSTRUCTIONS.
14. INLET PROTECTION IN ACCORDANCE WITH SPECIFICATION 1.08 SHALL BE PROVIDED FOR ALL STORM DRAIN INLETS AS SOON AS PRACTICAL FOLLOWING CONSTRUCTION OF SAME.
15. TEMPORARY LINERS, SUCH AS POLYETHYLENE SHEETS, SHALL BE PROVIDED FOR ALL PAVED DITCHES UNTIL THE PERMANENT CONCRETE LINER IS INSTALLED.
16. PAVED DITCHES SHALL BE REQUIRED WHEREVER EROSION IS EVIDENT. PARTICULAR ATTENTION SHALL BE PAID TO THOSE AREAS WHERE GRADES EXCEED 3%.
17. TEMPORARY EROSION CONTROL MEASURES ARE NOT TO BE REMOVED UNTIL ALL DISTURBED AREAS ARE STABILIZED. AFTER STABILIZATION IS COMPLETE, ALL MEASURES SHALL BE REMOVED WITHIN 30 DAYS. TRAPPED SEDIMENT SHALL BE SPREAD AND SEEDED.
18. OFF-SITE WASTE OR BORROW AREAS SHALL BE APPROVED BY THE OFFICE OF CODE COMPLIANCE PRIOR TO THE IMPORT OF ANY BORROW OR EXPORT OF ANY WASTE TO OR FROM THE PROJECT SITE.
19. ALL PAVED AND/OR PIPED OUTFALLS WILL BE CONSTRUCTED BEFORE ROAD GRADING AND UTILITY INSTALLATION BEGINS.

NOTE: ALL STANDARD DETAILS FROM THE VIRGINIA EROSION CONTROL HANDBOOK

EROSION CONTROL DETAILS

WILLIAMSBURG CHRISTIAN RETREAT CENTER
MAIN LODGE & CONFERENCE CENTER
STONEHOUSE DISTRICT JAMES CITY COUNTY, VIRGINIA

THE DEYOUNG-JOHNSON GROUP, INC.
ENGINEERS · ARCHITECTS · SURVEYORS
P.O. BOX 197 WILLIAMSBURG, VIRGINIA 23187 (804) 253-0673

DATE 5-2-90 | DESIGNED | DRAWN | CHECKED

1900050

DC009_WILLIAMSBURG_CHRISTIAN_RETREAT - 008

WILLIAMSBURG CHRISTIAN RETREAT CENTER

YOUTH FACILITY

JAMES CITY COUNTY, VIRGINIA

RECORD DRAWING and SWM POND CONSTRUCTION CERTIFICATION PLANS

JAMES CITY COUNTY PLAN # SP-0054-2011 (AMENDS #SP-12-08)

SEPTEMBER 06, 2012

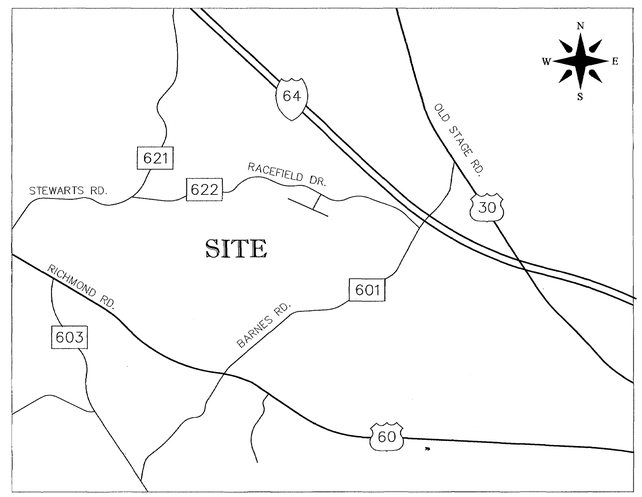
PREPARED BY:

TERRA ENGINEERING AND LAND SOLUTIONS, PC

CIVIL ENGINEERS PLANNERS LAND SURVEYORS
2374 STUARTS DRAFT HIGHWAY STUARTS DRAFT, VIRGINIA 24477
PH. 540-337-4591 FAX 540-337-5291

LEGEND

W	WATER LINE (EX. / PROP.)
WV WM	WATER VALVE / METER
FHA	FIRE HYDRANT
YH	YARD HYDRANT
BOA	BLOW-OFF ASSEMBLY
SS	SANITARY SEWER LINE (EX. / PROP.)
CO	CLEANOUT
MH	MANHOLE
SD	STORM LINE (EX. / PROP.)
DI	STORM INLET
YD	YARD DRAIN
DS	DOWNSPOUT
G	GAS LINE (EX. / PROP.)
GV GM	GAS VALVE / METER
OHE	OVERHEAD ELECTRIC (EX. / PROP.)
UGE	UNDERGROUND ELECTRIC (EX. / PROP.)
PP	POWER POLE
LP	LIGHT POLE
GUY	GUY WIRE
EM	ELECTRIC METER
T	TRANSFORMER
OHT	OVERHEAD COMMUNICATIONS (EX. / PROP.)
UGT	UNDERGROUND COMMUNICATIONS (EX. / PROP.)
PED	UTILITY PEDESTAL
	BOUNDARY / RIGHT-OF-WAY LINE
I.F.	IRON PIN FOUND
I.S.	IRON PIN SET
	SETBACK LINE
	EASEMENT LIMITS
	CENTERLINE
	CONTOUR LINE (EX. / PROP.)
←3:1 — ←2.50%	DEGREE / DIRECTION OF SLOPE
479.70 +	SPOT ELEVATION
HP	HIGH POINT
LP	LOW POINT
	DITCH / SWALE
	WATER COURSE
BM	BENCHMARK
CG-2	VDOT STD. HEADER CURB
CG-6	VDOT STD. CURB & GUTTER
CG-12	VDOT STD. HANDICAP RAMP
HC	HANDICAP PARKING SYMBOL
DIP	DUCTILE IRON PIPE
RCP	REINFORCED CONCRETE PIPE
CMP	CORRUGATED METAL PIPE
PVC	POLYVINYLCHLORIDE PIPE
HDPE	HIGH-DENSITY POLYETHYLINE PIPE
VC	VITRIFIED CLAY PIPE
FFE	FINISHED FLOOR ELEVATION
TBR	TO BE REMOVED
TBT	TO BE TRANSPLANTED



VICINITY MAP

SCALE: 1"= 2000'

SHEET INDEX

SHEET C1.0.0	COVER SHEET
SHEET C2.2.2	STORMDRAIN PLAN AND PROFILE
SHEET C3.0.0	PHASE 1 SITE PLAN
SHEET C7.0.0	STORMWATER AND ROAD SECTION DETAILS

LAND USE SUMMARY:

PROJECT NAME:	WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
OWNER–DEVELOPER:	WILLIAMSBURG CHRISTIAN RETREAT ASSOCIATION, INC.
CONTACT PERSON:	BOB BRISCOE, PH. 757–566–2256, FAX 757–566–4875
TAX MAP – PARCEL #:	3–4, 1–3D
MAGISTERIAL DISTRICT:	STONEHOUSE
PROPERTY ADDRESS:	9275 BARNES ROAD, TOANO, VA 23168
ZONING:	A–1
PROFFERS:	NA
WAIVER – VARIANCE REQUESTS:	NA
SURVEY SOURCES:	PHOTOGRAMMETRIC MAPPING – LOUISA AERIAL SURVEYS, INC., P.O. BOX 430 MINERAL, VA, 23117
DATUM:	NAVD 88 – MONUMENT WITH BRASS CAP AT INTERSECTION OF BARNES ROAD AND BARHAMSVILLE ROAD
WATERSHED	THIS SITE LIES IN THE DIASCUND WATERSHED
FEMA FIRM PANEL	MAP #51095C0040C, ZONE X

NOTE:
PRIVATELY OWNED UTILITIES (E.G. WATER LINES, FIRE MAINS) SHOWN ON THIS PLAN ARE REGULATED BY THE VIRGINIA UNIFORM STATEWIDE BUILDING CODE AND ENFORCED BY THE CODE COMPLIANCE DIVISION. THESE PRIVATELY OWNED UTILITIES MUST COMPLY FULLY WITH THE INTERNATIONAL PLUMBING CODE, THE NATIONAL FIRE PREVENTION ASSOCIATION STANDARD 24, AND THE INTERNATIONAL FIRE CODE. CONTRACTORS WORKING FROM THIS SITE PLAN ARE CAUTIONED NOT TO INSTALL OR CONCEAL PRIVATELY OWNED SITE UTILITIES WITHOUT OBTAINING REQUIRED PERMITS AND INSPECTIONS.

AREA TABULATIONS (BASED ON AS–BUILT AND FUTURE PLANS):

TOTAL SITE AREA:	149.8 ACRES
EX. BUILDINGS:	20,412 S.F.
FUTURE MULTIPURPOSE BLDG.:	7,004 S.F.
AS–BUILT COMMONS AT CABINS:	2,770 S.F.
FUTURE COMMONS 2 AND 3:	EACH 2,312 S.F. – TOTAL 4,624 S.F.
AS–BUILT CABINS (5):	EACH 1,480 S.F. – TOTAL 7,400 S.F.
FUTURE CABINS (10):	EACH 965 S.F. – TOTAL 9,650
TOTAL AS–BUILT AND FUTURE BLDGS:	31,448 S.F.
TOTAL BUILDINGS:	51,860 S.F. = 1.19 AC = 0.80%
EX. PAVED SURFACES:	195,380 S.F.
AS–BUILT ROAD & PARKING:	29,801
FUTURE ROAD & PARKING:	18,016 SF
TOTAL PAVED:	243,197 S.F. = 5.58 AC = 3.73%
NET OPEN SPACE:	143.03 AC = 95.48%
MULTIPURPOSE BLDG. CONST.:	STEEL FRAME
HEIGHT:	SINGLE STORY, APPROX. 22 FEET INTERIOR HEIGHT
COMMONS CONSTRUCTION:	POLYSTEEL AND WOOD
HEIGHT:	SINGLE STORY, CATHEDRAL CEILING, APPROX. 20 FEET INTERIOR HEIGHT
CABIN CONSTRUCTION:	POLYSTEEL AND WOOD
HEIGHT:	SINGLE STORY, 9 FOOT INTERIOR CEILING
PARKING TABULATIONS:	
FUTURE MULTIPURPOSE BLDG.:	51 SPACES
PER COMMONS:	10 SPACES – TOTAL 30 SPACES
TOTAL PROVIDED:	81 SPACES

PROJECTED OVERALL IMPERVIOUS AREA OF SITE BASED ON MASTER PLAN: 8.0%

Environmental Division
NOV 07 2012
RECEIVED

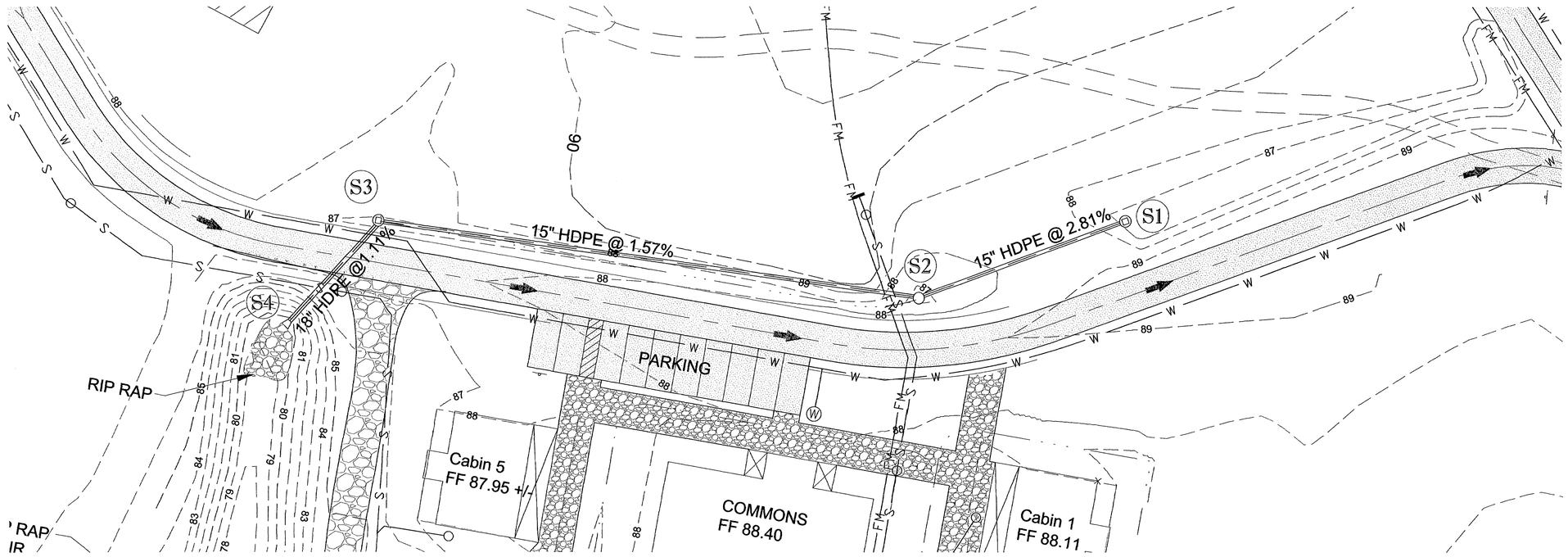
SEAL

COMMONWEALTH OF VIRGINIA
STEVEN L. DRIVER
NO. 019933
9-6-12
PROFESSIONAL ENGINEER

APPROVALS

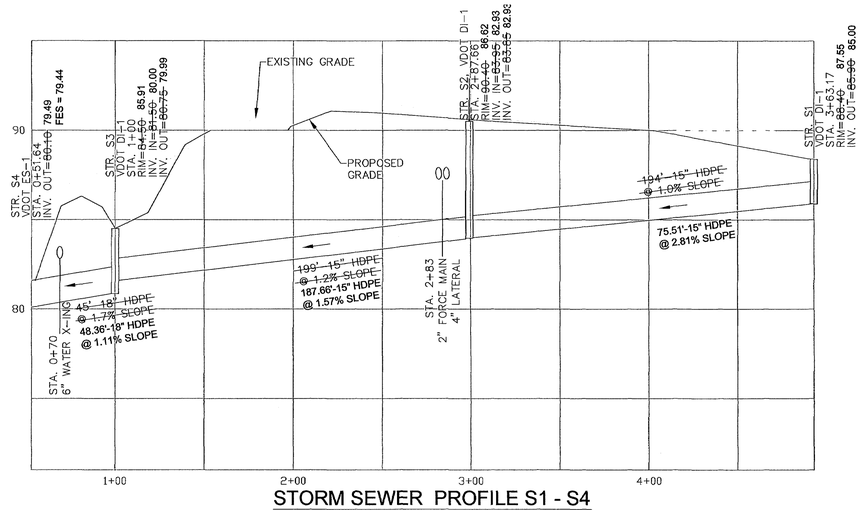
SHEET

C1.0.0



GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.



STORM SEWER PROFILE S1 - S4

SCALE: HORIZ. 1" = 40' (AS-BUILT, NTS)
VERT. 1" = 4'

RECORD DRAWING

TERRA ENGINEERING AND LAND SOLUTIONS, PC
PLANNING
LAND SURVEYING
CIVIL ENGINEERING
2374 STUARTS DRAFT HIGHWAY
STUARTS DRAFT, VIRGINIA 24477
PH. 540-337-4591 FAX 540-337-5291

WILLIAMSBURG CHRISTIAN RETREAT CENTER

JAMES CITY COUNTY, VIRGINIA

STORMDRAIN PLAN AND PROFILE

JAMES CITY COUNTY PLAN # SP-0054-2011 (AMENDS # SP 012-08)

COMMONWEALTH OF VIRGINIA
STEVEN L. DRIVER
NO. 019933
9-6-12
PROFESSIONAL ENGINEER

SCALE: AS SHOWN
ISSUED: 03-19-12
DRAWN: JEF & PAB
DESIGN: JEF, JHF
CHECKED: SLD
REVISED: ATE

REVISIONS:
1. 9-6-12 RECORD DRAWING
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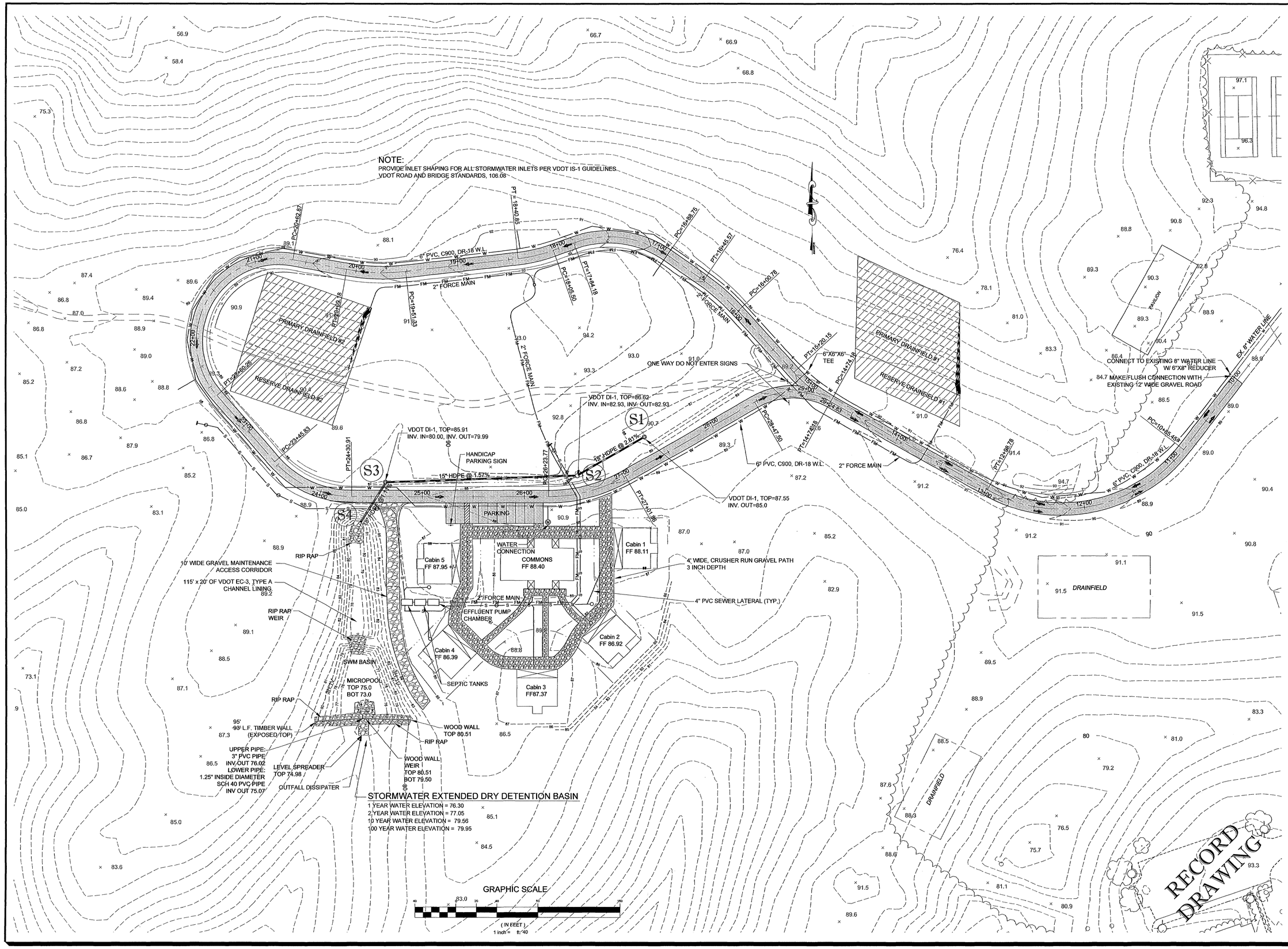

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CIVIL ENGINEERING
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WILLIAMSBURG CHRISTIAN RETREAT CENTER

JAMES CITY COUNTY, VIRGINIA

PHASE 1 SITE PLAN

JAMES CITY COUNTY PLAN # SP-0054-2011 (AMENDS # SP 012-08)

COMMONWEALTH OF VIRGINIA
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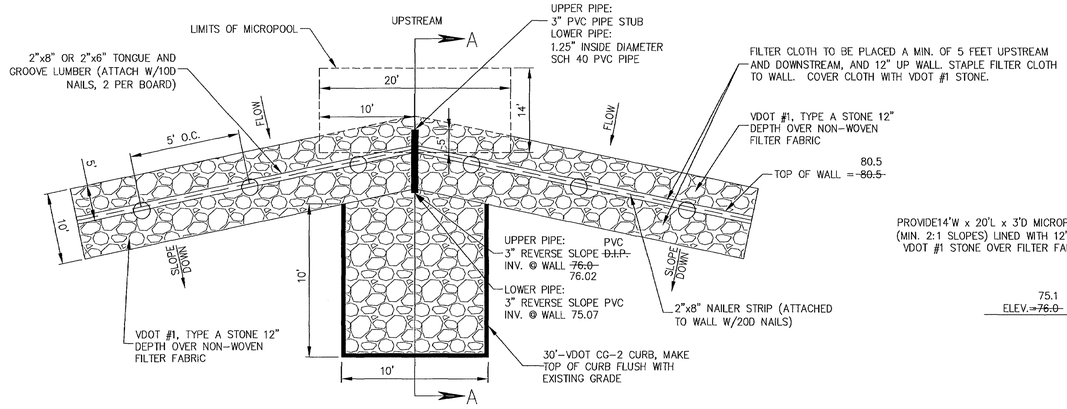
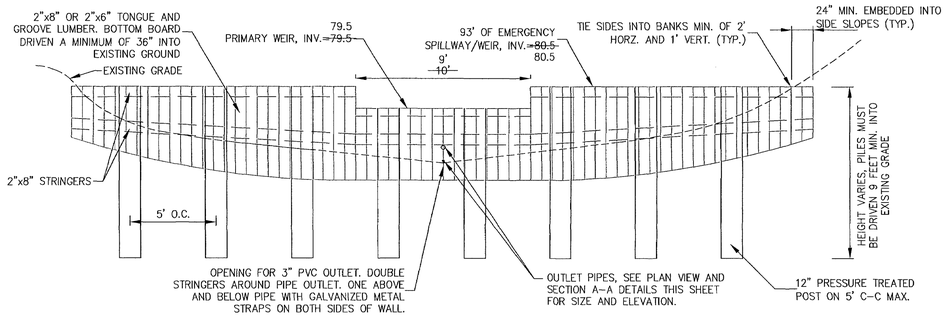


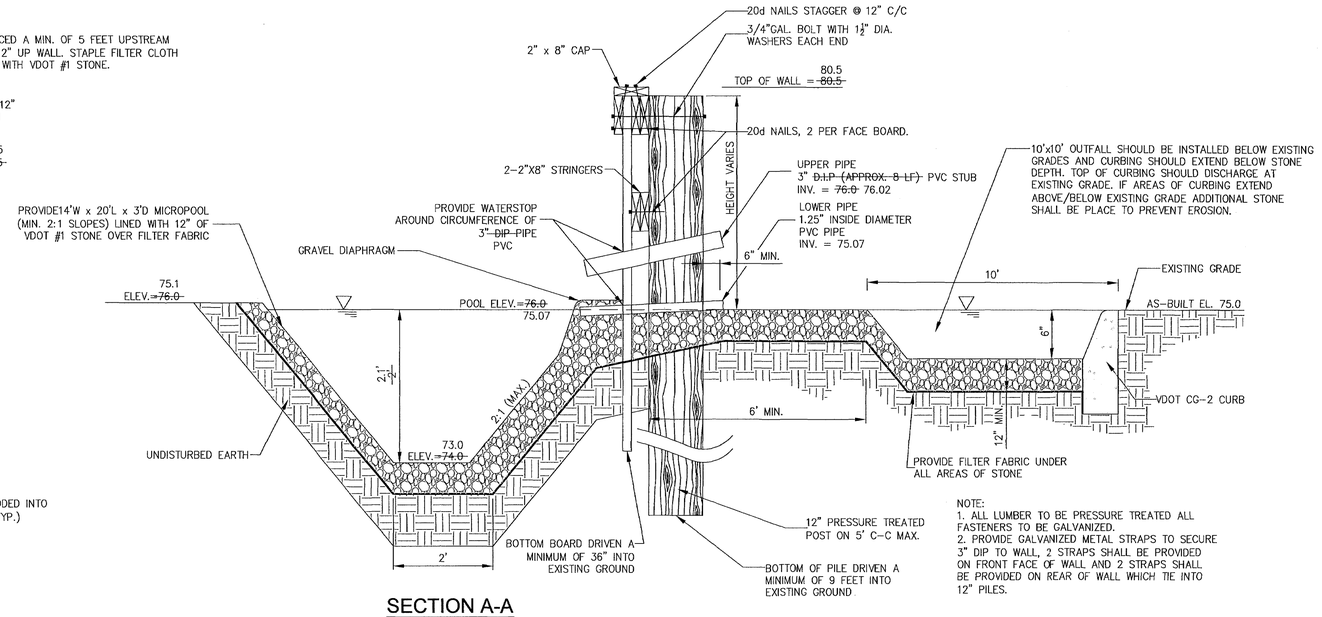
PLAN VIEW
PRESSURE TREATED WOOD DRY DETENTION STRUCTURE

NOT TO SCALE



UPSTREAM ELEVATION
PRESSURE TREATED WOOD DRY DETENTION STRUCTURE

NOT TO SCALE

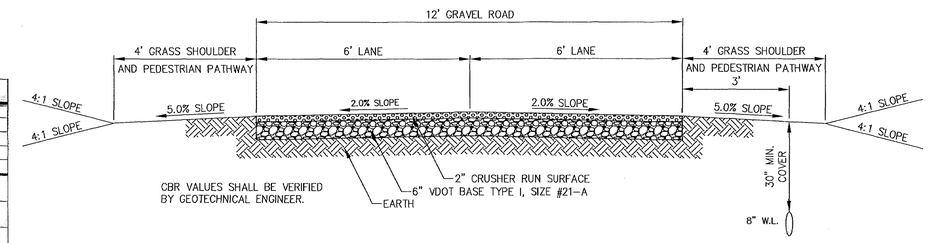


NOTE:
1. ALL LUMBER TO BE PRESSURE TREATED ALL FASTENERS TO BE GALVANIZED.
2. PROVIDE GALVANIZED METAL STRAPS TO SECURE 3" DIP TO WALL, 2 STRAPS SHALL BE PROVIDED ON FRONT FACE OF WALL AND 2 STRAPS SHALL BE PROVIDED ON REAR OF WALL WHICH TIE INTO 12" PILES.

SECTION A-A
PRESSURE TREATED WOOD DRY DETENTION STRUCTURE

NOT TO SCALE

75.1
EL. ~~76.0~~ DENOTES AS-BUILT ELEVATION



ROAD SECTION

NOT TO SCALE

Step 1: Determine Design ADT	
ADT	30
%HCV = 100 x HCV x ADT) or 20 x HCV Note: For %HCV ≤ 5%, use ADT	0 Note: For %HCV>5%, EPT>ADT
Design ADT Use greater of ADT or EPT	30

Step 2: Determine Design Values CBR, RF, and SSV			
Sample	DBR_T	Resiliency Factor	(RF)
# 1	4	Source	Value
# 2		Table 1	
# 3		Appendix I	1.0
#		DME approved RF	
#		For preliminary designs, use the lowest RF value in the equation	
#			
CBR_D x RF =			SSV
(4) x (1) =			4

Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

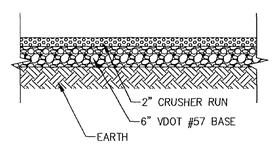
☒ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☐ (B) Show pavement section as developed in the Pavement Design Guide. (See Appendix III for material notations and thickness equivalency values (a)). D_R = _____ from Appendix II

Description of Proposed Pavement Section

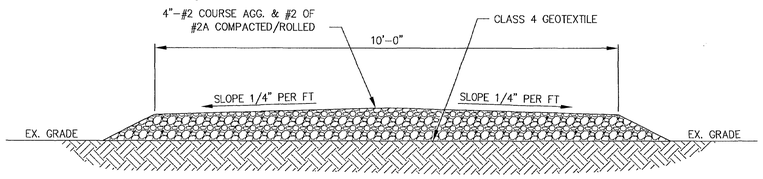
	Material Notation	Thickness, h	a	(a x h)
Surface	Crusher Run	2"		
Base	Type I, Size #21-A	6"		
Subbase				

D_P must equal or exceed the value of D_R. $D_P = \Sigma(a \times h) =$



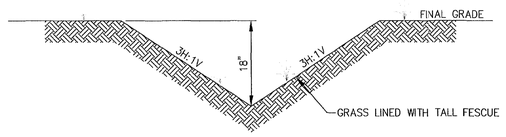
TYPICAL PARKING LOT SECTION DETAIL

NOT TO SCALE



GRAVEL MAINTENANCE CORRIDOR DETAIL

NOT TO SCALE



TYPICAL STORMWATER CONVEYANCE CHANNEL DETAIL

NOT TO SCALE

Maintenance Plan Extended Detention Basin

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 will be performed at least quarterly. It is anticipated that under normal conditions, sediment removal will 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 should be implemented with inspections performed at least once weekly.

The Owner or its designated representative will 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 County may jointly inspect the structure. Appropriate action, performed at the cost of the owner will be taken to ensure appropriate maintenance. Keys to locked access points or structures shall be made available to the County upon request.

BMP Description: Extended Detention Basin serves a drainage area of 3.6 acres associated with Williamsburg Christian Retreat Center Youth Facility. The facility is a 4 point, dry-type detention facility, County Type F-1 TIMBER WALL BMP. A dry-type detention basin temporarily stores runoff and is normally dry during non-rainfall periods. Typically draw down times range from 24 to 72 hours following a storm event. Principal structures associated with the BMP consist of a TIMBER WALL. There is a broad crested weir and orifice in the wall to provide for water quality draw down and to offer control for the 2- and 10- year design storm events. During the 100-year storm, the maximum water level should rise to about 0.6 feet below the top of the wall.

Inspection and maintenance of the facility will consist of the following additional 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 1' _ 0" above the bottom of pond (or Cleanout Elevation of 77.0) , removal is required. At the same time, or at least once per year, clean pretreatment devices, the riser bottom and outlet pipes of accumulated sediments. Dispose of sediments removed from the facility at an acceptable disposal area.
2. In stabilized pond areas, if vegetation covers less than 40 % of soil surfaces, lime, fertilize and seed in accordance with recommendations for new seedlings. If vegetation covers more than 40 % but less than 70 % of soil surfaces, lime, fertilize and over seed in accordance with current seeding recommendations or requirements of the Virginia Erosion and Sediment Control Handbook (VESCH).
3. Perform quarterly inspections of the crest 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 drain or channel inflow locations to maintain the integrity of the structure and provide an attractive appearance.
4. Perform yearly structural inspections of the facility for damage. Structural inspection shall be performed on the piles and lumber. If damage is evident, further investigation by a professional engineer may be required to assess the integrity of the structure.
5. 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 reseeding.
6. 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. Appropriate action is required to ensure adequacy and to provide a clear, safe passage for maintenance vehicles to the engineered embankment and principal flow control structures.
7. Inspect and exercise pond drain valves, if provided, on a regular basis.
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 County upon request.
9. The facility shall not accept additional drainage or be modified in any way without prior consent or approval by the Environmental Division of James City County.

RECORD DRAWING

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WILLIAMSBURG CHRISTIAN RETREAT CENTER

JAMES CITY COUNTY, VIRGINIA

STORMWATER AND ROAD SECTION DETAILS

JAMES CITY COUNTY PLAN # SP-0054-2011 (AMENDS # SP 012-08)

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NO. 019933
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WILLIAMSBURG CHRISTIAN RETREAT CENTER

YOUTH FACILITY

JAMES CITY COUNTY, VIRGINIA

RECORD DRAWING and SWM POND CONSTRUCTION CERTIFICATION PLANS

JAMES CITY COUNTY PLAN # SP-0054-2011 (AMENDS #SP-12-08)

SEPTEMBER 06, 2012

PREPARED BY:

TERRA ENGINEERING AND LAND SOLUTIONS, PC

CIVIL ENGINEERS PLANNERS LAND SURVEYORS
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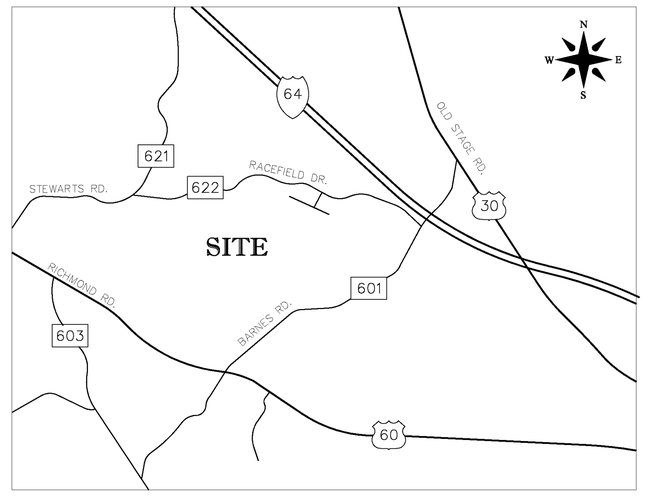
PH. 540-337-4591 FAX 540-337-5291

LEGEND

W	WATER LINE (EX. / PROP.)
WV WM	WATER VALVE / METER
FH	FIRE HYDRANT
YH	YARD HYDRANT
BOA	BLOW-OFF ASSEMBLY
SS	SANITARY SEWER LINE (EX. / PROP.)
CO	CLEANOUT
MH	MANHOLE
SD	STORM LINE (EX. / PROP.)
DI	STORM INLET
YD	YARD DRAIN
DS	DOWNSPOUT
G	GAS LINE (EX. / PROP.)
GV GM	GAS VALVE / METER
OHE	OVERHEAD ELECTRIC (EX. / PROP.)
UGE	UNDERGROUND ELECTRIC (EX. / PROP.)
PP	POWER POLE
LP	LIGHT POLE
GUY	GUY WIRE
EM	ELECTRIC METER
T	TRANSFORMER
OHT	OVERHEAD COMMUNICATIONS (EX. / PROP.)
UGT	UNDERGROUND COMMUNICATIONS (EX. / PROP.)
PED	UTILITY PEDESTAL
	BOUNDARY / RIGHT-OF-WAY LINE
I.F.	IRON PIN FOUND
I.S.	IRON PIN SET
	SETBACK LINE
	EASEMENT LIMITS
	CENTERLINE
	CONTOUR LINE (EX. / PROP.)
←3:1	←2.50% DEGREE / DIRECTION OF SLOPE
479.70 +	SPOT ELEVATION
HP	HIGH POINT
LP	LOW POINT
	DITCH / SWALE
	WATER COURSE
BM	BENCHMARK
CG-2	VDOT STD. HEADER CURB
CG-6	VDOT STD. CURB & GUTTER
CG-12	VDOT STD. HANDICAP RAMP
HC	HANDICAP PARKING SYMBOL
DIP	DUCTILE IRON PIPE
RCP	REINFORCED CONCRETE PIPE
CMP	CORRUGATED METAL PIPE
PVC	POLYVINYLCHLORIDE PIPE
HDPE	HIGH-DENSITY POLYETHYLINE PIPE
VC	VITRIFIED CLAY PIPE
FFE	FINISHED FLOOR ELEVATION
TBR	TO BE REMOVED
TBT	TO BE TRANSPLANTED



VICINITY MAP

SCALE: 1"= 2000'

SHEET INDEX

SHEET C1.0.0	COVER SHEET
SHEET C2.2.2	STORMDRAIN PLAN AND PROFILE
SHEET C3.0.0	PHASE 1 SITE PLAN
SHEET C7.0.0	STORMWATER AND ROAD SECTION DETAILS

LAND USE SUMMARY:

PROJECT NAME:	WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
OWNER–DEVELOPER:	WILLIAMSBURG CHRISTIAN RETREAT ASSOCIATION, INC.
CONTACT PERSON:	BOB BRISCOE, PH. 757–566–2256, FAX 757–566–4875
TAX MAP – PARCEL #:	3–4, 1–3D
MAGISTERIAL DISTRICT:	STONEHOUSE
PROPERTY ADDRESS:	9275 BARNES ROAD, TOANO, VA 23168
ZONING:	A–1
PROFFERS:	NA
WAIVER – VARIANCE REQUESTS:	NA
SURVEY SOURCES:	PHOTOGRAMMETRIC MAPPING – LOUISA AERIAL SURVEYS, INC., P.O. BOX 430 MINERAL, VA, 23117
DATUM:	NAVD 88 – MONUMENT WITH BRASS CAP AT INTERSECTION OF BARNES ROAD AND BARHAMSVILLE ROAD
WATERSHED	THIS SITE LIES IN THE DIASCUND WATERSHED
FEMA FIRM PANEL	MAP #51095C0040C, ZONE X

NOTE:
PRIVATELY OWNED UTILITIES (E.G. WATER LINES, FIRE MAINS) SHOWN ON THIS PLAN ARE REGULATED BY THE VIRGINIA UNIFORM STATEWIDE BUILDING CODE AND ENFORCED BY THE CODE COMPLIANCE DIVISION. THESE PRIVATELY OWNED UTILITIES MUST COMPLY FULLY WITH THE INTERNATIONAL PLUMBING CODE, THE NATIONAL FIRE PREVENTION ASSOCIATION STANDARD 24, AND THE INTERNATIONAL FIRE CODE. CONTRACTORS WORKING FROM THIS SITE PLAN ARE CAUTIONED NOT TO INSTALL OR CONCEAL PRIVATELY OWNED SITE UTILITIES WITHOUT OBTAINING REQUIRED PERMITS AND INSPECTIONS.

AREA TABULATIONS (BASED ON AS–BUILT AND FUTURE PLANS):

TOTAL SITE AREA:	149.8 ACRES
EX. BUILDINGS:	20,412 S.F.
FUTURE MULTIPURPOSE BLDG..:	7,004 S.F.
AS–BUILT COMMONS AT CABINS:	2,770 S.F.
FUTURE COMMONS 2 AND 3:	EACH 2,312 S.F. – TOTAL 4,624 S.F.
AS–BUILT CABINS (5):	EACH 1,480 S.F. – TOTAL 7,400 S.F.
FUTURE CABINS (10):	EACH 965 S.F. – TOTAL 9,650
TOTAL AS–BUILT AND FUTURE BLDGS:	31,448 S.F.
TOTAL BUILDINGS:	51,860 S.F. = 1.19 AC = 0.80%
EX. PAVED SURFACES:	195,380 S.F.
AS–BUILT ROAD & PARKING:	29,801
FUTURE ROAD & PARKING:	18,016 SF
TOTAL PAVED:	243,197 S.F. = 5.58 AC = 3.73%
NET OPEN SPACE:	143.03 AC = 95.48%
MULTIPURPOSE BLDG. CONST.:	STEEL FRAME
HEIGHT:	SINGLE STORY, APPROX. 22 FEET INTERIOR HEIGHT
COMMONS CONSTRUCTION:	POLYSTEEL AND WOOD
HEIGHT:	SINGLE STORY, CATHEDRAL CEILING, APPROX. 20 FEET INTERIOR HEIGHT
CABIN CONSTRUCTION:	POLYSTEEL AND WOOD
HEIGHT:	SINGLE STORY, 9 FOOT INTERIOR CEILING

PARKING TABULATIONS:

FUTURE MULTIPURPOSE BLDG..:	51 SPACES
PER COMMONS:	10 SPACES – TOTAL 30 SPACES
TOTAL PROVIDED:	81 SPACES

PROJECTED OVERALL IMPERVIOUS AREA OF SITE BASED ON MASTER PLAN: 8.0%

SEAL

COMMONWEALTH OF VIRGINIA
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NO. 019933
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APPROVALS

SHEET

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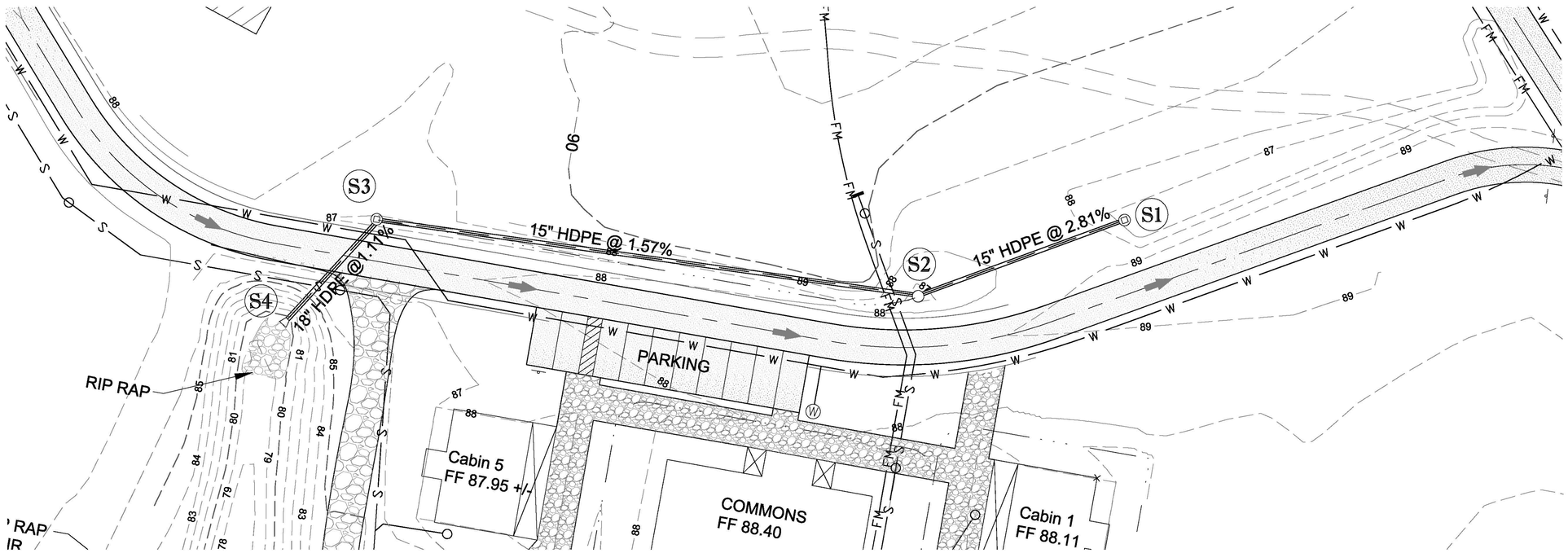
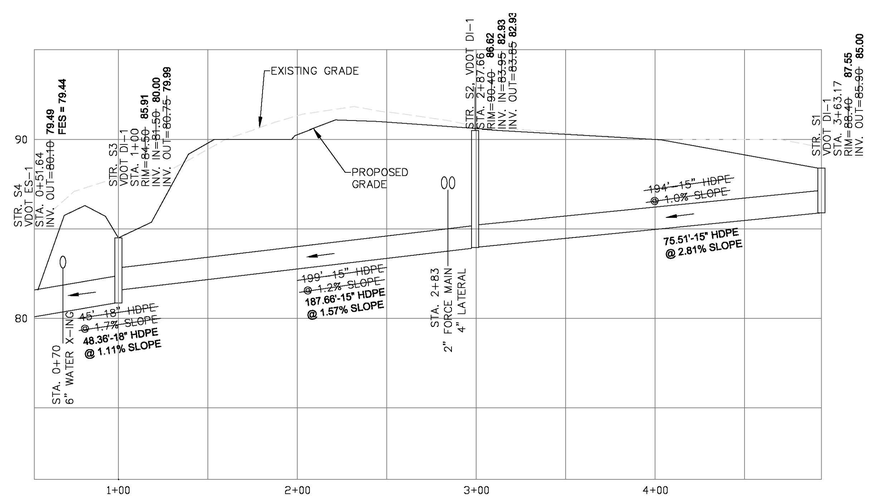


GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.



STORM SEWER PROFILE S1 - S4

SCALE: HORIZ. 1" = 40' (AS-BUILT, NTS)
VERT. 1" = 4'

RECORD DRAWING

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NOTE:
PROVIDE INLET SHAPING FOR ALL STORMWATER INLETS PER VDOT IS-1 GUIDELINES.
VDOT ROAD AND BRIDGE STANDARDS, 106.08

6" PVC, C900, DR-18 W.L.
2" FORCE MAIN
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PRIMARY DRAINFIELD #1
RESERVE DRAINFIELD #1
ONE WAY DO NOT ENTER SIGNS
6"X6"X6" TEE
CONNECT TO EXISTING 8" WATER LINE W/ 6"X8" REDUCER
MAKE FLUSH CONNECTION WITH EXISTING 12' WIDE GRAVEL ROAD
EX. 8" WATER LINE
PAVILION
VDOT DI-1, TOP=86.62
INV. IN=82.93, INV. OUT=82.93
VDOT DI-1, TOP=85.91
INV. IN=80.00, INV. OUT=79.99
HANDICAP PARKING SIGN
15" HDPE @ 2.81%
15" HDPE @ 1.57%
15" HDPE @ 1.57%
PARKING
VDOT DI-1, TOP=87.55
INV. OUT=85.0
S1
S2
S3
S4
WATER CONNECTION
COMMONS FF 88.40
Cabin 1 FF 88.11
Cabin 2 FF 86.92
Cabin 3 FF87.37
Cabin 4 FF 86.39
Cabin 5 FF 87.95
4' WIDE, CRUSHER RUN GRAVEL PATH 3 INCH DEPTH
4" PVC SEWER LATERAL (TYP.)
2" FORCE MAIN
EFFLUENT PUMP CHAMBER
SEPTIC TANKS
DRAINFIELD
10' WIDE GRAVEL MAINTENANCE ACCESS CORRIDOR
115' x 20' OF VDOT EC-3, TYPE A CHANNEL LINING.
RIP RAP
RIP RAP WEIR
SWM BASIN
MICROPOOL TOP 75.0 BOT 73.0
3H:1V
95' 93' L.F. TIMBER WALL (EXPOSED TOP)
WOOD WALL TOP 80.51
WOOD WALL WEIR TOP 80.51 BOT 79.50
UPPER PIPE: 3" PVC PIPE INV OUT 76.02
LOWER PIPE: 1.25" INSIDE DIAMETER SCH 40 PVC PIPE INV OUT 75.07
LEVEL SPREADER TOP 74.98
OUTFALL DISSIPATER

STORMWATER EXTENDED DRY DETENTION BASIN
1 YEAR WATER ELEVATION = 76.30
2 YEAR WATER ELEVATION = 77.05
10 YEAR WATER ELEVATION = 79.56
100 YEAR WATER ELEVATION = 79.95

GRAPHIC SCALE
(IN FEET)
1 inch = ft. 40

RECORD DRAWING

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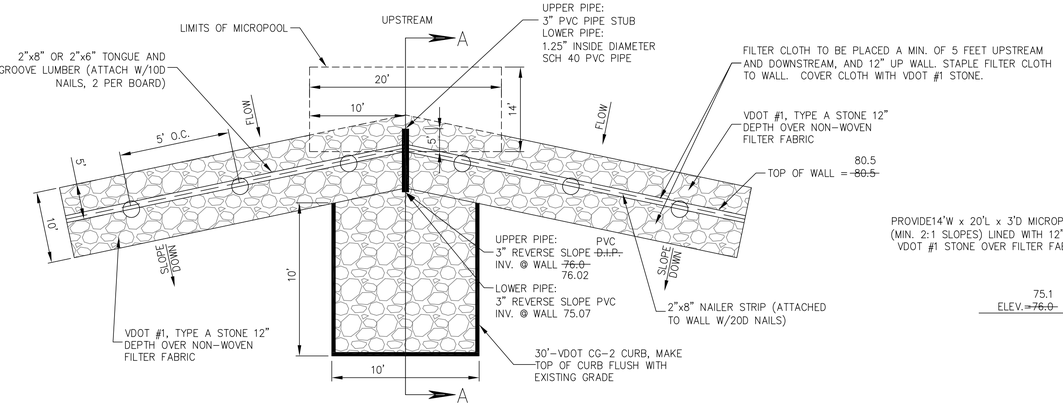
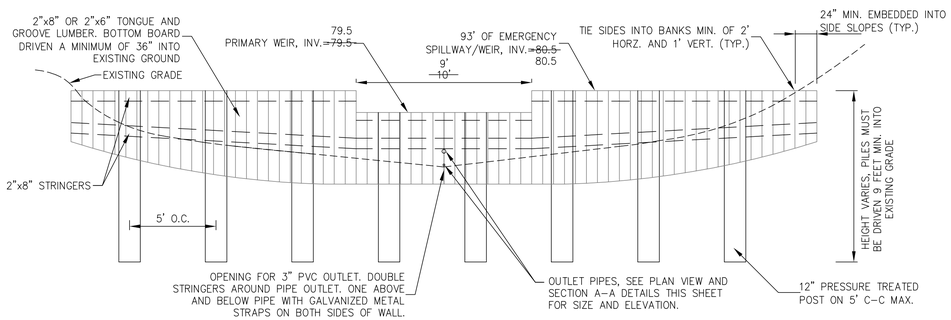
J.N.0716



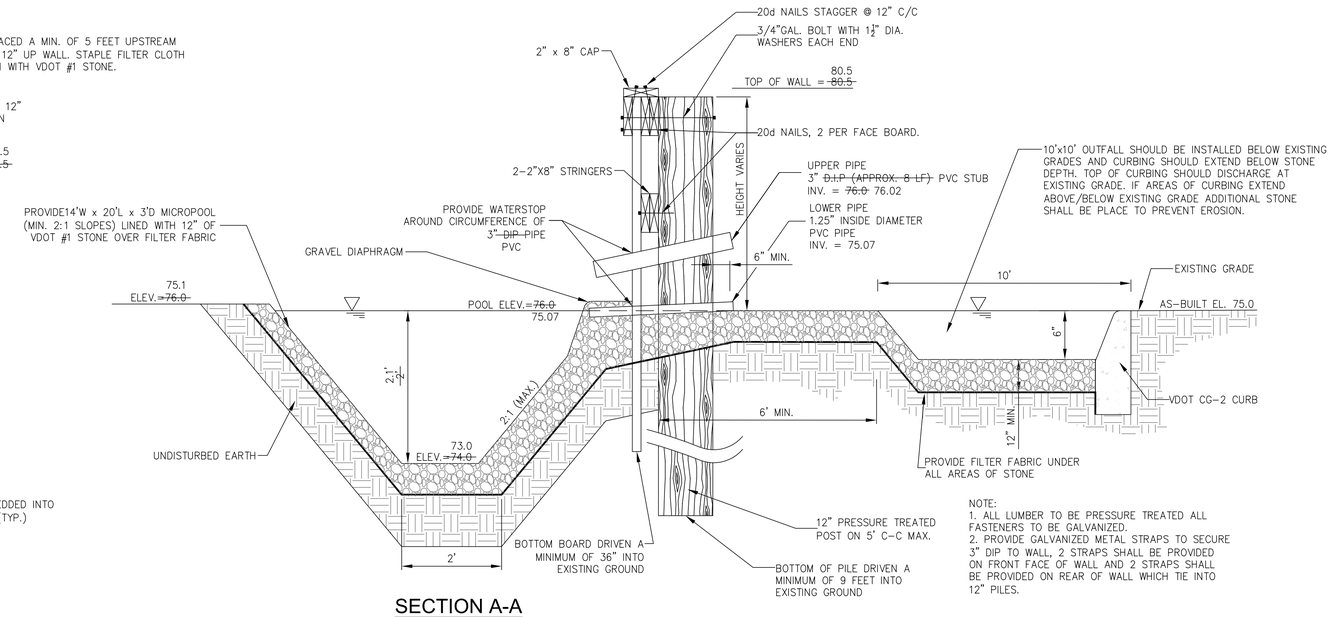
PLAN VIEW
PRESSURE TREATED WOOD DRY DETENTION STRUCTURE

NOT TO SCALE



UPSTREAM ELEVATION
PRESSURE TREATED WOOD DRY DETENTION STRUCTURE

NOT TO SCALE



NOTE:
1. ALL LUMBER TO BE PRESSURE TREATED ALL FASTENERS TO BE GALVANIZED.
2. PROVIDE GALVANIZED METAL STRAPS TO SECURE 3" DIP TO WALL, 2 STRAPS SHALL BE PROVIDED ON FRONT FACE OF WALL AND 2 STRAPS SHALL BE PROVIDED ON REAR OF WALL WHICH TIE INTO 12" PILES.

SECTION A-A
PRESSURE TREATED WOOD DRY DETENTION STRUCTURE

NOT TO SCALE

75.1
EL. ~~76.0~~ DENOTES AS-BUILT ELEVATION

Maintenance Plan Extended Detention Basin

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 will be performed at least quarterly. It is anticipated that under normal conditions, sediment removal will 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 should be implemented with inspections performed at least once weekly.

The Owner or its designated representative will 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 County may jointly inspect the structure. Appropriate action, performed at the cost of the owner will be taken to ensure appropriate maintenance. Keys to locked access points or structures shall be made available to the County upon request.

BMP Description: Extended Detention Basin serves a drainage area of 3.6 acres associated with Williamsburg Christian Retreat Center Youth Facility. The facility is a 4 point, dry-type detention facility, County Type F-1 TIMBER WALL BMP. A dry-type detention basin temporarily stores runoff and is normally dry during non-rainfall periods. Typically draw down times range from 24 to 72 hours following a storm event. Principal structures associated with the BMP consist of a TIMBER WALL. There is a broad crested weir and orifice in the wall to provide for water quality draw down and to offer control for the 2- and 10- year design storm events. During the 100-year storm, the maximum water level should rise to about 0.6 feet below the top of the wall.

Inspection and maintenance of the facility will consist of the following additional 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 1' _ 0" above the bottom of pond (or Cleanout Elevation of 77.0) , removal is required. At the same time, or at least once per year, clean pretreatment devices, the riser bottom and outlet pipes of accumulated sediments. Dispose of sediments removed from the facility at an acceptable disposal area.
2. In stabilized pond areas, if vegetation covers less than 40 % of soil surfaces, lime, fertilize and seed in accordance with recommendations for new seedlings. If vegetation covers more than 40 % but less than 70 % of soil surfaces, lime, fertilize and over seed in accordance with current seeding recommendations or requirements of the Virginia Erosion and Sediment Control Handbook (VESCH).
3. Perform quarterly inspections of the crest 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 drain or channel inflow locations to maintain the integrity of the structure and provide an attractive appearance.
4. Perform yearly structural inspections of the facility for damage. Structural inspection shall be performed on the piles and lumber. If damage is evident, further investigation by a professional engineer may be required to assess the integrity of the structure.
5. 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 reseeding.
6. 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. Appropriate action is required to ensure adequacy and to provide a clear, safe passage for maintenance vehicles to the engineered embankment and principal flow control structures.
7. Inspect and exercise pond drain valves, if provided, on a regular basis.
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 County upon request.
9. The facility shall not accept additional drainage or be modified in any way without prior consent or approval by the Environmental Division of James City County.

Step 1: Determine Design ADT

ADT	30
%HCV = 100 x HCV x ADT) or 20 x HCV. Note: For %HCV ≤ 5%, use ADT	0 (Note: For %HCV>5%, EPT>ADT)
Design ADT. Use greater of ADT or EPT	30

Step 2: Determine Design Values CBR, RF, and SSV

Sample	DBR_T
# 1	4
# 2	
# 3	
#	
#	
#	

Resiliency Factor	(RF)
Source	Value
Table 1	
Appendix I	1.0
DME approved RF	

For preliminary designs, use the lowest RF value in the equation

CBR_D x RF = **SSV**

(4) x (1) = 4

Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

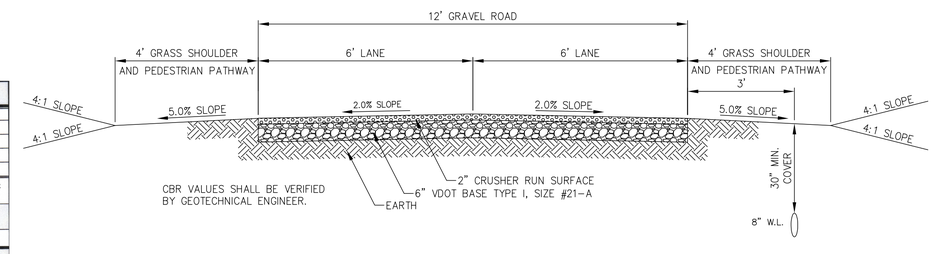
☒ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B

☐ (B) Show pavement section as developed in the Pavement Design Guide. (See Appendix III for material notations and thickness equivalency values (a)) D_R = _____ from Appendix II

Description of Proposed Pavement Section

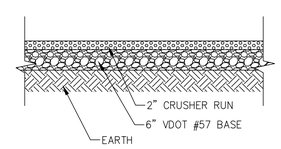
	Material Notation	Thickness, h	a	(a x h)
Surface	Crusher Run	2"		
Base	Type I, Size #21-A	6"		
Subbase				

D_P must equal or exceed the value of D_R. $D_P = \Sigma(a \times h) =$



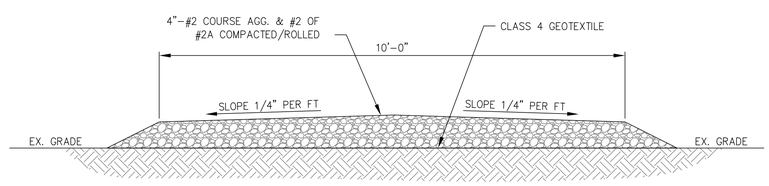
ROAD SECTION

NOT TO SCALE



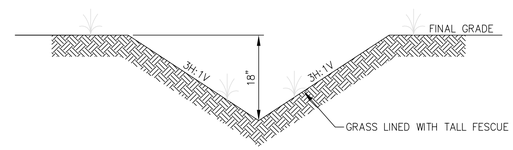
TYPICAL PARKING LOT SECTION DETAIL

NOT TO SCALE



GRAVEL MAINTENANCE CORRIDOR DETAIL

NOT TO SCALE



TYPICAL STORMWATER CONVEYANCE CHANNEL DETAIL

NOT TO SCALE

RECORD DRAWING

TERRA ENGINEERING AND LAND SOLUTIONS, PC
PLANNING
LAND SURVEYING
CIVIL ENGINEERING
2374 STUARTS DRAFT HIGHWAY
STUARTS DRAFT, VIRGINIA 24477
PH. 540-337-4591 FAX 540-337-5291

WILLIAMSBURG CHRISTIAN RETREAT CENTER

JAMES CITY COUNTY, VIRGINIA

STORMWATER AND ROAD SECTION DETAILS

JAMES CITY COUNTY PLAN # SP-0054-2011 (AMENDS # SP 012-08)

COMMONWEALTH OF VIRGINIA
STEVEN L. DRIVER
NO. 019933
PROFESSIONAL ENGINEER

SCALE: AS SHOWN
ISSUED: 03-19-12
DRAWN: JEF & PAB
DESIGN: JEF, JHF
CHECKED: SLD
REVISED: ATE

REVISIONS:
1. 9-6-12 RECORD DRAWING
2.
3.
4.
5.
6.
7.
8.
9.
10.

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J.N.0716

SP-58-92

~~H003~~

DC 009

SP-42-90

WILLIAMSBURG CHRISTIAN RETREAT CENTER

RECEPTION BUILDING ADDITION

JAMES CITY COUNTY, VIRGINIA

STORM DRAINAGE CALCULATIONS

& DETENTION BASIN ANALYSIS CHECK

MAY 1992

COMMONWEALTH OF VIRGINIA
LOUIS M. PENCI
No. 1328-B
LAND SURVEYOR

PREPARED BY

LOUIS M PENCI, INC.

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

ANALYSIS CHECK - SEDIMENT BASIN DESIGN

DEVELOPED CONDITION (PER 5/2/90 CALCULATIONS)

8.10 ACRES (0.0127 SQ. MI.)
HGS = B & C
CN = 75 AVG.

0.20 AC. PAVED @ 98
0.33 AC. BLDG @ 98
1.05 AC. GRAVEL @ 87
6.52 AC. OPEN SPACE @ 71

CN = 74.8 USE 75

DEVELOPED CONDITION (ADJUSTED TO INCLUDE NEW BLDG & PARKING)

8.10 ACRES (0.0127 SQ. MI.)
HGS = B & C
CN = 75 AVG.

0.21 AC. PAVED @ 98
0.41 AC. BLDG @ 98
1.16 AC. GRAVEL @ 87
6.32 AC. OPEN SPACE @ 71

CN = 75.4 USE 75

NO APPRECIABLE CHANGE

CONCLUSION: THE MINOR CHANGE FROM OPEN SPACE TO PROPOSED RECEPTION BLDG. & PARKING WILL YIELD THE SAME RESULTS AS THE ORIGINAL CALCULATIONS, SINCE ALL INPUT VARIABLES WILL BE THE SAME.

Calculated By: L. PENCI Date: 4-11-92
Checked By: _____ Date: _____
N= 0.013 RCP ; 0.030 EARTH DITCH
Storm Frequency 10 YEAR

LOUIS M. PENCI, INC.

LAND PLANNING SUBDIVISIONS SITE PLANS SURVEYING

STORM DRAINAGE COMPUTATION SHEET

Project No.: 910242
Project Desc. RECEPTION BLDG. ADDITION
WMBG. CHRISTIAN RETREAT CENTER
Sheet _____ of _____ Sheets

LOCATION				RUN-OFF										PIPE - CHANNEL DESIGN						HYDRAULIC GRADE LINE								
				AREA-ACRES					TIME OF FLOW - MIN.																			
LINE	RUN	FROM	TO	INCREMENT	TOTAL	RUN-OFF COEFF.	INCREMENTAL CA	ACCUMULATED CA	TO INLET/ UPPER REACH	WITHIN REACH CONVEYANCE	TIME OF CONCENTRATION	INTENSITY	DISCHARGE C.F.S.	PIPE SIZE	CHANNEL SECTION	SLOPE FT./FT.	CAPACITY FULL C.F.S.	VELOCITY FULL F.P.S.	DESIGN VELOCITY F.P.S.	CONVEYANCE LENGTH FT.	INVERT UPSTREAM	INVERT DOWNSTREAM	FRICTION SLOPE FT./FT.	VELOCITY F.P.S.	$V^2/2G$ FT.	H.G.L. ELEV. UPSTREAM	H.G.L. ELEV. DOWNSTREAM	COVER ELEV. TOP OF BANK
CULVERT "A"				0.21	0.21	0.39	0.08	0.08	7.0	0.3	7.3	6.70	0.54	12"		0.0050	2.52	3.21	2.50	40	94.15	93.95	0.0002	0.69				
ROAD DITCH RETREAT PKWY				0.24	0.45	0.48	0.12	0.20		1.9	9.2	6.64	1.33	d=0.7'	2:1 2:1	0.0040	1.33	1.42	1.42	160	93.95	93.00						
ROAD DITCH LODGE ENTRANCE				0.15	0.60	0.45	0.07							d=.8	n=.05		3.56	2.8										
				1.50	2.10	0.30	0.45	0.72	16.0			4.98	3.59	d=0.66'	2:1 2:1	0.0345	3.59	4.09	4.09	75	93.00	90.40						
				(PER ORIGINAL CALCULATIONS FOR THIS SECTION =									3.43	d=0.65'	"	0.0350	3.43	4.06	4.06	) NEGLIGIBLE CHANGE IN C.F.S. OR VELOCITY								
CULVERT "B"													3.59	15"		0.0325	11.63	9.46	8.32	40	90.40	89.10	0.0031	2.92				

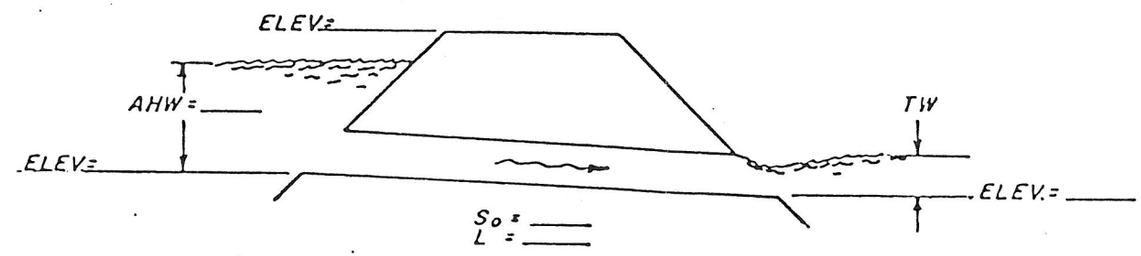
CALCULATED BY: L. PENGI DATE 4-11-92
CHECKED BY: _____ DATE _____

CULVERT COMPUTATION SHEET

JOB NO. 910242
PROJECT WMBG. CHRISTIAN RETREAT CENTER RECEPTION BUILDING ADDITION
SHEET _____ OF _____ SHEETS

HYDROLOGIC AND CHANNEL INFORMATION

SKETCH



CULVERT LOCATION _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW = H + ho − LSo: Ke	H	dc	(dc+D)/2	TW	ho	LSo	HW	CONT. HW	OUTLET VEL.	COST.	COMMENTS
CULVERT "A"	0.54	12" RCP	0.4±	0.4	0.5	0.1±	0.4	0.7	0.7	0.7	0.20	0.6	0.6	2.50		
CULVERT "B"	3.59	15" RCP	0.93	1.16	0.5	0.35±	0.75	1.0	0.7	1.0	1.30	0.05	1.16	8.32		PROVIDE RIPRAP OUTLET PROTECTION

SUMMARY & RECOMMENDATIONS:

TERRA ENGINEERING
AND
LAND SOLUTIONS, PC

2374 STUARTS DRAFT HIGHWAY, STUARTS DRAFT, VA 24477
PH. (540) 337-4591 FAX (540) 337-5291

RECEIVED
AUG 2008
Planning Department

WILLIAMSBURG CHRISTIAN RETREAT CENTER YOUTH FACILITY

JAMES CITY COUNTY, VIRGINIA

STORMWATER MANAGEMENT AND DRAINAGE DESIGN CALCULATIONS

January 18, 2008
Revised June 6, 2008
Revised August 20, 2008

COMMONWEALTH OF VIRGINIA
JAMES H. FULTZ, JR.
Lic. No. 042582
8-20-08
PROFESSIONAL ENGINEER

TERRA ENGINEERING
AND
LAND SOLUTIONS, PC

2374 STUARTS DRAFT HIGHWAY, STUARTS DRAFT, VA 24477
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4. PROPOSED RUNOFF CALCULATIONS AT TIMBER WALL SWM/BMP STRUCTURE.
5. TIMBER WALL PILE SIZING CALCULATIONS.
6. STORM SEWER DESIGN COMPUTATIONS.
7. COMPOSITE RUNOFF SURVE NUMBER CALCULATIONS AND ASSOCIATED DRAINGAGE AREA MAP.
8. CHANNEL ADEQUACY CALCULATIONS.
9. TEMPORARY SEDIMENT TRAP CALCULATIONS.
10. REFERENCE MATERIALS:
    - FEMA FIRM #51095C0040C
    - VSMH RUNOFF CURVE NUMBERS TABLE 4-6A AND 4-6B.

STORMWATER MANAGEMENT/BMP NARRATIVE

This narrative is intended for detailed descriptions concerning the design and analysis of storm water management (SWM) facilities for Williamsburg Christian Retreat Center Youth Facility. The project will create 15 cabins, 3 commons buildings, one multipurpose building and associated utilities. The site currently is covered with naturally regenerative woods that are approximately 40 years old. The total site is comprised of 149.8 acres of woods, open pasture and small areas of development. The terrain consists of gentle to moderate slopes. Existing storm water runoff exits the site through well defined natural channels. Visual inspection has confirmed that the existing channels have no indication of erosion or stressed streams. The proposed project site consists of 7.4 acres of which 6.2 acres will be disturbed. In order to minimize the environmental impacts of development on this site we have designed a Type 1 Timber Wall Extended Dry Detention Basin in order to meet storm water management requirements. The total proposed impervious area for the 149.8 acre parcel will be 6.65 acres or 4.4% of the total site.

The extended dry detention basin, a permanent water quantity facility will capture approximately 3.7 acres of the project area and maintain the 2 and 10 year existing flows. The extended detention basin will not be used for any erosion control measures. This SWM facility has been designed to release the 1-year storm event over a 24-hour period in order to satisfy stream protection volume requirements. The 1-year and 2-year storm events will be released through a 3" diameter pipe with a 1.5" circular orifice. The 10-year and 100-year storm events will be released through a 10 foot wide sharp crested weir. Extensive erosion control measures will be installed downstream of the timber wall in order to significantly reduce channel erosion possibilities.

Runoff Summary Table for Extended Detention Basin Outfall

Existing Runoff (cfs)			Proposed Runoff (cfs)	
Q_1	0.10		Q_1	0.06
Q_2	0.29		Q_2	0.08
Q_{10}	1.97		Q_{10}	1.12
Q_{100}	4.21		Q_{100}	8.00

STREAM CHANNEL PROTECTION VOLUME CALCULATIONS

Extended-Detention Basin "A" - Channel Erosion Control Volume and Orifice Design

Method 2 of VSMH,

1. The channel erosion control volume, Vs = 4,320 cubic feet. Determined from the 1-yr 24-hr storm. See hydrograph worksheet for Type II 24-hr 1 year storm.

2. Determine the *average hydraulic head*, h_{avg}, corresponding to the required channel erosion control volume.

Stage - Storage Curve: 4,320 cubic feet occurs at elevation 77.45 *ft.* Therefore,
$h_{avg} = (77.4 - 76) / 2 = 0.70\,ft.$

3. Determine the *average discharge*, Q_{avg}, resulting from the 24-hour draw down requirement.

The average discharge is calculated by dividing the required volume, in cubic feet, by the required time, in seconds, to find the average discharge.

$$Q_{avg} = \frac{4{,}320\,ft^3}{(24hr.)(3{,}600\,\text{sec.}/hr.)} = 0.05cfs$$

4. Determine the required orifice diameter by rearranging the Orifice Equation to solve for the orifice area, in ft^2, and then diameter, in *ft.*

Insert the values for Q_{avg} and h_{avg} into the Rearranged Orifice Equation to solve for the orifice area, and then solve for the orifice diameter.

$$Q = Ca\sqrt{2gh} \qquad\qquad a = \frac{Q}{C\sqrt{2gh}}$$

Orifice Equation Rearranged Orifice Equation
where:
Q = discharge, cfs
C = dimensionless coefficient = 0.6
a = area of the orifice, ft^2
g = gravitational acceleration, 32.2 ft/sec^2
h = head, ft.

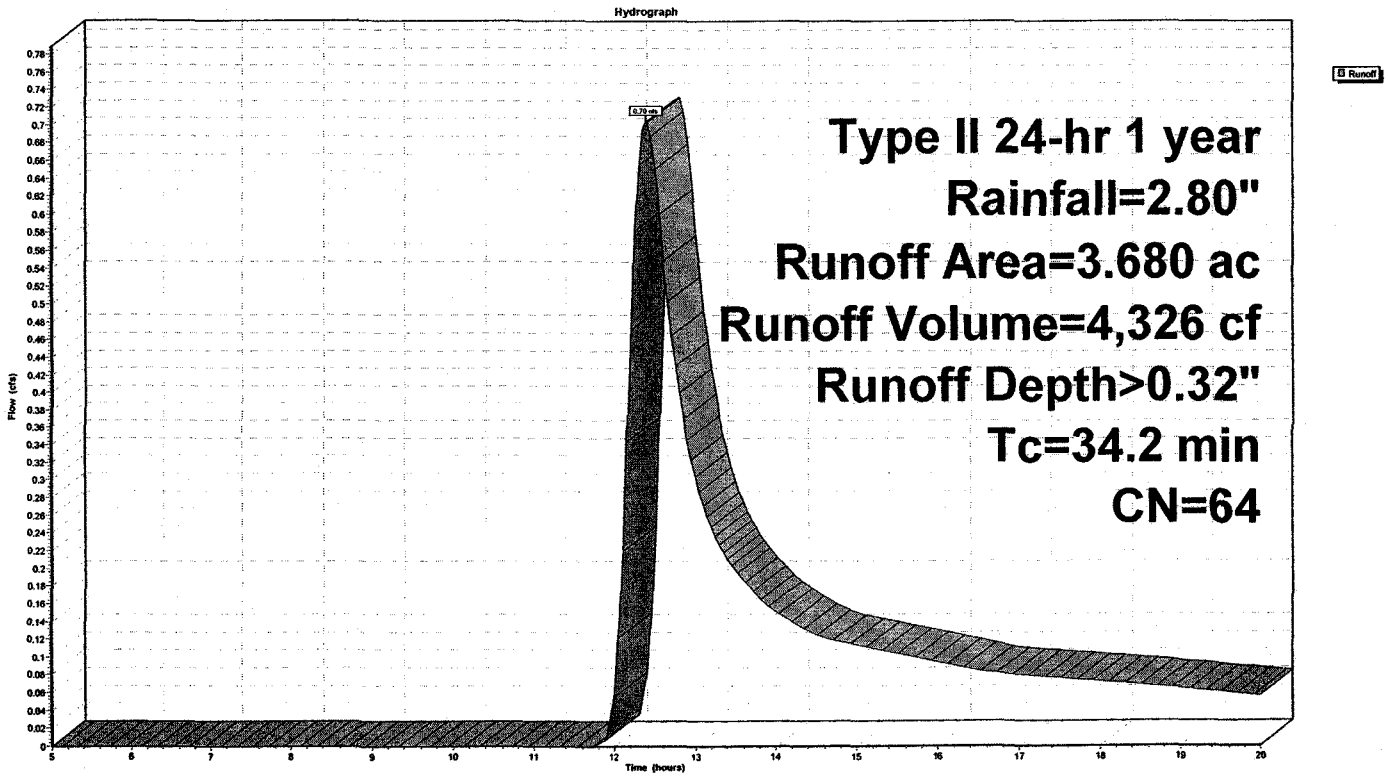
$$a = \frac{0.05}{0.6\sqrt{2 * 32.2 * 0.70}} = 0.0124\ ft^2$$

$$d = \sqrt{\frac{4a}{\pi}} = \sqrt{\frac{4(0.008)}{\pi}} = 0.126\,ft.$$

d = orifice diameter = 0.126 ft = 1.5 inches

Use 1.50-inch diameter channel erosion extended detention orifice

Subcatchment 1S: BASIN A SUBAREA



EXISTING RUNOFF CALCULATIONS AT PROPOSED TIMBER WALL SWM/BMP STRUCTURE

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
PRE-DEVELOPED FLOW AT PROPOSED TIMBER WALL

Graphical Peak Discharge method

Given Input Data:

Description	BASIN A PRE-DEVELOPED
Rainfall distribution	Type II
Frequency	1 years
Rainfall, P (24-hours)	2.8000 in
Drainage area	2.0600 ac
Runoff curve number, CN	55
Time of concentration, Tc	31.4356 min
Pond and Swamp Areas	0.0000 % of Area

Computed Results:

Initial abstraction, Ia	1.6364 in
Ia/P	0.5000
Unit peak discharge, qu	222.1679 csm/in
Runoff, Q	0.1449 in
Pond and swamp adjustment, Fp ...	1.0000
Peak discharge, qp	0.1036 cfs

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
PRE-DEVELOPED FLOW AT PROPOSED TIMBER WALL

Graphical Peak Discharge method

Given Input Data:

Description	BASIN A PRE-DEVELOPED
Rainfall distribution	Type II
Frequency	2 years
Rainfall, P (24-hours)	3.5000 in
Drainage area	2.0600 ac
Runoff curve number, CN	55
Time of concentration, Tc	31.4356 min
Pond and Swamp Areas	0.0000 % of Area

Computed Results:

Initial abstraction, Ia	1.6364 in
Ia/P	0.4675
Unit peak discharge, qu	261.1731 csm/in
Runoff, Q	0.3457 in
Pond and swamp adjustment, Fp ...	1.0000
Peak discharge, qp	0.2906 cfs

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
PRE-DEVELOPED FLOW AT PROPOSED TIMBER WALL

Graphical Peak Discharge method

Given Input Data:

Description	BASIN A PRE-DEVELOPED
Rainfall distribution	Type II
Frequency	10 years
Rainfall, P (24-hours)	5.8000 in
Drainage area	2.0600 ac
Runoff curve number, CN	55
Time of concentration, Tc	31.4356 min
Pond and Swamp Areas	0.0000 % of Area

Computed Results:

Initial abstraction, Ia	1.6364 in
Ia/P	0.2821
Unit peak discharge, qu	435.4163 csm/in
Runoff, Q	1.4042 in
Pond and swamp adjustment, Fp ...	1.0000
Peak discharge, qp	1.9680 cfs

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
PRE-DEVELOPED FLOW AT PROPOSED TIMBER WALL

Graphical Peak Discharge method

Given Input Data:

Description	BASIN A PRE-DEVELOPED
Rainfall distribution	Type II
Frequency	100 years
Rainfall, P (24-hours)	8.0000 in
Drainage area	2.0600 ac
Runoff curve number, CN	55
Time of concentration, Tc	31.4356 min
Pond and Swamp Areas	0.0000 % of Area

Computed Results:

Initial abstraction, Ia	1.6364 in
Ia/P	0.2045
Unit peak discharge, qu	469.9140 csm/in
Runoff, Q	2.7841 in
Pond and swamp adjustment, Fp ...	1.0000
Peak discharge, qp	4.2110 cfs

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
PRE-DEVELOPED TIME OF CONCENTRATION AT PROPOSED TIMBER WALL

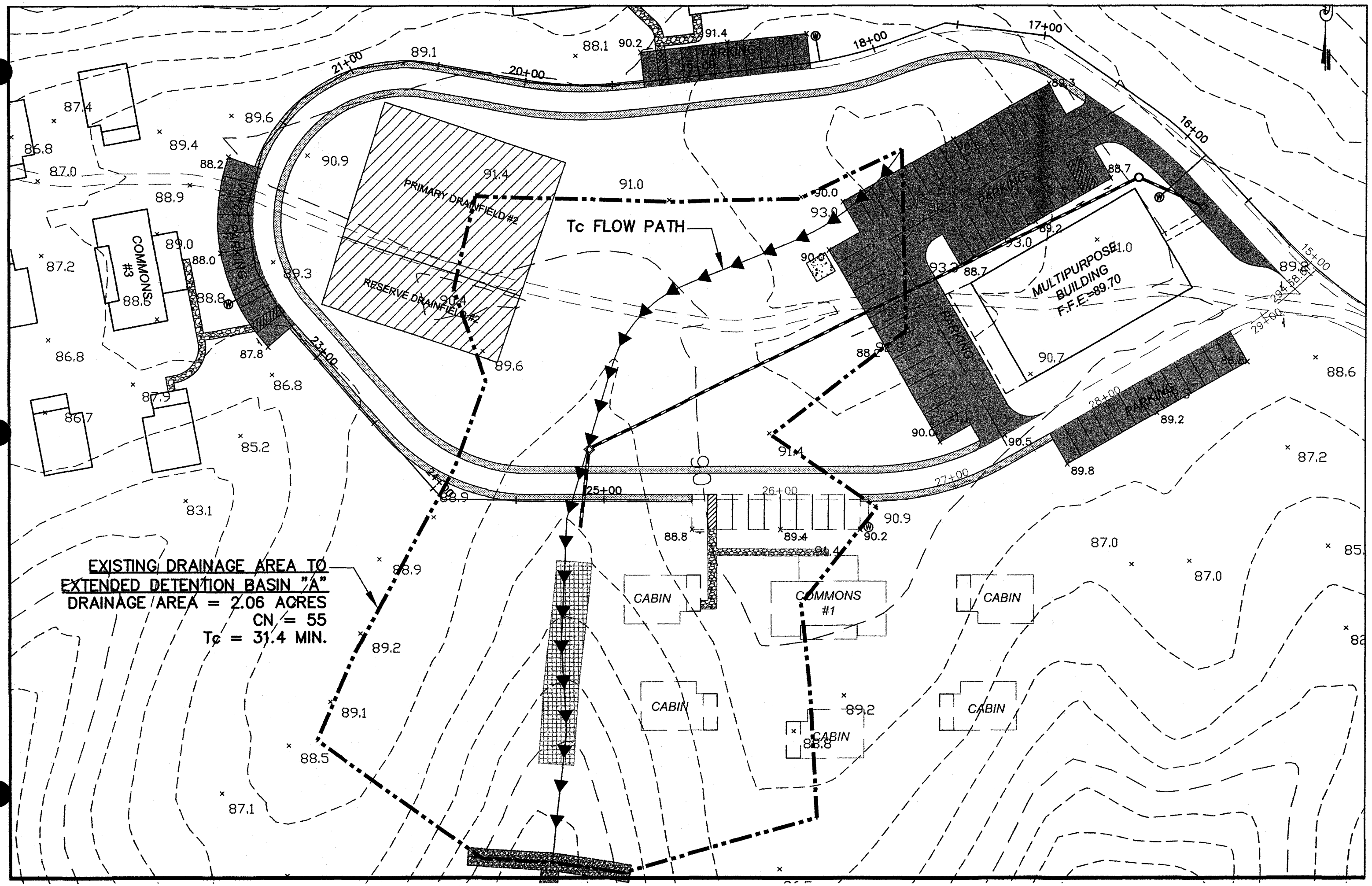
Sheet Flow

Description	pre Basin A sheet
Manning's n	0.4000
Flow Length	200.0000 ft
Two Yr, 24 hr Rainfall	3.5000 in
Land Slope	0.0310 ft/ft
Computed Sheet flow time .....>	30.0015 min

Shallow Concentrated Flow

Description	Pre Basin A shallow
Surface	Unpaved
Flow Length	256.0000 ft
Watercourse Slope	0.0340 ft/ft
Velocity	2.9751 fps
Computed Shallow flow time .....>	1.4341 min

****
Total Time of Concentration .....> 31.4356 min
****


PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
Tc FLOW PATH
PARKING
COMMONS #3
MULTIPURPOSE BUILDING
F.F.E.=89.70
COMMONS #1
CABIN
CABIN
CABIN
CABIN
CABIN
EXISTING DRAINAGE AREA TO
EXTENDED DETENTION BASIN "A"
DRAINAGE AREA = 2.06 ACRES
CN = 55
Tc = 31.4 MIN.
15+00
16+00
17+00
18+00
20+00
21+00
23+00
25+00
26+00
27+00
28+00
29+00

PROPOSED RUNOFF CALCULATIONS AT TIMBER WALL SWM/BMP STRUCTURE

Pond 2P: BASIN A

Inflow Area = 3.680 ac, Inflow Depth > 0.32" for 1 year event
Inflow = 0.70 cfs @ 12.39 hrs, Volume= 0.099 af
Outflow = 0.06 cfs @ 19.72 hrs, Volume= 0.035 af, Atten= 92%, Lag= 439.6 min
Primary = 0.06 cfs @ 19.72 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 77.00' @ 19.72 hrs Surf.Area= 3,186 sf Storage= 2,798 cf
Plug-Flow detention time= 232.1 min calculated for 0.035 af (35% of inflow)
Center-of-Mass det. time= 113.6 min (980.4 - 866.7)

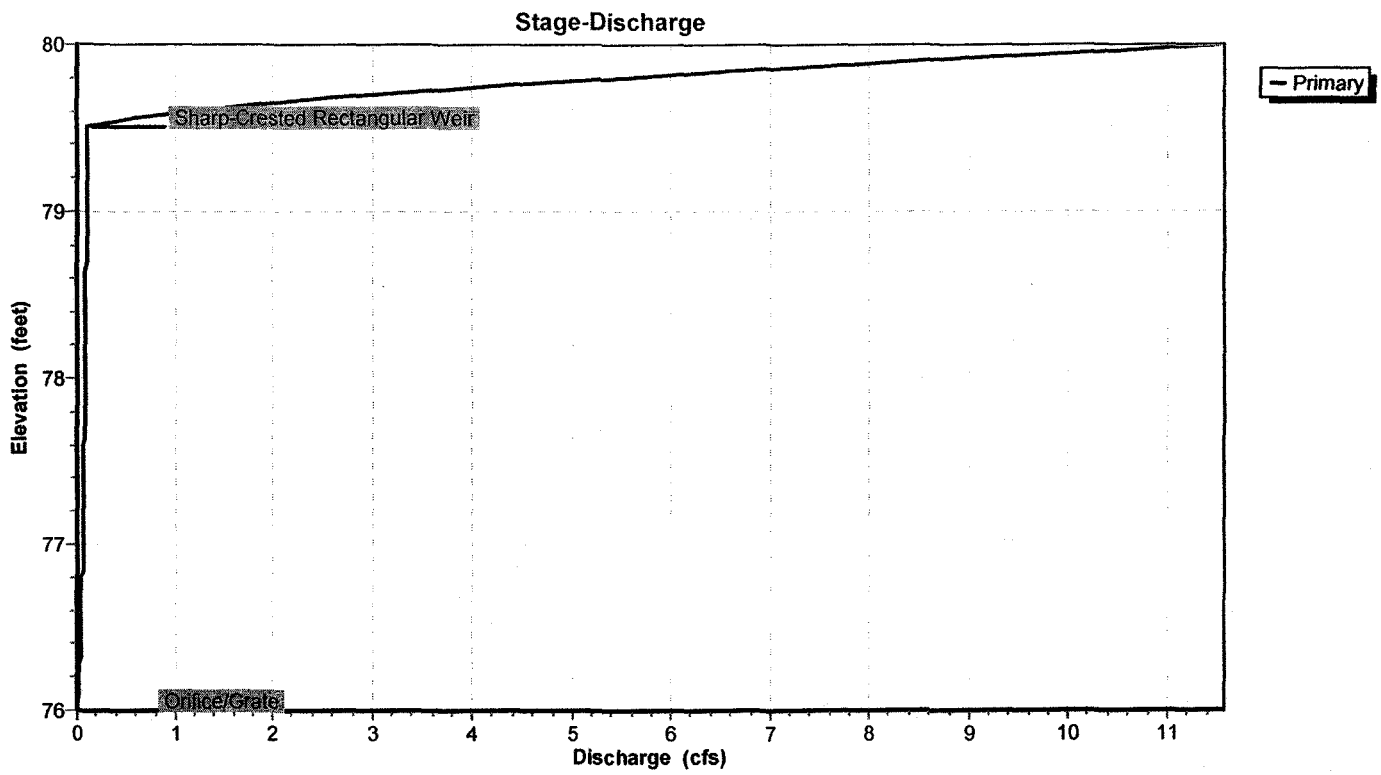
Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	17,068 cf	**BASIN A (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
76.00	2,437	252.0	0	0	2,437
78.00	4,038	389.0	6,408	6,408	9,455
80.00	6,737	481.0	10,660	17,068	15,883

Device	Routing	Invert	Outlet Devices
#1	Primary	79.50'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	76.00'	**1.5" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.06 cfs @ 19.72 hrs HW=77.00' (Free Discharge)
└─**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Orifice/Grate** (Orifice Controls 0.06 cfs @ 4.8 fps)

Pond 2P: BASIN A



Hydrograph for Pond 2P: BASIN A

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	76.00	0.00
5.25	0.00	0	76.00	0.00
5.50	0.00	0	76.00	0.00
5.75	0.00	0	76.00	0.00
6.00	0.00	0	76.00	0.00
6.25	0.00	0	76.00	0.00
6.50	0.00	0	76.00	0.00
6.75	0.00	0	76.00	0.00
7.00	0.00	0	76.00	0.00
7.25	0.00	0	76.00	0.00
7.50	0.00	0	76.00	0.00
7.75	0.00	0	76.00	0.00
8.00	0.00	0	76.00	0.00
8.25	0.00	0	76.00	0.00
8.50	0.00	0	76.00	0.00
8.75	0.00	0	76.00	0.00
9.00	0.00	0	76.00	0.00
9.25	0.00	0	76.00	0.00
9.50	0.00	0	76.00	0.00
9.75	0.00	0	76.00	0.00
10.00	0.00	0	76.00	0.00
10.25	0.00	0	76.00	0.00
10.50	0.00	0	76.00	0.00
10.75	0.00	0	76.00	0.00
11.00	0.00	0	76.00	0.00
11.25	0.00	0	76.00	0.00
11.50	0.00	0	76.00	0.00
11.75	0.00	0	76.00	0.00
12.00	0.06	9	76.00	0.00
12.25	**0.58**	267	76.11	0.02
12.50	**0.65**	847	76.33	0.03
12.75	0.43	1,292	76.49	0.04
13.00	0.30	1,578	76.60	0.05
13.25	0.24	1,776	76.66	0.05
13.50	0.20	1,926	76.71	0.05
13.75	0.17	2,046	76.75	0.05
14.00	0.15	2,144	76.79	0.05
14.25	0.14	2,227	76.81	0.05
14.50	0.13	2,296	76.84	0.05
14.75	0.12	2,358	76.86	0.05
15.00	0.11	2,413	76.88	0.06
15.25	0.11	2,463	76.89	0.06
15.50	0.10	2,509	76.91	0.06
15.75	0.10	2,550	76.92	0.06
16.00	0.09	2,586	76.93	0.06
16.25	0.09	2,617	76.94	0.06
16.50	0.08	2,643	76.95	0.06
16.75	0.08	2,667	76.96	0.06
17.00	0.08	2,688	76.96	0.06
17.25	0.08	2,707	76.97	0.06
17.50	0.08	2,724	76.97	0.06
17.75	0.07	2,740	76.98	0.06
18.00	0.07	2,753	76.98	0.06
18.25	0.07	2,765	76.99	0.06
18.50	0.07	2,776	76.99	0.06
18.75	0.07	2,784	76.99	0.06
19.00	0.07	2,790	77.00	0.06
19.25	0.06	2,795	77.00	0.06
19.50	0.06	**2,798**	**77.00**	**0.06**
19.75	0.06	**2,798**	**77.00**	**0.06**
20.00	0.06	2,797	77.00	0.06

Stage-Discharge for Pond 2P: BASIN A

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
76.00	0.00	77.12	0.06	78.24	0.09	79.36	0.11
76.02	0.00	77.14	0.06	78.26	0.09	79.38	0.11
76.04	0.01	77.16	0.06	78.28	0.09	79.40	0.11
76.06	0.01	77.18	0.06	78.30	0.09	79.42	0.11
76.08	0.02	77.20	0.06	78.32	0.09	79.44	0.11
76.10	0.02	77.22	0.07	78.34	0.09	79.46	0.11
76.12	0.02	77.24	0.07	78.36	0.09	79.48	0.11
76.14	0.02	77.26	0.07	78.38	0.09	79.50	0.11
76.16	0.02	77.28	0.07	78.40	0.09	79.52	0.20
76.18	0.03	77.30	0.07	78.42	0.09	79.54	0.37
76.20	0.03	77.32	0.07	78.44	0.09	79.56	0.59
76.22	0.03	77.34	0.07	78.46	0.09	79.58	0.85
76.24	0.03	77.36	0.07	78.48	0.09	79.60	1.14
76.26	0.03	77.38	0.07	78.50	0.09	79.62	1.47
76.28	0.03	77.40	0.07	78.52	0.09	79.64	1.82
76.30	0.03	77.42	0.07	78.54	0.09	79.66	2.20
76.32	0.03	77.44	0.07	78.56	0.09	79.68	2.60
76.34	0.03	77.46	0.07	78.58	0.09	79.70	3.03
76.36	0.04	77.48	0.07	78.60	0.10	79.72	3.47
76.38	0.04	77.50	0.07	78.62	0.10	79.74	3.94
76.40	0.04	77.52	0.07	78.64	0.10	79.76	4.43
76.42	0.04	77.54	0.07	78.66	0.10	79.78	4.93
76.44	0.04	77.56	0.07	78.68	0.10	79.80	5.46
76.46	0.04	77.58	0.07	78.70	0.10	79.82	6.00
76.48	0.04	77.60	0.07	78.72	0.10	79.84	6.55
76.50	0.04	77.62	0.08	78.74	0.10	79.86	7.13
76.52	0.04	77.64	0.08	78.76	0.10	79.88	7.72
76.54	0.04	77.66	0.08	78.78	0.10	79.90	8.32
76.56	0.04	77.68	0.08	78.80	0.10	79.92	8.94
76.58	0.05	77.70	0.08	78.82	0.10	79.94	9.58
76.60	0.05	77.72	0.08	78.84	0.10	79.96	10.23
76.62	0.05	77.74	0.08	78.86	0.10	79.98	10.89
76.64	0.05	77.76	0.08	78.88	0.10	80.00	**11.56**
76.66	0.05	77.78	0.08	78.90	0.10		
76.68	0.05	77.80	0.08	78.92	0.10		
76.70	0.05	77.82	0.08	78.94	0.10		
76.72	0.05	77.84	0.08	78.96	0.10		
76.74	0.05	77.86	0.08	78.98	0.10		
76.76	0.05	77.88	0.08	79.00	0.10		
76.78	0.05	77.90	0.08	79.02	0.10		
76.80	0.05	77.92	0.08	79.04	0.10		
76.82	0.05	77.94	0.08	79.06	0.10		
76.84	0.05	77.96	0.08	79.08	0.10		
76.86	0.05	77.98	0.08	79.10	0.10		
76.88	0.06	78.00	0.08	79.12	0.10		
76.90	0.06	78.02	0.08	79.14	0.10		
76.92	0.06	78.04	0.08	79.16	0.11		
76.94	0.06	78.06	0.08	79.18	0.11		
76.96	0.06	78.08	0.09	79.20	0.11		
76.98	0.06	78.10	0.09	79.22	0.11		
77.00	0.06	78.12	0.09	79.24	0.11		
77.02	0.06	78.14	0.09	79.26	0.11		
77.04	0.06	78.16	0.09	79.28	0.11		
77.06	0.06	78.18	0.09	79.30	0.11		
77.08	0.06	78.20	0.09	79.32	0.11		
77.10	0.06	78.22	0.09	79.34	0.11		

Pond 2P: BASIN A

Inflow Area = 3.680 ac, Inflow Depth > 0.61" for 2 year event
Inflow = 1.61 cfs @ 12.35 hrs, Volume= 0.187 af
Outflow = 0.08 cfs @ 20.00 hrs, Volume= 0.049 af, Atten= 95%, Lag= 458.8 min
Primary = 0.08 cfs @ 20.00 hrs, Volume= 0.049 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 77.90' @ 20.00 hrs Surf.Area= 3,950 sf Storage= 6,015 cf
Plug-Flow detention time= 239.6 min calculated for 0.049 af (26% of inflow)
Center-of-Mass det. time= 128.0 min (977.4 - 849.4)

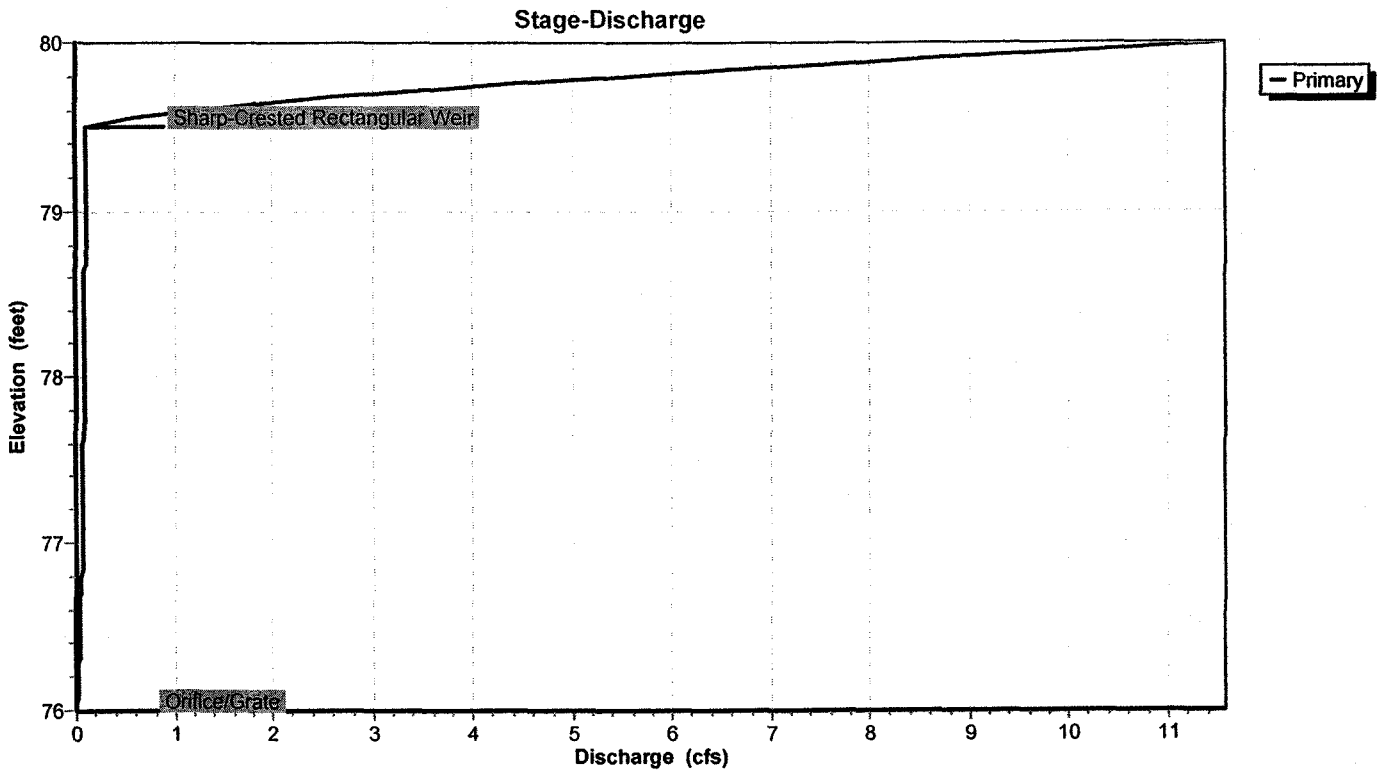
Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	17,068 cf	**BASIN A (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
76.00	2,437	252.0	0	0	2,437
78.00	4,038	389.0	6,408	6,408	9,455
80.00	6,737	481.0	10,660	17,068	15,883

Device	Routing	Invert	Outlet Devices
#1	Primary	79.50'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	76.00'	**1.5" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.08 cfs @ 20.00 hrs HW=77.90' (Free Discharge)
└─**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Orifice/Grate** (Orifice Controls 0.08 cfs @ 6.6 fps)

Pond 2P: BASIN A



Hydrograph for Pond 2P: BASIN A

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	76.00	0.00
5.25	0.00	0	76.00	0.00
5.50	0.00	0	76.00	0.00
5.75	0.00	0	76.00	0.00
6.00	0.00	0	76.00	0.00
6.25	0.00	0	76.00	0.00
6.50	0.00	0	76.00	0.00
6.75	0.00	0	76.00	0.00
7.00	0.00	0	76.00	0.00
7.25	0.00	0	76.00	0.00
7.50	0.00	0	76.00	0.00
7.75	0.00	0	76.00	0.00
8.00	0.00	0	76.00	0.00
8.25	0.00	0	76.00	0.00
8.50	0.00	0	76.00	0.00
8.75	0.00	0	76.00	0.00
9.00	0.00	0	76.00	0.00
9.25	0.00	0	76.00	0.00
9.50	0.00	0	76.00	0.00
9.75	0.00	0	76.00	0.00
10.00	0.00	0	76.00	0.00
10.25	0.00	0	76.00	0.00
10.50	0.00	0	76.00	0.00
10.75	0.00	0	76.00	0.00
11.00	0.00	0	76.00	0.00
11.25	0.00	0	76.00	0.00
11.50	0.00	0	76.00	0.00
11.75	0.00	0	76.00	0.00
12.00	0.24	53	76.02	0.01
12.25	**1.45**	783	76.31	0.03
12.50	**1.39**	2,126	76.78	0.05
12.75	0.84	3,051	77.08	0.06
13.00	0.56	3,610	77.25	0.07
13.25	0.42	3,982	77.35	0.07
13.50	0.34	4,257	77.43	0.07
13.75	0.29	4,475	77.49	0.07
14.00	0.26	4,655	77.54	0.07
14.25	0.23	4,806	77.58	0.07
14.50	0.21	4,935	77.62	0.08
14.75	0.20	5,049	77.65	0.08
15.00	0.19	5,153	77.68	0.08
15.25	0.18	5,249	77.70	0.08
15.50	0.17	5,337	77.73	0.08
15.75	0.16	5,416	77.75	0.08
16.00	0.15	5,488	77.77	0.08
16.25	0.14	5,551	77.78	0.08
16.50	0.14	5,606	77.80	0.08
16.75	0.13	5,656	77.81	0.08
17.00	0.13	5,702	77.82	0.08
17.25	0.13	5,745	77.83	0.08
17.50	0.12	5,785	77.84	0.08
17.75	0.12	5,822	77.85	0.08
18.00	0.12	5,856	77.86	0.08
18.25	0.11	5,887	77.87	0.08
18.50	0.11	5,915	77.88	0.08
18.75	0.11	5,939	77.88	0.08
19.00	0.10	5,961	77.89	0.08
19.25	0.10	5,979	77.89	0.08
19.50	0.10	5,995	77.90	0.08
19.75	0.09	6,007	77.90	0.08
20.00	0.09	**6,015**	**77.90**	**0.08**

Stage-Discharge for Pond 2P: BASIN A

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
76.00	0.00	77.12	0.06	78.24	0.09	79.36	0.11
76.02	0.00	77.14	0.06	78.26	0.09	79.38	0.11
76.04	0.01	77.16	0.06	78.28	0.09	79.40	0.11
76.06	0.01	77.18	0.06	78.30	0.09	79.42	0.11
76.08	0.02	77.20	0.06	78.32	0.09	79.44	0.11
76.10	0.02	77.22	0.07	78.34	0.09	79.46	0.11
76.12	0.02	77.24	0.07	78.36	0.09	79.48	0.11
76.14	0.02	77.26	0.07	78.38	0.09	79.50	0.11
76.16	0.02	77.28	0.07	78.40	0.09	79.52	0.20
76.18	0.03	77.30	0.07	78.42	0.09	79.54	0.37
76.20	0.03	77.32	0.07	78.44	0.09	79.56	0.59
76.22	0.03	77.34	0.07	78.46	0.09	79.58	0.85
76.24	0.03	77.36	0.07	78.48	0.09	79.60	1.14
76.26	0.03	77.38	0.07	78.50	0.09	79.62	1.47
76.28	0.03	77.40	0.07	78.52	0.09	79.64	1.82
76.30	0.03	77.42	0.07	78.54	0.09	79.66	2.20
76.32	0.03	77.44	0.07	78.56	0.09	79.68	2.60
76.34	0.03	77.46	0.07	78.58	0.09	79.70	3.03
76.36	0.04	77.48	0.07	78.60	0.10	79.72	3.47
76.38	0.04	77.50	0.07	78.62	0.10	79.74	3.94
76.40	0.04	77.52	0.07	78.64	0.10	79.76	4.43
76.42	0.04	77.54	0.07	78.66	0.10	79.78	4.93
76.44	0.04	77.56	0.07	78.68	0.10	79.80	5.46
76.46	0.04	77.58	0.07	78.70	0.10	79.82	6.00
76.48	0.04	77.60	0.07	78.72	0.10	79.84	6.55
76.50	0.04	77.62	0.08	78.74	0.10	79.86	7.13
76.52	0.04	77.64	0.08	78.76	0.10	79.88	7.72
76.54	0.04	77.66	0.08	78.78	0.10	79.90	8.32
76.56	0.04	77.68	0.08	78.80	0.10	79.92	8.94
76.58	0.05	77.70	0.08	78.82	0.10	79.94	9.58
76.60	0.05	77.72	0.08	78.84	0.10	79.96	10.23
76.62	0.05	77.74	0.08	78.86	0.10	79.98	10.89
76.64	0.05	77.76	0.08	78.88	0.10	80.00	**11.56**
76.66	0.05	77.78	0.08	78.90	0.10		
76.68	0.05	77.80	0.08	78.92	0.10		
76.70	0.05	77.82	0.08	78.94	0.10		
76.72	0.05	77.84	0.08	78.96	0.10		
76.74	0.05	77.86	0.08	78.98	0.10		
76.76	0.05	77.88	0.08	79.00	0.10		
76.78	0.05	77.90	0.08	79.02	0.10		
76.80	0.05	77.92	0.08	79.04	0.10		
76.82	0.05	77.94	0.08	79.06	0.10		
76.84	0.05	77.96	0.08	79.08	0.10		
76.86	0.05	77.98	0.08	79.10	0.10		
76.88	0.06	78.00	0.08	79.12	0.10		
76.90	0.06	78.02	0.08	79.14	0.10		
76.92	0.06	78.04	0.08	79.16	0.11		
76.94	0.06	78.06	0.08	79.18	0.11		
76.96	0.06	78.08	0.09	79.20	0.11		
76.98	0.06	78.10	0.09	79.22	0.11		
77.00	0.06	78.12	0.09	79.24	0.11		
77.02	0.06	78.14	0.09	79.26	0.11		
77.04	0.06	78.16	0.09	79.28	0.11		
77.06	0.06	78.18	0.09	79.30	0.11		
77.08	0.06	78.20	0.09	79.32	0.11		
77.10	0.06	78.22	0.09	79.34	0.11		

Pond 2P: BASIN A

Inflow Area =	3.680 ac,	Inflow Depth >	1.90"	for	10 year event
Inflow =	5.90 cfs @	12.31 hrs,	Volume=	0.583 af	
Outflow =	1.12 cfs @	13.26 hrs,	Volume=	0.261 af,	Atten= 81%, Lag= 57.0 min
Primary =	1.12 cfs @	13.26 hrs,	Volume=	0.261 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 79.60' @ 13.26 hrs Surf.Area= 6,140 sf Storage= 14,484 cf
Plug-Flow detention time= 192.8 min calculated for 0.261 af (45% of inflow)
Center-of-Mass det. time= 105.0 min (929.6 - 824.5)

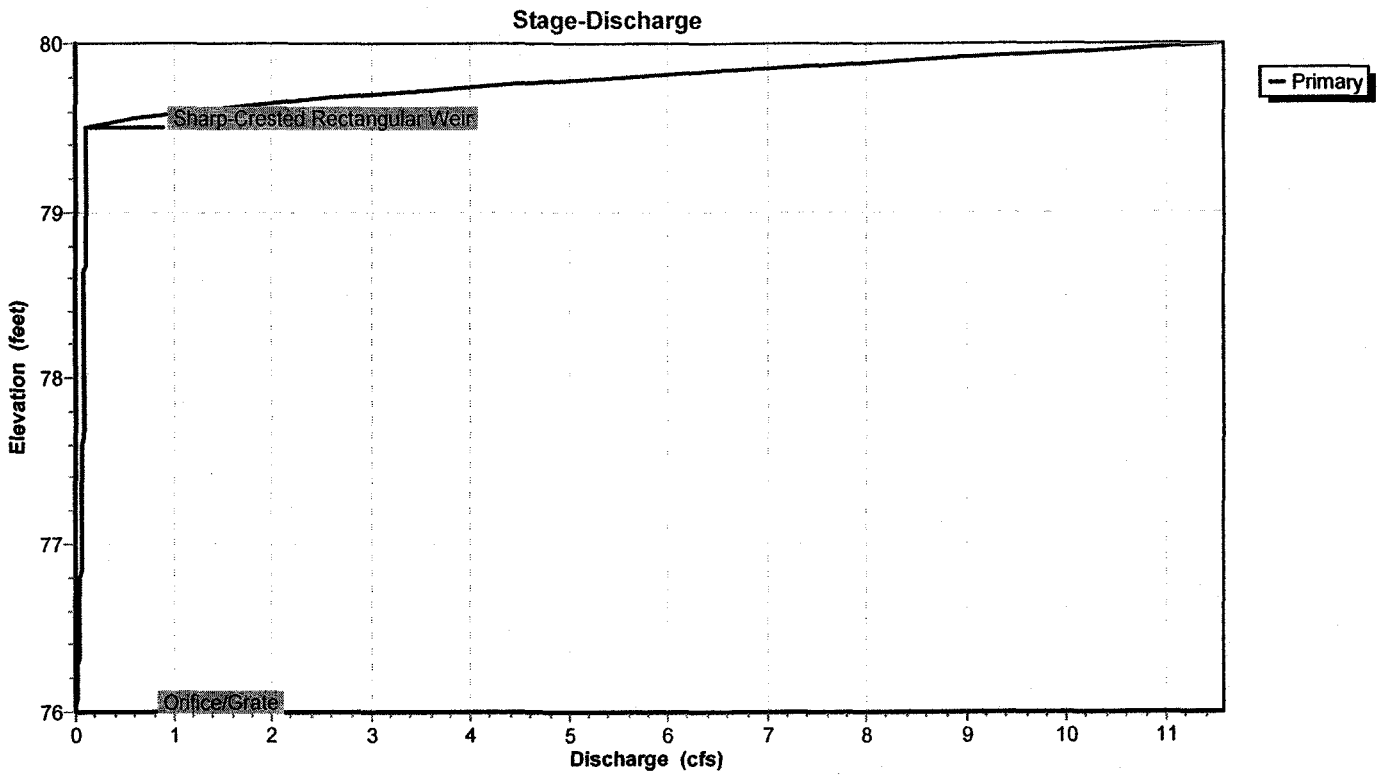
Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	17,068 cf	**BASIN A (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
76.00	2,437	252.0	0	0	2,437
78.00	4,038	389.0	6,408	6,408	9,455
80.00	6,737	481.0	10,660	17,068	15,883

Device	Routing	Invert	Outlet Devices
#1	Primary	79.50'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	76.00'	**1.5" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=1.12 cfs @ 13.26 hrs HW=79.60' (Free Discharge)
└─**1=Sharp-Crested Rectangular Weir** (Weir Controls 1.01 cfs @ 1.0 fps)
└─**2=Orifice/Grate** (Orifice Controls 0.11 cfs @ 9.1 fps)

Pond 2P: BASIN A



Hydrograph for Pond 2P: BASIN A

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	76.00	0.00
5.25	0.00	0	76.00	0.00
5.50	0.00	0	76.00	0.00
5.75	0.00	0	76.00	0.00
6.00	0.00	0	76.00	0.00
6.25	0.00	0	76.00	0.00
6.50	0.00	0	76.00	0.00
6.75	0.00	0	76.00	0.00
7.00	0.00	0	76.00	0.00
7.25	0.00	0	76.00	0.00
7.50	0.00	0	76.00	0.00
7.75	0.00	0	76.00	0.00
8.00	0.00	0	76.00	0.00
8.25	0.00	0	76.00	0.00
8.50	0.00	0	76.00	0.00
8.75	0.00	0	76.00	0.00
9.00	0.00	0	76.00	0.00
9.25	0.00	0	76.00	0.00
9.50	0.00	0	76.00	0.00
9.75	0.00	0	76.00	0.00
10.00	0.00	0	76.00	0.00
10.25	0.00	0	76.00	0.00
10.50	0.00	0	76.00	0.00
10.75	0.01	2	76.00	0.00
11.00	0.03	16	76.01	0.00
11.25	0.07	55	76.02	0.01
11.50	0.14	136	76.06	0.01
11.75	0.31	303	76.12	0.02
12.00	1.80	1,012	76.39	0.04
12.25	**5.67**	4,425	77.48	0.07
12.50	**4.63**	9,308	78.65	0.10
12.75	2.57	12,343	79.23	0.11
13.00	1.59	14,054	79.53	0.28
13.25	1.13	**14,484**	**79.60**	**1.12**
13.50	0.89	14,424	79.59	0.99
13.75	0.75	14,350	79.58	0.82
14.00	0.65	14,296	79.57	0.70
14.25	0.58	14,259	79.56	0.61
14.50	0.52	14,228	79.56	0.56
14.75	0.49	14,202	79.55	0.52
15.00	0.46	14,182	79.55	0.48
15.25	0.44	14,166	79.55	0.46
15.50	0.42	14,151	79.54	0.44
15.75	0.40	14,137	79.54	0.41
16.00	0.37	14,123	79.54	0.39
16.25	0.35	14,109	79.54	0.37
16.50	0.33	14,096	79.53	0.35
16.75	0.32	14,086	79.53	0.33
17.00	0.31	14,079	79.53	0.32
17.25	0.30	14,073	79.53	0.31
17.50	0.29	14,067	79.53	0.30
17.75	0.29	14,062	79.53	0.29
18.00	0.28	14,057	79.53	0.28
18.25	0.27	14,052	79.53	0.28
18.50	0.26	14,047	79.53	0.27
18.75	0.25	14,042	79.53	0.26
19.00	0.24	14,036	79.52	0.25
19.25	0.24	14,031	79.52	0.24
19.50	0.23	14,026	79.52	0.23
19.75	0.22	14,020	79.52	0.23
20.00	0.21	14,015	79.52	0.22

Stage-Discharge for Pond 2P: BASIN A

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
76.00	0.00	77.12	0.06	78.24	0.09	79.36	0.11
76.02	0.00	77.14	0.06	78.26	0.09	79.38	0.11
76.04	0.01	77.16	0.06	78.28	0.09	79.40	0.11
76.06	0.01	77.18	0.06	78.30	0.09	79.42	0.11
76.08	0.02	77.20	0.06	78.32	0.09	79.44	0.11
76.10	0.02	77.22	0.07	78.34	0.09	79.46	0.11
76.12	0.02	77.24	0.07	78.36	0.09	79.48	0.11
76.14	0.02	77.26	0.07	78.38	0.09	79.50	0.11
76.16	0.02	77.28	0.07	78.40	0.09	79.52	0.20
76.18	0.03	77.30	0.07	78.42	0.09	79.54	0.37
76.20	0.03	77.32	0.07	78.44	0.09	79.56	0.59
76.22	0.03	77.34	0.07	78.46	0.09	79.58	0.85
76.24	0.03	77.36	0.07	78.48	0.09	79.60	1.14
76.26	0.03	77.38	0.07	78.50	0.09	79.62	1.47
76.28	0.03	77.40	0.07	78.52	0.09	79.64	1.82
76.30	0.03	77.42	0.07	78.54	0.09	79.66	2.20
76.32	0.03	77.44	0.07	78.56	0.09	79.68	2.60
76.34	0.03	77.46	0.07	78.58	0.09	79.70	3.03
76.36	0.04	77.48	0.07	78.60	0.10	79.72	3.47
76.38	0.04	77.50	0.07	78.62	0.10	79.74	3.94
76.40	0.04	77.52	0.07	78.64	0.10	79.76	4.43
76.42	0.04	77.54	0.07	78.66	0.10	79.78	4.93
76.44	0.04	77.56	0.07	78.68	0.10	79.80	5.46
76.46	0.04	77.58	0.07	78.70	0.10	79.82	6.00
76.48	0.04	77.60	0.07	78.72	0.10	79.84	6.55
76.50	0.04	77.62	0.08	78.74	0.10	79.86	7.13
76.52	0.04	77.64	0.08	78.76	0.10	79.88	7.72
76.54	0.04	77.66	0.08	78.78	0.10	79.90	8.32
76.56	0.04	77.68	0.08	78.80	0.10	79.92	8.94
76.58	0.05	77.70	0.08	78.82	0.10	79.94	9.58
76.60	0.05	77.72	0.08	78.84	0.10	79.96	10.23
76.62	0.05	77.74	0.08	78.86	0.10	79.98	10.89
76.64	0.05	77.76	0.08	78.88	0.10	80.00	**11.56**
76.66	0.05	77.78	0.08	78.90	0.10		
76.68	0.05	77.80	0.08	78.92	0.10		
76.70	0.05	77.82	0.08	78.94	0.10		
76.72	0.05	77.84	0.08	78.96	0.10		
76.74	0.05	77.86	0.08	78.98	0.10		
76.76	0.05	77.88	0.08	79.00	0.10		
76.78	0.05	77.90	0.08	79.02	0.10		
76.80	0.05	77.92	0.08	79.04	0.10		
76.82	0.05	77.94	0.08	79.06	0.10		
76.84	0.05	77.96	0.08	79.08	0.10		
76.86	0.05	77.98	0.08	79.10	0.10		
76.88	0.06	78.00	0.08	79.12	0.10		
76.90	0.06	78.02	0.08	79.14	0.10		
76.92	0.06	78.04	0.08	79.16	0.11		
76.94	0.06	78.06	0.08	79.18	0.11		
76.96	0.06	78.08	0.09	79.20	0.11		
76.98	0.06	78.10	0.09	79.22	0.11		
77.00	0.06	78.12	0.09	79.24	0.11		
77.02	0.06	78.14	0.09	79.26	0.11		
77.04	0.06	78.16	0.09	79.28	0.11		
77.06	0.06	78.18	0.09	79.30	0.11		
77.08	0.06	78.20	0.09	79.32	0.11		
77.10	0.06	78.22	0.09	79.34	0.11		

Pond 2P: BASIN A

Inflow Area = 3.680 ac, Inflow Depth > 3.43" for 100 year event
Inflow = 10.90 cfs @ 12.30 hrs, Volume= 1.053 af
Outflow = 8.14 cfs @ 12.52 hrs, Volume= 0.730 af, Atten= 25%, Lag= 12.9 min
Primary = 8.14 cfs @ 12.52 hrs, Volume= 0.730 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 79.89' @ 12.52 hrs Surf.Area= 6,577 sf Storage= 16,363 cf
Plug-Flow detention time= 111.9 min calculated for 0.730 af (69% of inflow)
Center-of-Mass det. time= 44.5 min (857.1 - 812.6)

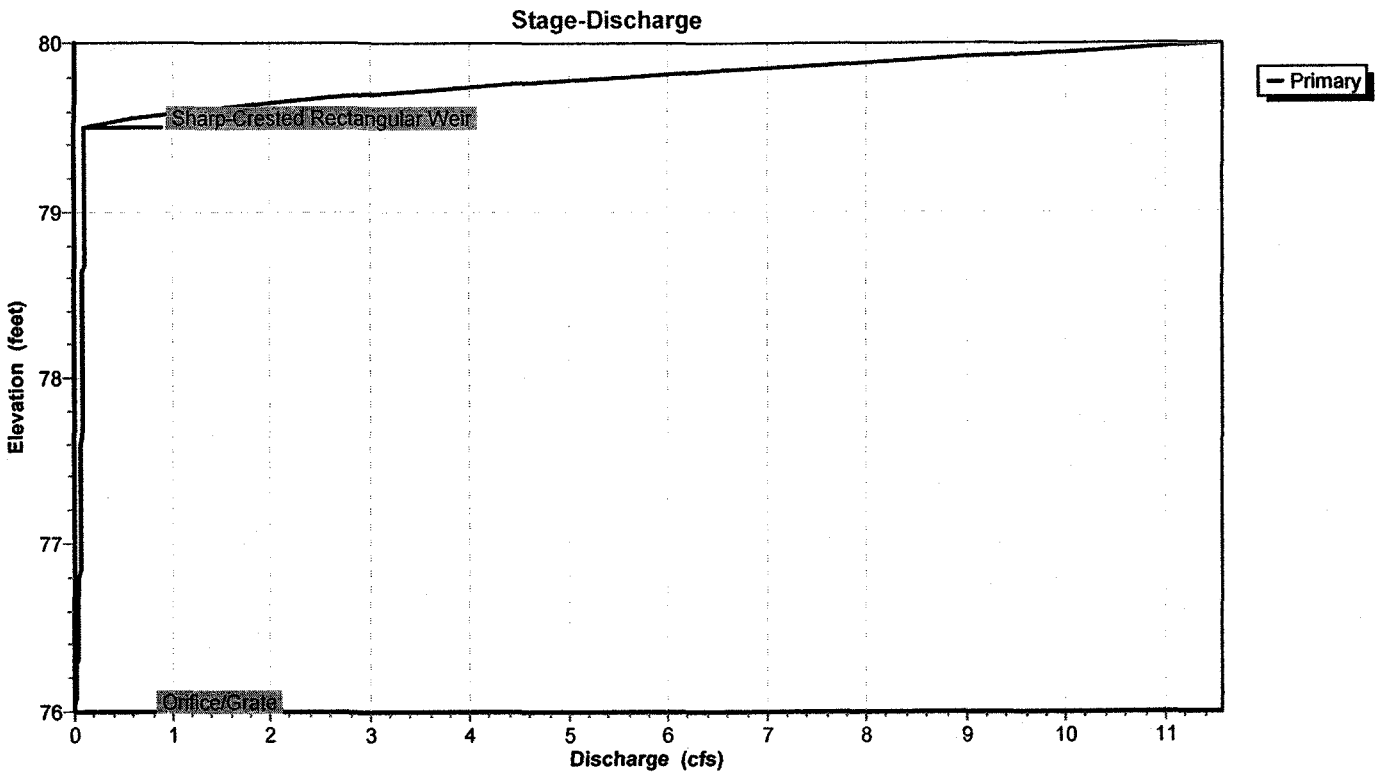
Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	17,068 cf	**BASIN A (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
76.00	2,437	252.0	0	0	2,437
78.00	4,038	389.0	6,408	6,408	9,455
80.00	6,737	481.0	10,660	17,068	15,883

Device	Routing	Invert	Outlet Devices
#1	Primary	79.50'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#2	Primary	76.00'	**1.5" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=8.00 cfs @ 12.52 hrs HW=79.89' (Free Discharge)
└─**1=Sharp-Crested Rectangular Weir** (Weir Controls 7.89 cfs @ 2.0 fps)
└─**2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 9.5 fps)

Pond 2P: BASIN A



Hydrograph for Pond 2P: BASIN A

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	76.00	0.00
5.25	0.00	0	76.00	0.00
5.50	0.00	0	76.00	0.00
5.75	0.00	0	76.00	0.00
6.00	0.00	0	76.00	0.00
6.25	0.00	0	76.00	0.00
6.50	0.00	0	76.00	0.00
6.75	0.00	0	76.00	0.00
7.00	0.00	0	76.00	0.00
7.25	0.00	0	76.00	0.00
7.50	0.00	0	76.00	0.00
7.75	0.00	0	76.00	0.00
8.00	0.00	0	76.00	0.00
8.25	0.00	0	76.00	0.00
8.50	0.00	0	76.00	0.00
8.75	0.00	0	76.00	0.00
9.00	0.00	0	76.00	0.00
9.25	0.00	2	76.00	0.00
9.50	0.02	11	76.00	0.00
9.75	0.04	33	76.01	0.00
10.00	0.06	71	76.03	0.01
10.25	0.09	128	76.05	0.01
10.50	0.13	210	76.09	0.02
10.75	0.18	330	76.13	0.02
11.00	0.25	500	76.20	0.03
11.25	0.35	742	76.29	0.03
11.50	0.51	1,092	76.42	0.04
11.75	0.89	1,643	76.62	0.05
12.00	3.87	3,339	77.16	0.06
12.25	**10.64**	10,038	78.80	0.10
12.50	**8.30**	**16,346**	**79.89**	**8.07**
12.75	4.49	15,704	79.79	5.27
13.00	2.72	15,155	79.71	3.18
13.25	1.90	14,846	79.66	2.15
13.50	1.48	14,671	79.63	1.63
13.75	1.23	14,560	79.61	1.33
14.00	1.06	14,486	79.60	1.13
14.25	0.94	14,429	79.59	1.00
14.50	0.85	14,383	79.58	0.89
14.75	0.79	14,351	79.58	0.82
15.00	0.75	14,329	79.57	0.77
15.25	0.71	14,311	79.57	0.73
15.50	0.67	14,294	79.57	0.69
15.75	0.64	14,278	79.56	0.66
16.00	0.60	14,261	79.56	0.62
16.25	0.56	14,244	79.56	0.58
16.50	0.53	14,225	79.56	0.55
16.75	0.51	14,209	79.55	0.53
17.00	0.50	14,197	79.55	0.51
17.25	0.48	14,188	79.55	0.49
17.50	0.47	14,179	79.55	0.48
17.75	0.46	14,171	79.55	0.47
18.00	0.44	14,162	79.55	0.45
18.25	0.43	14,154	79.54	0.44
18.50	0.42	14,145	79.54	0.43
18.75	0.40	14,137	79.54	0.41
19.00	0.39	14,128	79.54	0.40
19.25	0.37	14,120	79.54	0.38
19.50	0.36	14,111	79.54	0.37
19.75	0.35	14,102	79.54	0.36
20.00	0.33	14,094	79.53	0.34

Stage-Discharge for Pond 2P: BASIN A

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
76.00	0.00	77.12	0.06	78.24	0.09	79.36	0.11
76.02	0.00	77.14	0.06	78.26	0.09	79.38	0.11
76.04	0.01	77.16	0.06	78.28	0.09	79.40	0.11
76.06	0.01	77.18	0.06	78.30	0.09	79.42	0.11
76.08	0.02	77.20	0.06	78.32	0.09	79.44	0.11
76.10	0.02	77.22	0.07	78.34	0.09	79.46	0.11
76.12	0.02	77.24	0.07	78.36	0.09	79.48	0.11
76.14	0.02	77.26	0.07	78.38	0.09	79.50	0.11
76.16	0.02	77.28	0.07	78.40	0.09	79.52	0.20
76.18	0.03	77.30	0.07	78.42	0.09	79.54	0.37
76.20	0.03	77.32	0.07	78.44	0.09	79.56	0.59
76.22	0.03	77.34	0.07	78.46	0.09	79.58	0.85
76.24	0.03	77.36	0.07	78.48	0.09	79.60	1.14
76.26	0.03	77.38	0.07	78.50	0.09	79.62	1.47
76.28	0.03	77.40	0.07	78.52	0.09	79.64	1.82
76.30	0.03	77.42	0.07	78.54	0.09	79.66	2.20
76.32	0.03	77.44	0.07	78.56	0.09	79.68	2.60
76.34	0.03	77.46	0.07	78.58	0.09	79.70	3.03
76.36	0.04	77.48	0.07	78.60	0.10	79.72	3.47
76.38	0.04	77.50	0.07	78.62	0.10	79.74	3.94
76.40	0.04	77.52	0.07	78.64	0.10	79.76	4.43
76.42	0.04	77.54	0.07	78.66	0.10	79.78	4.93
76.44	0.04	77.56	0.07	78.68	0.10	79.80	5.46
76.46	0.04	77.58	0.07	78.70	0.10	79.82	6.00
76.48	0.04	77.60	0.07	78.72	0.10	79.84	6.55
76.50	0.04	77.62	0.08	78.74	0.10	79.86	7.13
76.52	0.04	77.64	0.08	78.76	0.10	79.88	7.72
76.54	0.04	77.66	0.08	78.78	0.10	79.90	8.32
76.56	0.04	77.68	0.08	78.80	0.10	79.92	8.94
76.58	0.05	77.70	0.08	78.82	0.10	79.94	9.58
76.60	0.05	77.72	0.08	78.84	0.10	79.96	10.23
76.62	0.05	77.74	0.08	78.86	0.10	79.98	10.89
76.64	0.05	77.76	0.08	78.88	0.10	80.00	**11.56**
76.66	0.05	77.78	0.08	78.90	0.10		
76.68	0.05	77.80	0.08	78.92	0.10		
76.70	0.05	77.82	0.08	78.94	0.10		
76.72	0.05	77.84	0.08	78.96	0.10		
76.74	0.05	77.86	0.08	78.98	0.10		
76.76	0.05	77.88	0.08	79.00	0.10		
76.78	0.05	77.90	0.08	79.02	0.10		
76.80	0.05	77.92	0.08	79.04	0.10		
76.82	0.05	77.94	0.08	79.06	0.10		
76.84	0.05	77.96	0.08	79.08	0.10		
76.86	0.05	77.98	0.08	79.10	0.10		
76.88	0.06	78.00	0.08	79.12	0.10		
76.90	0.06	78.02	0.08	79.14	0.10		
76.92	0.06	78.04	0.08	79.16	0.11		
76.94	0.06	78.06	0.08	79.18	0.11		
76.96	0.06	78.08	0.09	79.20	0.11		
76.98	0.06	78.10	0.09	79.22	0.11		
77.00	0.06	78.12	0.09	79.24	0.11		
77.02	0.06	78.14	0.09	79.26	0.11		
77.04	0.06	78.16	0.09	79.28	0.11		
77.06	0.06	78.18	0.09	79.30	0.11		
77.08	0.06	78.20	0.09	79.32	0.11		
77.10	0.06	78.22	0.09	79.34	0.11		

TIMBER WALL PILE SIZING CALCULATIONS

TERRA ENGINEERING
AND
LAND SOLUTIONS, PC

415 4TH STREET, NE CHARLOTTESVILLE, VA 22902
PH. (434) 244-0600 FAX (434) 975-0900

TIMBER WALL SIZING CALCULATIONS

Know input parameters:

1. Butt Diameter = 12 inches
2. Pile Spacing = 4 feet
3. h_w = 4.5 feet
4. h_s = 5.0 feet
5. γ_w = 62.4 pcf

Assumptions:

6. γ_{soil} = 120 pcf
7. e_{soil} = 50%
8. γ_{sat} = 131 pcf
9. K_a = 0.31 (Rankine Active Coefficient)

Average soil below 5 feet (medium clay / sandy clay)
(From table 4.8 in Timber Construction Manual)
p = 200 psf
s = 2,500 psf

Determine required embedment of pole

$$d = \frac{A}{2}\left(\sqrt{1+\frac{4.36h}{A}}\right)$$

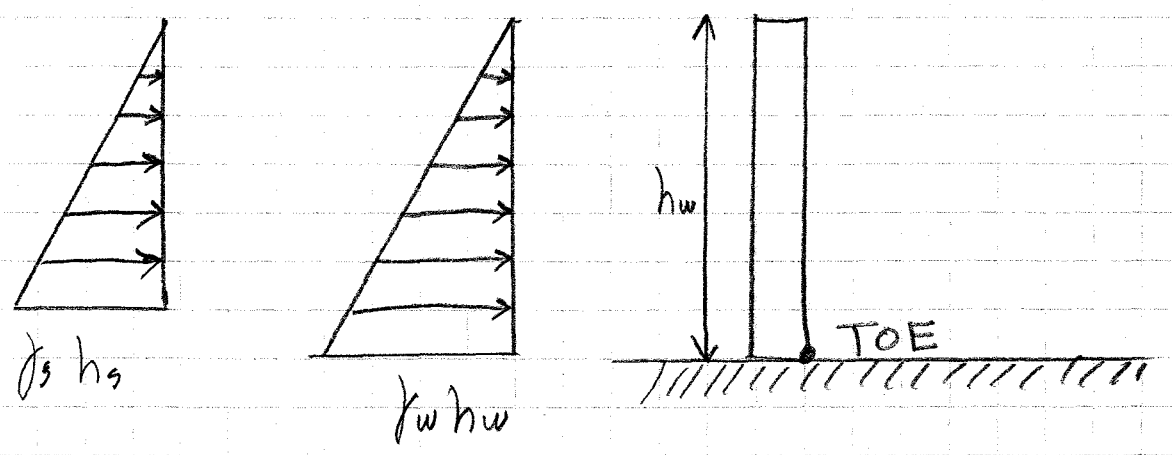
d = assumed depth of embedment, ft
$A = 2.34P/S_1B$
P = applied horz. force on pole = 2,641 lb
S_1 = pd/3
h = height above ground line at which force P is applied, ft = 4.5 ft
B = Butt diameter = 12"

Calculations based on procedure outlined in Timber Construction Manual Section 4 on Pole-Type Framing. See attached iteration worksheet.

d, assumed	S1	A	d,actual
1.0	66.7	92.7	51.0
2.0	133.3	46.3	27.6
3.0	200.0	30.9	19.8
4.0	266.7	23.2	15.7
5.0	333.3	18.5	13.3
6.0	400.0	15.4	11.6
7.0	466.7	13.2	10.4
8.0	533.3	11.6	9.5
8.1	540.0	11.4	9.4
8.2	546.7	11.3	9.3
8.3	553.3	11.2	9.3
8.4	560.0	11.0	9.2
8.5	566.7	10.9	9.1
8.6	573.3	10.8	9.1
8.7	580.0	10.7	9.0
8.8	586.7	10.5	8.9
8.9	593.3	10.4	8.8
9.0	600.0	10.3	8.8
9.1	606.7	10.2	8.7
9.2	613.3	10.1	8.6
9.3	620.0	10.0	8.6
9.4	626.7	9.9	8.5
9.5	633.3	9.8	8.5
9.6	640.0	9.7	8.4
9.7	646.7	9.6	8.3
9.8	653.3	9.5	8.3
9.9	660.0	9.4	8.2
10.0	666.7	9.3	8.2
10.1	673.3	9.2	8.1
10.2	680.0	9.1	8.1
10.3	686.7	9.0	8.0

TIMBER PILE DEPTH BELOW GRADE = 9 FEET

Total Moment about toe, M_o



$h_w = 4.5'$
$h_s = 5$
$\gamma_w = 62.4\ lb/ft^3$
$\gamma_s = 120\ lb/ft^3$
$\gamma_{sat} = 131\ lb/ft^3$

$$M_o = \left(\frac{\gamma' h_s^2}{2}\right)\left(\frac{h_s}{3}\right) + \left(\frac{\gamma_w h_w^2}{2}\right)\left(\frac{h_w}{3}\right)$$

$$M_o = \left(\frac{(131-62.4)(5)^2}{2}\right)\left(\frac{5}{3}\right) + \left(\frac{62.4\,(4.5)^2}{2}\right)\left(\frac{4.5}{3}\right)$$

$M_o = 1{,}429\ lb\text{-}ft + 947.7\ lb\text{-}ft$

$M_o = 2{,}376.7\ lb\text{-}ft$

$M_o = 2{,}377\ lb\text{-}ft / 5'$ spacing

$M_o = 11{,}884\ lb/ft$

$$P = \frac{11{,}884\ lb/ft}{4.5\ ft} = 2{,}641\ lb$$

STORM SEWER DESIGN COMPUTATIONS

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE:
PROJ: WCRC Youth Facility
COUNTY: James City Co.
DISTRICT:
DESCRIPTION:
SHEET 1 OF 1

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. CN (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT / ACCUMULATED (17)	REMARKS (18)
S1	S2	0.43	75			5		2.1	85.9	85.5	40	0.013	15"	7.4	6	.11 / .11	
S2	S3	"	"						85.3	80.9	348	0.013	15"	7.4	6	.97 / 1.1	
S3	S4	2.1	65			33		3.4 / 5.5	80.9	80.1	45	0.017	18"	13.7	7.7	0.1 / 1.2	

Appendix 9B-3 LD-347 Hydraulic Grade Line Computations

LD-347 Rev. 7/00
HYDRAULIC GRADE LINE

PROJECT: WCRC Youth Facility
SHEET: 1 of 1

INLET NUMBER (1)	Outlet Water Surface Elev. (2)	D_o (3)	Q_o (4)	L_o (5)	S_{fo} % (6)	H_f (7)	JUNCTION LOSS V_o (8)	H_o (9)	Q_i (10)	V_i (11)	Q_iV_i (12)	$\frac{V_i^2}{2g}$	H_i (13)	Angle (14)	H_Δ (15)	H_t (16)	1.3 H_t (17)	0.5 H_t (18)	Final H (19)	Inlet Water Surface Elev. (20)	Rim Elev. (21)
	(0.8d)																				
S4	81.3	18	5.5	45	.29	.13	7.3	.21	2.1	5.2	10.9	.42	.29	45	.34	.84	1.1		1.23	82.5	84.5
S3	82.5	15	2.1	348	.14	0.5	5.1	0.1	5.1	2.1	10.7	0.07	0.02	35	0.02	.54		.27	.77	83.3	88.5
S2	83.3	15	2.1	40	.14	0.06	5.1	0.1								.1		.13	0.2	83.5	88.4

$$H_i = 0.35\frac{V_i^2}{2g} \quad H_o = 0.25\frac{V_o^2}{2g} \quad H_\Delta = K\frac{V_i^2}{2g}$$

FINAL H = $H_f + H_t$

$H_t = H_o + H_i + H_\Delta$

90° K = 0.70	50° K = 0.47	20° K = 0.16
80° K = 0.66	40° K = 0.38	15° K = 0.10
70° K = 0.61	30° K = 0.28	
60° K = 0.55	25° K = 0.22	

See LD-72 D)67

$$S = 0.453\frac{Q^2 n^2}{A^2 R^{4/3}}$$

COMPOSITE RUNOFF SURVE NUMBER CALCULATIONS AND ASSOCIATED DRAINGAGE AREA MAP

Williamsburg Christian Retreat Center, Youth Facility

Proposed BMP/SWM Basin A

Composite Runoff Curve Number Calculator

Description		Area (ac)	Curve Number	
Woods		2.8100	55	
Grass		0.1800	61	
Impervious		0.6770	98	
Total Area	----->	3.6670	63	<----- Weighted CN

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
POST-DEVELOPED TIME OF CONCENTRATION AT PROPOSED TIMBER WALL

Sheet Flow

Description	Basin A sheet
Manning's n	0.4000
Flow Length	200.0000 ft
Two Yr, 24 hr Rainfall	3.5000 in
Land Slope	0.0242 ft/ft
Computed Sheet flow time .....>	33.1254 min

Shallow Concentrated Flow

Description	Basin A shallow
Surface	Unpaved
Flow Length	268.0000 ft
Watercourse Slope	0.0373 ft/ft
Velocity	3.1161 fps
Computed Shallow flow time .....>	1.4334 min

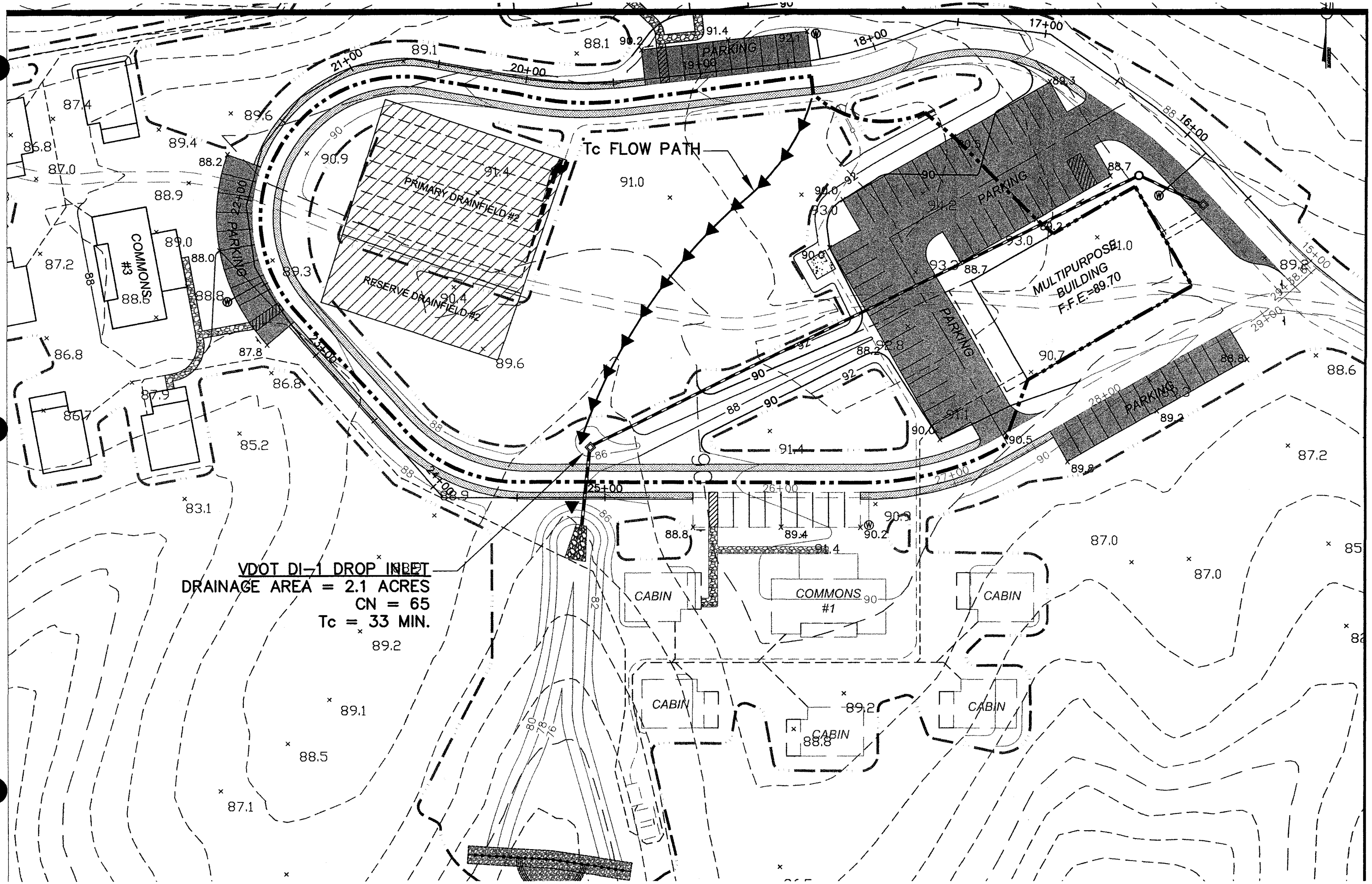
****
Total Time of Concentration .....> 34.5588 min
****

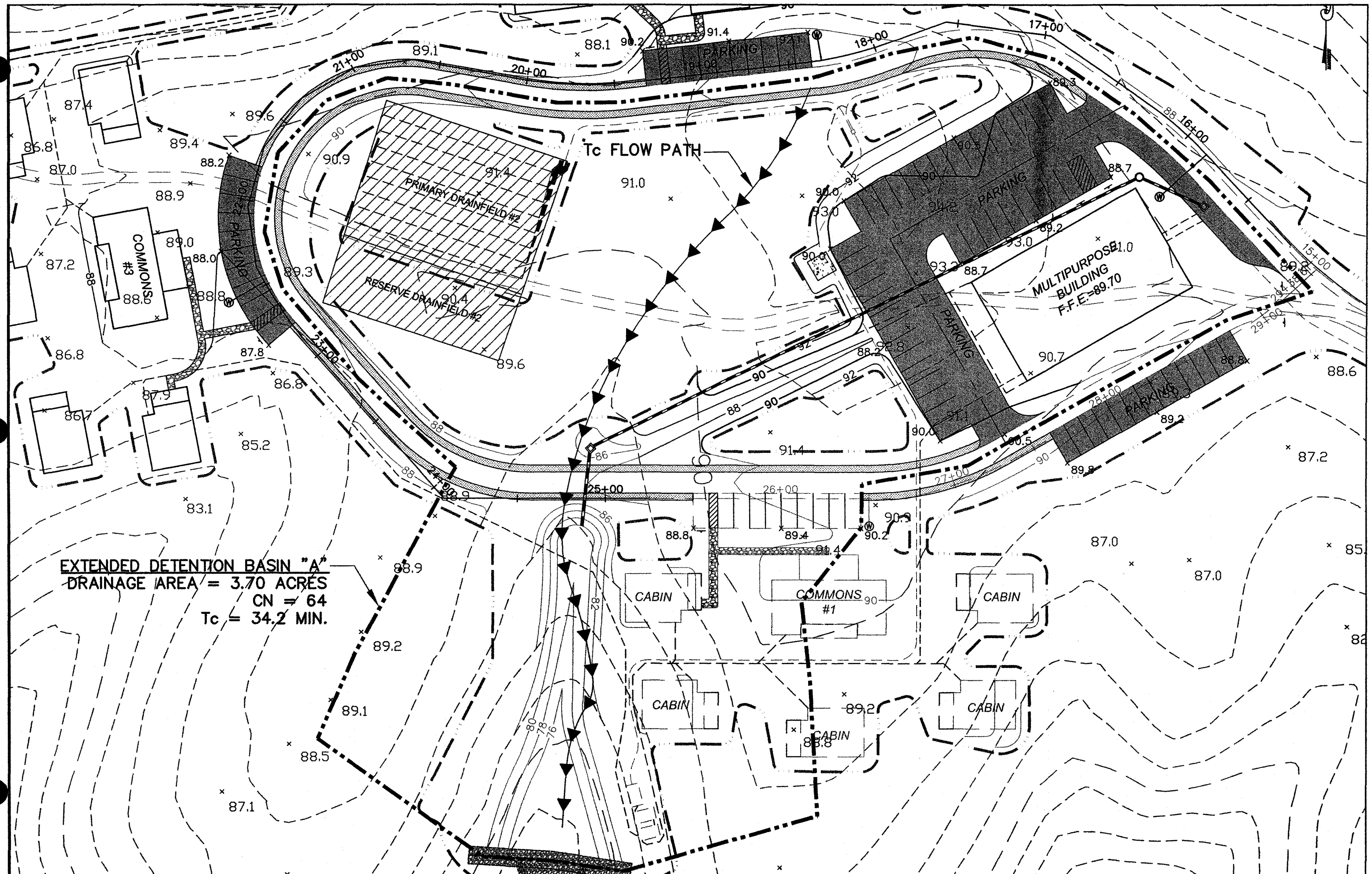
Williamsburg Christian Retreat Center, Youth Facility

Proposed DI-1

Composite Runoff Curve Number Calculator

Description		Area (ac)	Curve Number	
Woods		0.0300	55	
Grass		0.2276	61	
Impervious		0.1724	98	
Total Area	----->	0.4300	75	<----- Weighted CN


Tc FLOW PATH
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PARKING
COMMONS #3
MULTIPURPOSE BUILDING
F.F.E.=89.70
COMMONS #1
CABIN
VDOT DI-1 DROP INLET
DRAINAGE AREA = 2.1 ACRES
CN = 65
Tc = 33 MIN.

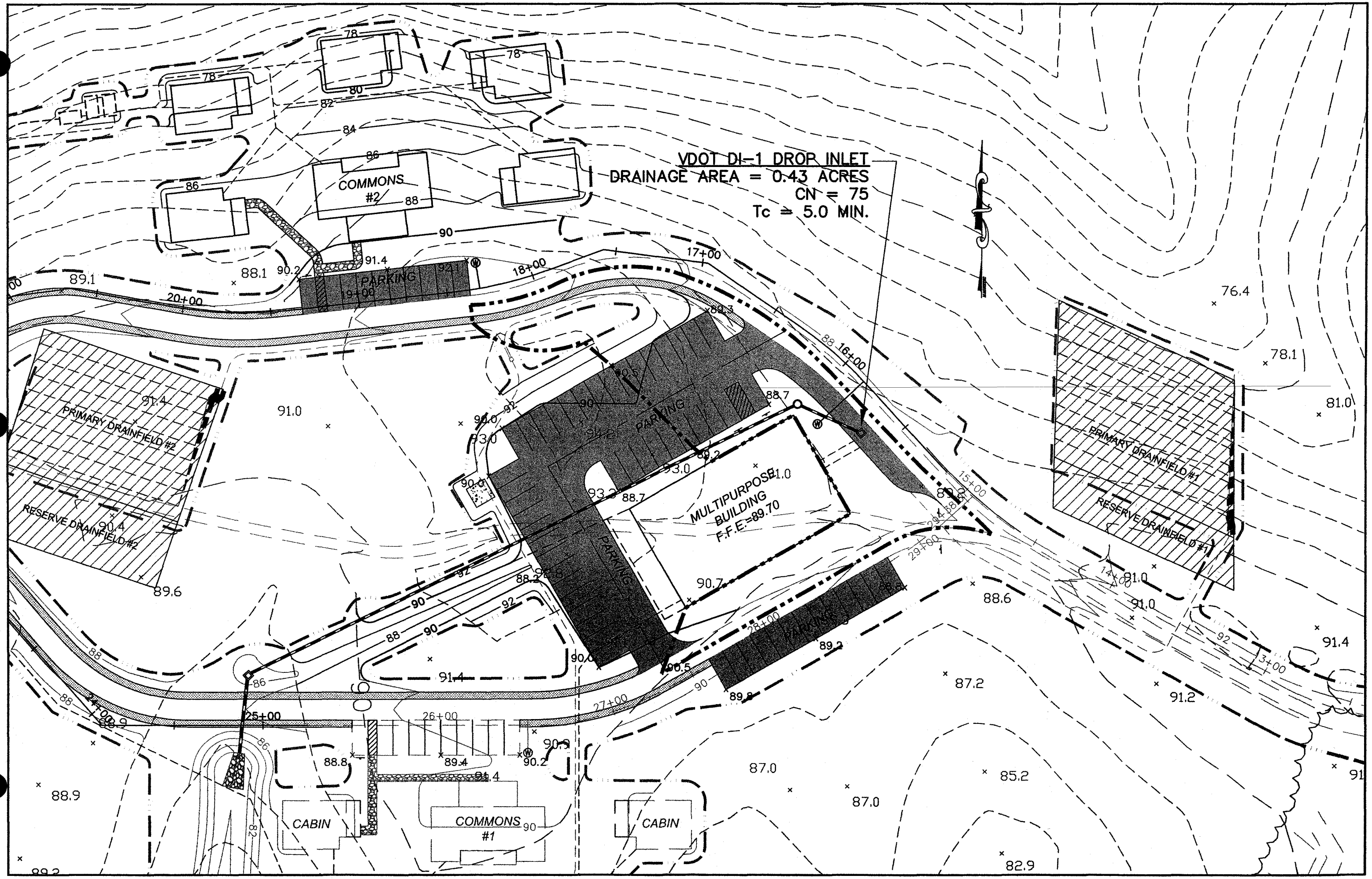

Tc FLOW PATH
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PARKING
COMMONS #3
MULTIPURPOSE BUILDING
F.F.E.=89.70
COMMONS #1
CABIN
EXTENDED DETENTION BASIN "A"
DRAINAGE AREA = 3.70 ACRES
CN = 64
Tc = 34.2 MIN.

Williamsburg Christian Retreat Center, Youth Facility

Proposed DI-1

Composite Runoff Curve Number Calculator

Description		Area (ac)	Curve Number	
Woods		1.5188	55	
Grass		0.0787	61	
Impervious		0.5025	98	
Total Area	----->	2.1000	65	<----- Weighted CN


VDOT DI-1 DROP INLET
DRAINAGE AREA = 0.43 ACRES
CN = 75
Tc = 5.0 MIN.
COMMONS #2
PARKING
MULTIPURPOSE BUILDING
F.F.E.=89.70
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PRIMARY DRAINFIELD #1
RESERVE DRAINFIELD #1
CABIN
COMMONS #1
CABIN
17+00
18+00
19+00
20+00
16+00
15+00
14+00
13+00
29+00
28+00
27+00
26+00
25+00

CHANNEL ADEQUACY CALCULATIONS

Williamsburg Christian Retreat Center, Youth Facility

Proposed Channel Section A-A

Composite Runoff Curve Number Calculator

Description		Area (ac)	Curve Number	
Woods		1.8300	55	
Grass		0.3600	61	
Impervious		0.7000	98	
Total Area	----->	2.8900	66	<----- Weighted CN

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
CHANNEL SECTION A-A 2-YEAR RUNOFF

Graphical Peak Discharge method

Given Input Data:

Description	Channel A
Rainfall distribution	Type II
Frequency	2 year
Rainfall, P (24-hours)	3.5000 in
Drainage area	2.9000 ac
Runoff curve number, CN	66
Time of concentration, Tc	33.0000 min
Pond and Swamp Areas	0.0000 % of Area

Computed Results:

Initial abstraction, Ia	1.0303 in
Ia/P	0.2944
Unit peak discharge, qu	418.4684 csm/in
Runoff, Q	0.8003 in
Pond and swamp adjustment, Fp ...	1.0000
Peak discharge, qp	1.5176 cfs

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
CHANNEL SECTION A-A 10-YEAR RUNOFF

Graphical Peak Discharge method

Given Input Data:

Description	Channel A
Rainfall distribution	Type II
Frequency	10 year
Rainfall, P (24-hours)	5.8000 in
Drainage area	2.9000 ac
Runoff curve number, CN	66
Time of concentration, Tc	33.0000 min
Pond and Swamp Areas	0.0000 % of Area

Computed Results:

Initial abstraction, Ia	1.0303 in
Ia/P	0.1776
Unit peak discharge, qu	469.4529 csm/in
Runoff, Q	2.2931 in
Pond and swamp adjustment, Fp ...	1.0000
Peak discharge, qp	4.8778 cfs

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
CHANNEL SECTION A-A 10-YEAR FLOW

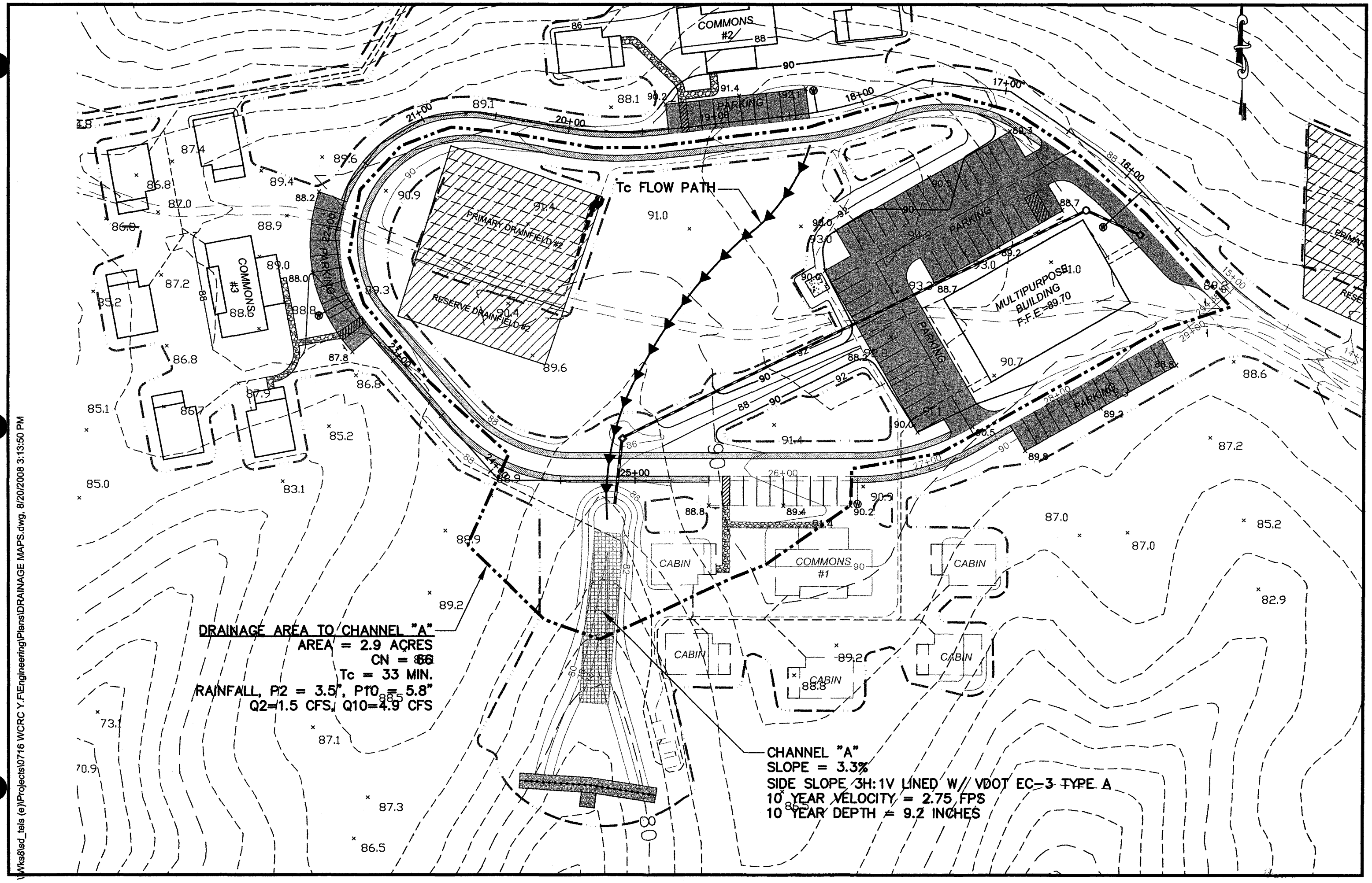
Channel Calculator

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	4.8700 cfs
Slope	0.0330 ft/ft
Manning's n	0.0500
Height	18.0000 in
Bottom width	0.0000 in
Left slope	0.3333 ft/ft (V/H)
Right slope	0.3333 ft/ft (V/H)

Computed Results:

Depth	9.2136 in
Velocity	2.7534 fps
Full Flowrate	29.0476 cfs
Flow area	1.7687 ft2
Flow perimeter	58.2772 in
Hydraulic radius	4.3704 in
Top width	55.2871 in
Area	6.7507 ft2
Perimeter	113.8522 in
Percent full	51.1867 %



\Wks8\sd_tels (e)\Projects\0716 WCRC Y.F\Engineering\Plans\DRAINAGE MAPS.dwg, 8/20/2008 3:13:50 PM

Williamsburg Christian Retreat Center, Youth Facility

Proposed Channel Section B-B

Composite Runoff Curve Number Calculator

Description		Area (ac)	Curve Number	
Woods		0.0150	55	
Grass		0.2500	61	
Impervious		0.3800	98	
Total Area	----->	0.6450	82	<----- Weighted CN

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
CHANNEL SECTION B-B 2-YEAR RUNOFF

Graphical Peak Discharge method

Given Input Data:

Description	Channel B
Rainfall distribution	Type II
Frequency	2 year
Rainfall, P (24-hours)	3.5000 in
Drainage area	0.6400 ac
Runoff curve number, CN	82
Time of concentration, Tc	6.0000 min
Pond and Swamp Areas	0.0000 % of Area

Computed Results:

Initial abstraction, Ia	0.4390 in
Ia/P	0.1254
Unit peak discharge, qu	1000.5982 csm/in
Runoff, Q	1.7826 in
Pond and swamp adjustment, Fp ...	1.0000
Peak discharge, qp	1.7837 cfs

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
CHANNEL SECTION B-B 10-YEAR RUNOFF

Graphical Peak Discharge method

Given Input Data:

Description	Channel B
Rainfall distribution	Type II
Frequency	10 year
Rainfall, P (24-hours)	5.8000 in
Drainage area	0.6400 ac
Runoff curve number, CN	82
Time of concentration, Tc	6.0000 min
Pond and Swamp Areas	0.0000 % of Area

Computed Results:

Initial abstraction, Ia	0.4390 in
Ia/P	0.1000
Unit peak discharge, qu	1009.9968 csm/in
Runoff, Q	3.8036 in
Pond and swamp adjustment, Fp ...	1.0000
Peak discharge, qp	3.8416 cfs

WILLIAMSBURG CHRISTIAN RETREAT CENTER, YOUTH FACILITY
CHANNEL SECTION B-B 10-YEAR FLOW

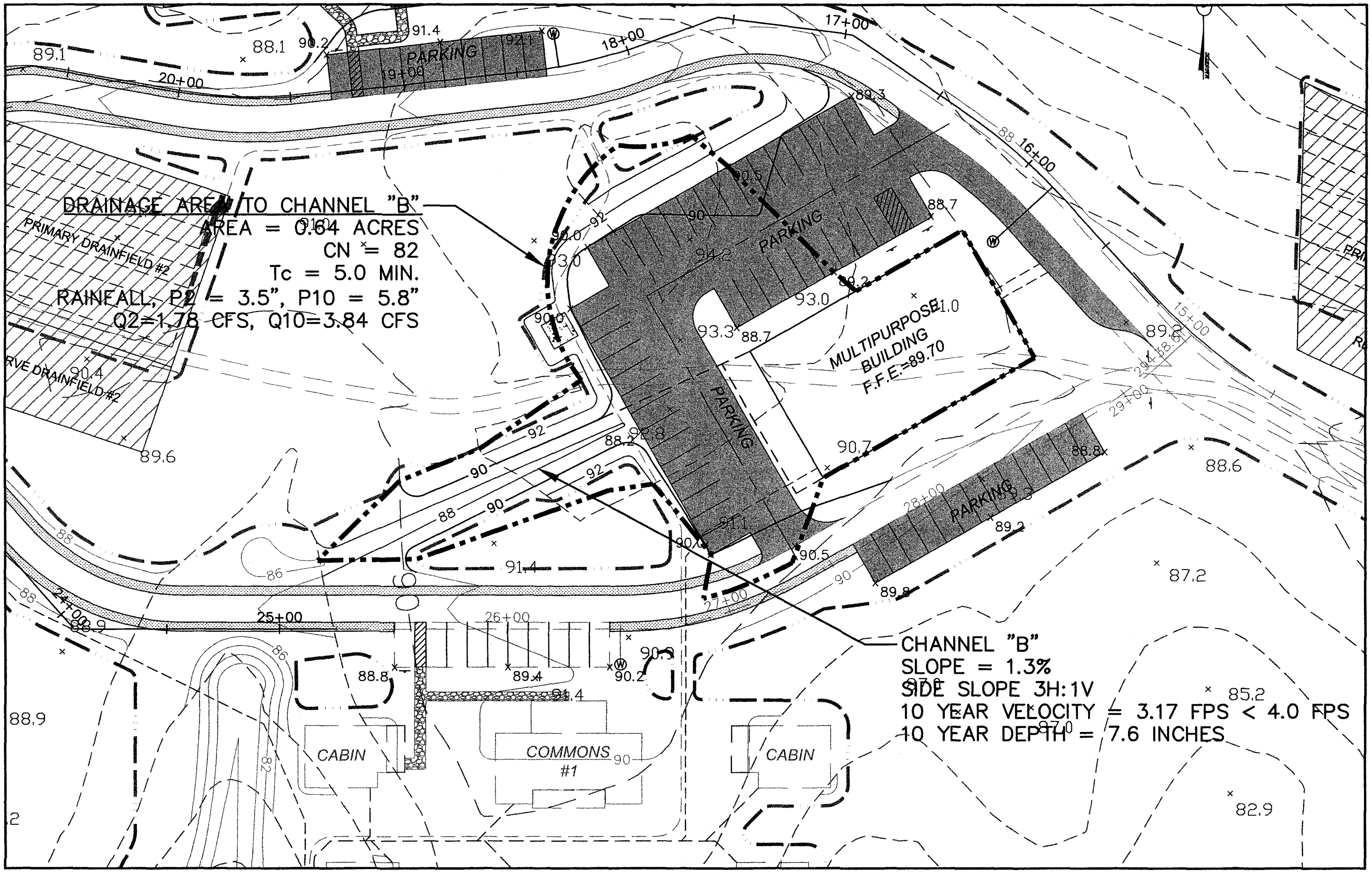
Channel Calculator

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	3.8400 cfs
Slope	0.0130 ft/ft
Manning's n	0.0240
Height	18.0000 in
Bottom width	0.0000 in
Left slope	0.3333 ft/ft (V/H)
Right slope	0.3333 ft/ft (V/H)

Computed Results:

Depth	7.6217 in
Velocity	3.1727 fps
Full Flowrate	37.9826 cfs
Flow area	1.2103 ft2
Flow perimeter	48.2083 in
Hydraulic radius	3.6153 in
Top width	45.7349 in
Area	6.7507 ft2
Perimeter	113.8522 in
Percent full	42.3428 %


DRAINAGE AREA TO CHANNEL "B"
AREA = 0.64 ACRES
CN = 82
Tc = 5.0 MIN.
RAINFALL, P2 = 3.5", P10 = 5.8"
Q2=1.78 CFS, Q10=3.84 CFS
CHANNEL "B"
SLOPE = 1.3%
SIDE SLOPE 3H:1V
10 YEAR VELOCITY = 3.17 FPS < 4.0 FPS
10 YEAR DEPTH = 7.6 INCHES
PARKING
MULTIPURPOSE BUILDING
F.F.E.=89.70
PRIMARY DRAINFIELD #2
CABIN
COMMONS #1
CABIN
17+00
18+00
19+00
20+00
15+00
16+00
25+00
26+00
27+00
28+00
29+00

TEMPORARY SEDIMENT TRAP CALCULATIONS

STD & SPEC 3.13

TEMPORARY SEDIMENT TRAP

ST

Definition

A temporary ponding area formed by constructing an earthen embankment with a stone outlet.

Purpose

To detain sediment-laden runoff from small disturbed areas long enough to allow the majority of the sediment to settle out.

Conditions Where Practice Applies

1. Below disturbed areas where the total contributing drainage area is less than 3 acres.

2. Where the sediment trap will be used no longer than 18 months (the maximum useful life is 18 months).

3. The sediment trap may be constructed either independently or in conjunction with a TEMPORARY DIVERSION DIKE (Std. & Spec. 3.09).

Planning Considerations

Sediment traps should be used only for small drainage areas. If the contributing drainage area is 3 acres or greater, refer to SEDIMENT BASIN (Std. & Spec. 3.14).

Sediment traps, along with other perimeter controls intended to trap sediment, shall be constructed as a first step in any land-disturbing activity and shall be made functional before upslope land disturbance takes place.

Recent studies have been conducted on the performance of sediment traps (and basins) which were constructed using the design criteria found in previous editions of this handbook. The studies indicate that the control measures only achieved a 46% removal of sediment which flowed into them during storm events which caused measurable outflow. To achieve a more acceptable removal rate (60%), it was necessary to revise the design of these measures in this handbook. The total initial storage volume for both the sediment trap and the TEMPORARY SEDIMENT BASIN (Std. & Spec. 3.14) has been doubled. There are both a "wet" storage volume and a drawdown or "dry" storage volume which help to enhance sediment fall-out and prevent excessive sediment losses during large storm events which occur during the advanced stages of land disturbance (28).

In most cases excavation will be required to attain the necessary storage volume. Also, sediment must be periodically removed from the trap to maintain the required volume. Plans should detail how excavated sediment is to be disposed of, such as by use in fill areas on site or removal to an approved off-site location.

As noted previously in this handbook, there are numerous other acceptable ways to design many of the erosion control practices within. This is certainly true in the case of the sediment trap. However, variations in its design should be considered judiciously by plan reviewers to ensure that the minimum storage requirements and structural integrity noted in this specification are maintained.

Design Criteria

Trap Capacity

The sediment trap must have an initial storage volume of 134 cubic yards per acre of drainage area, half of which shall be in the form of a permanent pool or wet storage to provide a stable settling medium. The remaining half shall be in the form of a drawdown

Required Wet/Dry storage = 64 cu. yd./ac. (2.5) = 160

 * $V_1 = V_2 = 160$ cu. yd. required

or dry storage which will provide extended settling time during less frequent, larger storm events. The volume of the wet storage shall be measured from the low point of the excavated area to the base of the stone outlet structure. The volume of the dry storage shall be measured from the base of the stone outlet to the crest of the stone outlet (overflow mechanism). Sediment should be removed from the basin when the volume of the wet storage is reduced by one-half.

For a sediment trap, the wet storage volume may be approximated as follows:

$$V_1 = 0.85 \times A_1 \times D_1$$

$$V_1 = 0.85\,(1{,}270\,ft^2)\,(4\,ft) = 4{,}320\,ft^3 = 160\,yd^3$$

where,

V_1 = the wet storage volume in cubic feet

A_1 = the surface area of the flooded area at the base of the stone outlet in square feet

D_1 = the maximum depth in feet, measured from the low point in the trap to the base of the stone outlet

The dry storage volume may be approximated as follows:

$$V_2 = \frac{A_1 + A_2}{2} \times D_2$$

$$V_2 = \frac{3{,}350 + 1{,}270}{2}\,(2') = 4{,}620\,ft^3 = 171\,yd^3$$

where,

V_2 = the dry storage volume in cubic feet

A_1 = the surface area of the flooded area at the base of the stone outlet in square feet

A_2 = the surface area of the flooded area at the crest of the stone outlet (overflow mechanism), in square feet

D_2 = the depth in feet, measured from the base of the stone outlet to the crest of the stone outlet

The designer should seek to provide a storage area which has a minimum 2:1 length to width ratio (measured from point of maximum runoff introduction to outlet).

Note: Conversion between cubic feet and cubic yards is as follows:

number of cubic feet x 0.037 = number of cubic yards

Excavation

Side slopes of excavated areas should be no steeper than 1:1. The maximum depth of excavation within the wet storage area should be 4 feet to facilitate clean-out and for site safety considerations.

Outlet

The outlet for the sediment trap shall consist of a stone section of the embankment located at the low point in the basin. A combination of coarse aggregate and riprap shall be used to provide for filtering/detention as well as outlet stability. The smaller stone shall be VDOT #3, #357, or #5 Coarse Aggregate (smaller stone sizes will enhance filter efficiency) and riprap shall be "Class I." Filter cloth which meets the physical requirements noted in Std. & Spec. 3.19, RIPRAP shall be placed at the stone-soil interface to act as a "separator." The minimum length of the outlet shall be 6 feet times the number of acres comprising the total area draining to the trap. The crest of the stone outlet must be at least 1.0 foot below the top of the embankment to ensure that the flow will travel over the stone and not the embankment. The outlet shall be configured as noted in Plate 3.13-2.

Embankment Cross-Section

The maximum height of the sediment trap embankment shall be 5 feet as measured from the base of the stone outlet. Minimum top widths (W) and outlet heights (Ho) for various embankment heights (H) are shown in Plate 3.13-1. Side slopes of the embankment shall be 2:1 or flatter.

Removal

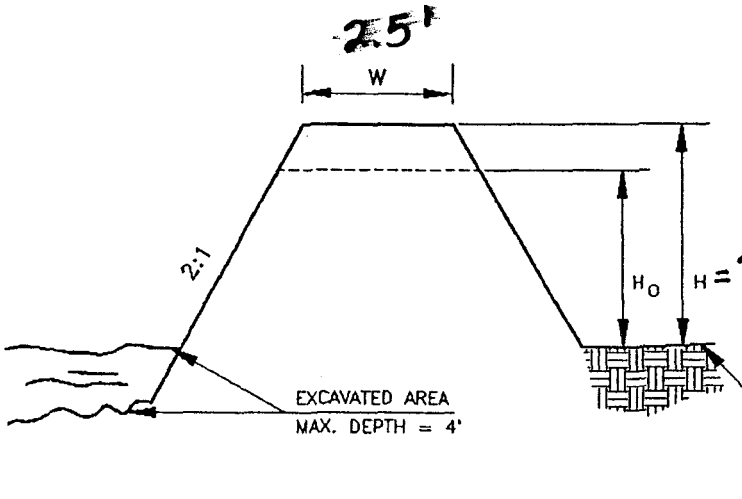
Sediment traps must be removed after the contributing drainage area is stabilized. Plans should show how the site of the sediment trap is to be graded and stabilized after removal.

Construction Specifications

1. The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat.

2. Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment should be compacted in 6-inch layers by traversing with construction equipment.

MINIMUM TOP WIDTH (W) REQUIRED FOR SEDIMENT TRAP EMBANKMENTS ACCORDING TO HEIGHT OF EMBANKMENT (FEET)



H	H_O	W
1.5	0.5	2.0
2.0	1.0	2.0
2.5	1.5	2.5
3.0	2.0	2.5 *
3.5	2.5	3.0
4.0	3.0	3.0
4.5	3.5	4.0
5.0	4.0	4.5

Source: Va. DSWC

Plate 3.13-1

3. The earthen embankment shall be seeded with temporary or permanent vegetation (see Std. & Spec.'s 3.31 and 3.32) immediately after installation.

4. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.

5. The structure shall be removed and the area stabilized when the upslope drainage area has been stabilized.

6. All cut and fill slopes shall be 2:1 or flatter (except for excavated, wet storage area which may be at a maximum 1:1 grade).

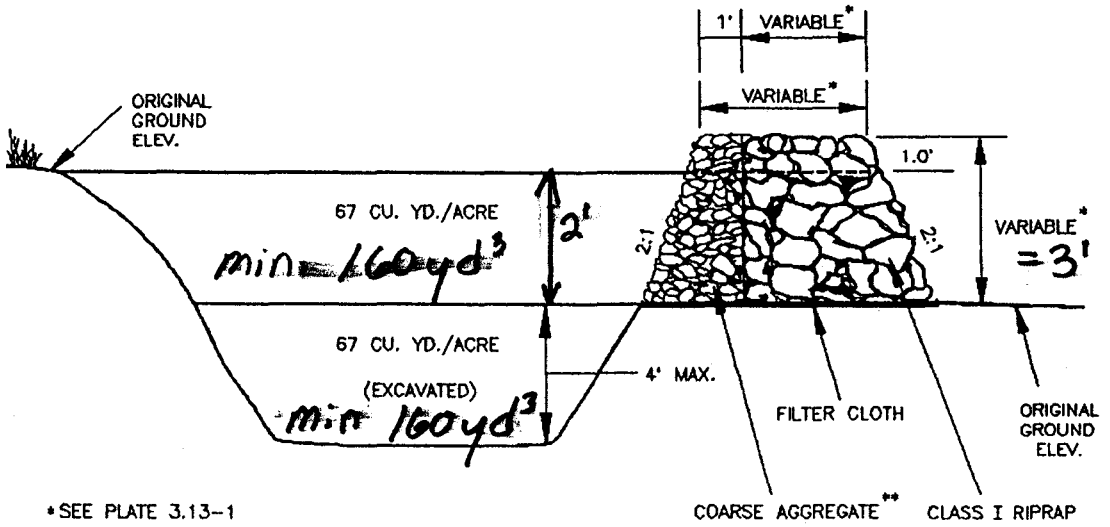
Maintenance

1. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one half the design volume of the wet storage. Sediment removal from the basin shall be deposited in a suitable area and in such a manner that it will not erode and cause sedimentation problems.

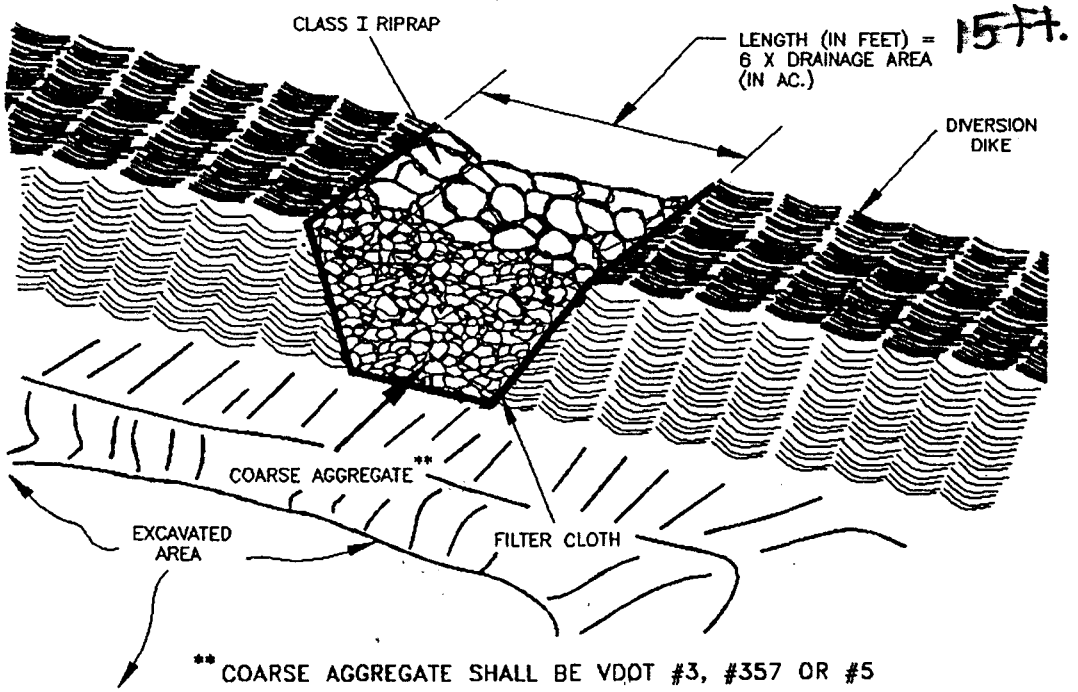
2. Filter stone shall be regularly checked to ensure that filtration performance is maintained. Stone choked with sediment shall be removed and cleaned or replaced.

3. The structure should be checked regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The height of the stone outlet should be checked to ensure that its center is at least 1 foot below the top of the embankment.

TEMPORARY SEDIMENT TRAP



CROSS SECTION OF OUTLET



OUTLET (PERSPECTIVE VIEW)

Source: Va. DSWC

Plate 3.13-2

REFERENCE MATERIALS:

- **FEMA FIRM #51095C0040C**
- **VSMH RUNOFF CURVE NUMBERS TABLE 4-6A AND 4-6B.**

MAP SCALE 1" = 1000'

00 0 1000 2000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0040C

FIRM

FLOOD INSURANCE RATE MAP

JAMES CITY COUNTY, VIRGINIA

AND INCORPORATED AREAS

PANEL 40 OF 240

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JAMES CITY COUNTY	510201	0040	C

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
51095C0040C

EFFECTIVE DATE
SEPTEMBER 28, 2007

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

TABLE 4 - 6a
Runoff Curve Numbers for Urban Areas [1]

*Adapted from TR-55 Table 2-2a. --Runoff Curve Numbers for Urban Areas**

Cover Description		Curve Numbers for Hydrologic Soil Group:			
Cover Type and Hydrologic Condition	**Average percent impervious area**[2]	**A**	**B**	**C**	**D**
Fully developed urban areas (vegetation established) :					
Open space (lawns, parks, golf courses, cemeteries, etc.)[2]:					
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
½ acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas:					
Newly graded areas (pervious areas only, no vegetation)[2]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in TR-55 Table 2-2c).					

**Average runoff condition and $I_a = 0.2S$*

[1]*Refer to TR-55 for additional cover types and general assumptions and limitations.*
[2]*For specific footnotes, see TR-55* ***Table 2-2a.***

TABLE 4 - 6b
Runoff Curve Numbers for Agricultural Areas[1]

*Adapted from TR-55 Table 2-2b-- Runoff Curve Numbers for Other Agricultural Lands**					
Cover Description		**Curve Numbers for Hydrologic Soil Group:**			
Cover Type	**Hydrologic Condition**	**A**	**B**	**C**	**D**
Pasture, grassland, or range - continuous forage for grazing [2].	Good	39	61	74	80
Meadow - continuous grass, protected from grazing and generally mowed for hay . . .	----	30	58	71	78
Brush - brush-weed-grass mixture with brush the major element[2]	Good	[2]30	48	65	73
Woods - grass combination (orchard or tree farm)[2]	Good	32	58	72	79
Woods [2]	Good	[2]30	55	70	77
Farmsteads - buildings, lanes, driveways, and surrounding lots.	----	59	74	82	86

**Average runoff condition and $I_a = 0.2S$*

[1]*Refer to TR-55 for additional cover types and general assumptions and limitations.*
[2]*For specific footnotes, see TR-55* ***Table 2-2b.***

RCN Determination Assumptions (TR-55):

1. *The urban curve numbers, for such land uses as residential, commercial, and industrial, are computed with the percentage of impervious area as shown. A composite curve number should be re-computed using the actual percentage of imperviousness if it differs from the value shown.*

2. *The impervious areas are directly connected to the drainage system.*

3. *Impervious areas have a runoff curve number of 98.*

TERRA ENGINEERING
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Williamsburg Christian Retreat Center

James City County, Virginia

Stormwater Management Report
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23 March 2012
Revised 6 September 2012

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WILLIAMSBURG CHRISTIAN RETREAT CENTER YOUTH FACILITY

James City County, Virginia

Stormwater Management Computations Summary

September 6, 2012

This narrative is intended for detailed descriptions concerning the adequacy of the design of storm water management (SWM) facility for Williamsburg Christian Retreat Center Youth Facility. Based on the as-built plans and recent field inspection a few items were noted that could affect the adequacy of the system. First, there is an earthen berm and rip rap weir located in the detention basin that will reduce available storage. Second, originally there was one three inch outlet pipe with a 1 ¼" orifice plate. That pipe has since lost the orifice plate to damage and now operates as a 3" orifice. Additionally, another pipe with a 1 ¼" inside diameter plate was added approximately one foot below the original pipe.

The extended dry detention basin, a permanent water quantity facility will capture roughly 3.79 acres of the project area and maintain the 2 and 10 year existing flows. The extended detention basin will not be used for any erosion control measures but currently has a temporary sediment trap created by an earthen berm and riprap weir. The berm will decrease the amount of available pond storage until it is removed. This SWM facility has been designed to release the 1-year storm event over a 24-hour period in order to satisfy stream protection volume requirements. The 1-year and 2-year storm events are released through two orifice holes located near the bottom of the timber weir wall. The 10-year and 100-year storm events are released through a 9 foot wide broad crested weir. Extensive erosion control measures are installed downstream of the timber wall in order to significantly reduce channel erosion possibilities.

Pre-development runoff was acquired employing revised stormwater calculations dated 6/6/08, see runoff summary table below. Post development runoff calculations were then performed for the detention basin as it is currently built. Since the earthen berm and riprap weir will not account for significant storage, the basin was broken into two storage areas. Those areas are: (1) storage above the sediment trap and (2) storage of the main basin between the sediment trap and timber wall. The drainage area for the basin was determined to be 3.79 acres. Time of concentration was then calculated; the calculated Tc confirmed Tc used in previous calculations. Therefore the same rainfall parameters were used in the TR-55 calculations. As a result of the added outlet pipe when compared to original design, 1 and 2 year storm events will see an increase in runoff. On the other hand 10 and 100 year storm events will have a decrease in runoff because the two outlet pipes allow more water to discharge before the water level riser high enough to flow over the weir. Overall the basin and timber wall outflow structure were determined to be adequate since the post-development 10-year runoff was subjacent to the pre-development 10-year runoff.

Runoff Summary Table for Detention Basin Outfall

(See attached hydrographs)

Pre-development Runoff (cfs)			Post-development Runoff (cfs)	
Q_1	0.10		Q_1	0.16
Q_2	0.27		Q_2	0.29
Q_{10}	1.82		Q_{10}	0.90
Q_{100}	3.88		Q_{100}	8.26

WCRC Youth Facility

Drainage Areas

Terra Engineering and Land Solutions **Revised:**

March 1, 2012 -

Area ID	Area Description	Area SF	Area Ac.	Wtd. C	Area CA	Up ID 1	Up ID 2	Σ CA	Area Tc	2 year I	10 year I	25 year I	100 year I	2 year Q	10 year Q	25 year Q	100 year Q
1	Drainage Area Inlet 1	24169	0.555	0.64	0.36			0.36	7.1	5.2	6.8	7.7	9.0	1.89	2.45	3.05	4.05
2	Drainage Area Inlet 2	19169	0.440	0.66	0.29	1		0.65	5.0	5.8	7.5	8.5	10.0	3.76	4.87	6.07	8.12
3	Drainage Area Inlet 3	66465	1.526	0.34	0.52	2		1.17	17.0	3.7	4.9	5.5	6.5	4.32	5.68	7.13	9.46
4	Drainage Area Channel A	21738	0.499	0.63	0.31			0.31	7.1	5.2	6.8	7.7	9.0	1.63	2.11	2.63	3.49
5	Drainage Area Channel B	14126	0.324	0.63	0.20			0.20	5.0	5.8	7.5	8.5	10.0	1.16	1.50	1.87	2.50
6	Drainage Area Channel C	9899	0.227	0.38	0.09			0.09	11.7	4.4	5.7	6.5	7.5	0.39	0.51	0.64	0.85
7	Drainage Area Channel D	26584	0.610	0.41	0.25			0.25	16.5	3.7	4.9	5.6	6.6	0.94	1.23	1.54	2.05
8	Drainage Area Culvert A	6627	0.152	0.47	0.07			0.07	5.0	5.8	7.5	8.5	10.0	0.40	0.52	0.65	0.87

WCRC Youth Facility

Composite C values

Terra Engineering and Land Solutions
March 1, 2012

Revised:
-

Area ID	Area SF	Area in C value = (SF)															Weighted C	Area Check SF	Wtd. C Check
		0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90			
1	24169			9607						1948						12613	0.64	24169	OK
2	19169			7089						1387						10693	0.66	19169	OK
3	66465		28111	29129						4247						4978	0.34	66465	OK
4	21738			8731						1948						11059	0.63	21738	OK
5	14126			5774						1387						6965	0.63	14126	OK
6	9899			8062						887						950	0.38	9899	OK
7	26584		3760	15852						3360						3612	0.41	26584	OK
8	6627			4198						1050						1379	0.47	6627	OK

WCRC Youth Facility

Time of Concentration Calculator (VDOT methods)

Terra Engineering and Land Solutions
March 1, 2012

Revised:
-

	Subarea Computations																										
Area	Sheet Flow 1				Sheet Flow 2				Shallow Flow 1				Shallow Flow 2				Channel Flow			Sub	Up ID	Up ID	Up ID	Up ID	Max. US	Area	Use
ID	L (ft)	S (%)	C	T (min)	L (ft)	S (%)	C	T (min)	L (ft)	S (%)	C	T (min)	L (ft)	S (%)	C	T (min)	L (ft)	H (ft)	T (min)	Tc	1	2	3	4	Tc	Tc	Tc
1	19	5.00	0.85	1.6																7.1						7.1	7.1
2																	261	5.4	2.7	2.7						2.7	5.0
3	200	2.60	0.25	16.7					58	3.60	0.30	0.3								17.0						17.0	17.0
4	19	5.00	0.85	1.6																7.1						7.1	7.1
5																	261	5.4	2.7	2.7						2.7	5.0
6	61	2.47	0.30	8.5	12	33.33	0.60	1.3									111	1.1	1.9	11.7						11.7	17.4
7	143	1.75	0.25	15.6	5	33.33	0.60	0.9									150	0.8	2.9	19.4						19.4	19.4
8																	175	1.0	3.2	3.2						3.2	5.0
												#####															

Inlet 1: Sheet flow to ditch Tc1:1.6 Tc=1.6+1.8+.6+3.1=7.1

+ Channel flow to entrace culvert Tc2:1.8	175	4.8	1.8
+ Pipe flow Tc3:0.6	38	1.0	0.6
+ Channel flow to Inlet S-1 Tc4:3.1	157	0.8	3.1

Channel A: Sheet flow to ditch Tc1:1.6 Tc=1.6+1.8+.6+3.1=7.1

+ Channel flow to entrace culvert Tc2:1.8
+ Pipe flow Tc3:0.6
+ Channel flow to Inlet S-1 Tc4:3.1

WCRC Youth Facility

Storm Drain Pipes

Terra Engineering and Land Solutions **Revised:**

March 1, 2012

Struct ID	Struct Type	Area 1 ID	Area 2 ID	Σ CA	Tc	I 25 yr	Q 25 yr	Top	Inv Upper	Inv Lower	Length ft	Slope ft/ft	Diam. in.	n	Cap'y cfs	Vel fps	Flow t min.	Remarks
S-1	DI-7	1	2	1.01	7.1	7.7	3.05	87.55	85.00	82.93	75.51	0.0274	15	0.013	10.70	8.72	0.1	15" HDPE
S-2	DI-7	2		0.65	5.0	8.5	6.07	86.62	82.93	80.00	187.66	0.0156	15	0.013	8.07	6.58	0.5	15" HDPE
S-3	DI-7	3		1.17	17.0	5.5	7.13	85.91	79.99	79.49	48.36	0.0103	18	0.013	10.68	6.04	0.1	15" HDPE

Notes:

LD-347 Rev. 3/20/07

HYDRAULIC GRADE LINE

PROJECT: 0716 WCRC

9

INLET STATION	Outlet Water Surface Elev. ft	D_o in.	Q_o cfs	L_o ft.	S_{f_o} %	H_f	JUNCTION LOSS V_o	H_o	Q_i	V_i	Q_iV_i	$V_i^2/2g$	H_i	Angle	H_d	H_t	1.3 H_t	0.5 H_t	Final H	Inlet Water Surface Elev.	Rim Elev.
1+00	80.69	18	5.68	48.36	2.9×10^{-3}	0.14	6.04	0.14	4.87	6.58	32.04	0.67	0.24	55°	0.36	0.74			0.88	81.57	85.91
2+87.66	81.57	15	4.87	187.66	5.65×10^{-3}	1.06	6.58	0.17	2.45	8.72	21.36	1.18	0.413	28°	0.39	0.97			2.03	83.60	86.62
3+63.17	83.60	15	2.45	75.51	1.43×10^{-3}	0.11	8.72	0.30								0.30			0.41	84.01	87.55

FINAL H = $H_f + H_t$

$H_i = 0.35\ V_i^2 / 2g$; $H_o = 0.25\ V_o^2 / 2g$; $H_d = K\ V_i^2 / 2g$; $H_t = H_o + H_i + H_d$

90° K = 0.70	50° K = 0.50	20° K = 0.25
80° K = 0.66	40° K = 0.43	15° K = 0.19
70° K = 0.61	30° K = 0.35	10° K = 0.13
60° K = 0.56	25° K = 0.30	5° K = 0.06

* Pipes Assumed to flow full

Outlet Water ELEV.

$TW = 0.8D = 0.8(1.5) = 1.2'$

$1.2 + 79.49 = 80.69'$

STAT. 1+00

$S_f = \frac{Q^2 n^2}{z^2 A^2 R^{4/3}}$

$Q = 5.68$ cfs $n = 0.013$

$z = 1.486$ $A = 1.77\ ft^2$ $R = 0.376$ ft

$= 0.002904$

$R = \frac{A}{P_w}$ $P_w = 4.71$ ft

$H_f = S_f L = 2.9 \times 10^{-3} \times 4836$

$= 0.14$ ft

$H_o = \frac{0.25\,(6.04)^2}{2\,(32.2)} = 0.1416$ ft

$H_i = \frac{0.35\,(6.58)^2}{2\,(32.2)} = 0.2353$ ft

$H_d = \frac{0.53\,(6.58^2)}{2(32.2)} = 0.3563$ ft

$H_t = 0.74$

STAT. 2+87.66

$Q = 4.87$ cfs $A = 1.23\ ft^2$

$P_w = 3.93$ ft $R = 0.313$ ft

$S_f = \frac{4.87^2 \times 0.013^2}{1.486^2 \times 1.23^2 (0.313)^{4/3}}$

$= 0.005645$

$H_o = \frac{0.25\,(6.58^2)}{2\,(32.2)} = 0.168$ ft

$H_f = 5.65 \times 10^{-3} \times 187.66 = 1.06$ ft

$H_i = \frac{0.35\,(8.72)^2}{2(32.2)} = 0.413$ ft

$H_d = \frac{0.33\,(8.72)^2}{2(32.2)} = 0.389$

$H_t = 0.168 + 0.413 + 0.389$

$= 0.97$ ft

STAT. 3+63.17

$Q = 2.45$ cfs

$S_f = \frac{2.45^2 \times 0.013^2}{1.486^2 \times 1.23^2 (0.313)^{4/3}}$

$= 0.001428$

$H_o = \frac{0.25\,(8.72^2)}{2\,(32.2)}$

$= 0.295$ ft

$H_f = 1.43 \times 10^{-3} \cdot 75.51$

$= 0.1079$

Subcatchment 3PO: Channel A

Runoff = 1.65 cfs @ 0.12 hrs, Volume= 0.020 af, Depth= 0.49"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Rainfall Duration=9 min, Inten=5.20 in/hr

Area (sf)	C	Description
21,738	0.63	Channel A

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

Reach 7R: Channel A 2 YR

Inflow Area = 0.499 ac, Inflow Depth = 0.49"
Inflow = 1.65 cfs @ 0.12 hrs, Volume= 0.020 af
Outflow = 1.42 cfs @ 0.22 hrs, Volume= 0.020 af, Atten= 14%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 6.7 min

Peak Depth= 0.48' @ 0.17 hrs
Capacity at bank full= 29.15 cfs
Inlet Invert= 92.00', Outlet Invert= 87.55'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 372.0' Slope= 0.0120 '/'

Subcatchment 3PO: Channel A

Runoff = 2.16 cfs @ 0.12 hrs, Volume= 0.027 af, Depth= 0.64"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Rainfall Duration=9 min, Inten=6.80 in/hr

Area (sf)	C	Description
21,738	0.63	Channel A

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

Reach 7R: Channel A 2 YR

Inflow Area = 0.499 ac, Inflow Depth = 0.64"
Inflow = 2.16 cfs @ 0.12 hrs, Volume= 0.027 af
Outflow = 1.89 cfs @ 0.21 hrs, Volume= 0.027 af, Atten= 12%, Lag= 5.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.2 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 6.4 min

Peak Depth= 0.54' @ 0.16 hrs
Capacity at bank full= 29.15 cfs
Inlet Invert= 92.00', Outlet Invert= 87.55'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 372.0' Slope= 0.0120 '/'

Reach 7R: Channel B 2 YR

Inflow Area =	0.324 ac,	Inflow Depth =	0.43"		
Inflow =	1.19 cfs @	0.09 hrs,	Volume=	0.011 af	
Outflow =	1.13 cfs @	0.15 hrs,	Volume=	0.011 af,	Atten= 6%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.5 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 4.7 min

Peak Depth= 0.39' @ 0.12 hrs
Capacity at bank full= 40.76 cfs
Inlet Invert= 92.00', Outlet Invert= 86.62'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 230.0' Slope= 0.0234 '/'

Reach 7R: Channel B 10 YR

Inflow Area =	0.324 ac,	Inflow Depth =	0.55"		
Inflow =	1.55 cfs @	0.09 hrs,	Volume=	0.015 af	
Outflow =	1.47 cfs @	0.14 hrs,	Volume=	0.015 af,	Atten= 5%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 4.5 min

Peak Depth= 0.43' @ 0.12 hrs
Capacity at bank full= 40.76 cfs
Inlet Invert= 92.00', Outlet Invert= 86.62'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 230.0' Slope= 0.0234 '/'

Reach 7R: Channel C 2 YR

Inflow Area =	0.227 ac,	Inflow Depth =	0.33"		
Inflow =	0.38 cfs @	0.20 hrs,	Volume=	0.006 af	
Outflow =	0.34 cfs @	0.27 hrs,	Volume=	0.006 af,	Atten= 12%, Lag= 4.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.1 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 5.3 min

Peak Depth= 0.32' @ 0.22 hrs
Capacity at bank full= 20.91 cfs
Inlet Invert= 87.00', Outlet Invert= 85.91'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 177.0' Slope= 0.0062 '/'

Reach 7R: Channel C 10 YR

Inflow Area =	0.227 ac,	Inflow Depth =	0.43"		
Inflow =	0.50 cfs @	0.20 hrs,	Volume=	0.008 af	
Outflow =	0.44 cfs @	0.26 hrs,	Volume=	0.008 af,	Atten= 11%, Lag= 3.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 5.0 min

Peak Depth= 0.35' @ 0.22 hrs
Capacity at bank full= 20.91 cfs
Inlet Invert= 87.00', Outlet Invert= 85.91'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 177.0' Slope= 0.0062 '/'

Reach 7R: Channel D 2 YR

Inflow Area =	0.610 ac,	Inflow Depth =	0.46"		
Inflow =	0.93 cfs @	0.28 hrs,	Volume=	0.023 af	
Outflow =	0.84 cfs @	0.40 hrs,	Volume=	0.023 af,	Atten= 10%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 6.5 min

Peak Depth= 0.39' @ 0.33 hrs
Capacity at bank full= 30.59 cfs
Inlet Invert= 92.00', Outlet Invert= 85.91'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 462.0' Slope= 0.0132 '/'

Reach 7R: Channel D 10 YR

Inflow Area =	0.610 ac,	Inflow Depth =	0.60"		
Inflow =	1.24 cfs @	0.28 hrs,	Volume=	0.031 af	
Outflow =	1.12 cfs @	0.39 hrs,	Volume=	0.030 af,	Atten= 9%, Lag= 6.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 6.1 min

Peak Depth= 0.43' @ 0.33 hrs
Capacity at bank full= 30.59 cfs
Inlet Invert= 92.00', Outlet Invert= 85.91'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 462.0' Slope= 0.0132 '/'

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Summary for Pond 2P: BASIN A

Inflow Area =	165,038 sf,	7.44% Impervious,	Inflow Depth >	0.32"	for 1 year event
Inflow =	0.78 cfs @	12.34 hrs, Volume=	4,464 cf		
Outflow =	0.16 cfs @	13.83 hrs, Volume=	3,308 cf,	Atten= 79%,	Lag= 89.0 min
Primary =	0.16 cfs @	13.83 hrs, Volume=	3,308 cf		
Secondary =	0.00 cfs @	5.00 hrs, Volume=	0 cf		

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 76.30' @ 13.83 hrs Surf.Area= 2,342 sf Storage= 1,720 cf

Plug-Flow detention time= 148.5 min calculated for 3,297 cf (74% of inflow)
Center-of-Mass det. time= 79.1 min (943.6 - 864.5)

Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	18,704 cf	**BASIN A Main Pond (Irregular)** Listed below (Recalc)
#2	77.00'	5,702 cf	**Storage Above Rip Rap Weir (Irregular)** Listed below (Recalc)
		24,406 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
75.00	235	61.8	0	0	235
76.00	2,194	189.5	1,049	1,049	2,792
77.00	2,714	213.4	2,449	3,498	3,584
78.00	3,236	235.2	2,971	6,470	4,394
79.00	3,781	257.2	3,505	9,975	5,291
80.00	4,353	277.5	4,064	14,038	6,195
81.00	4,986	294.0	4,666	18,704	6,998

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
77.00	2	6.3	0	0	2
78.00	582	132.2	206	206	1,391
79.00	1,457	231.7	987	1,193	4,278
80.00	2,309	267.4	1,867	3,059	5,718
81.00	2,991	280.2	2,643	5,702	6,339

Device	Routing	Invert	Outlet Devices
#1	Primary	76.02'	**3.0" Horiz. Orifice/Grate** C= 0.600
#2	Primary	79.50'	**9.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

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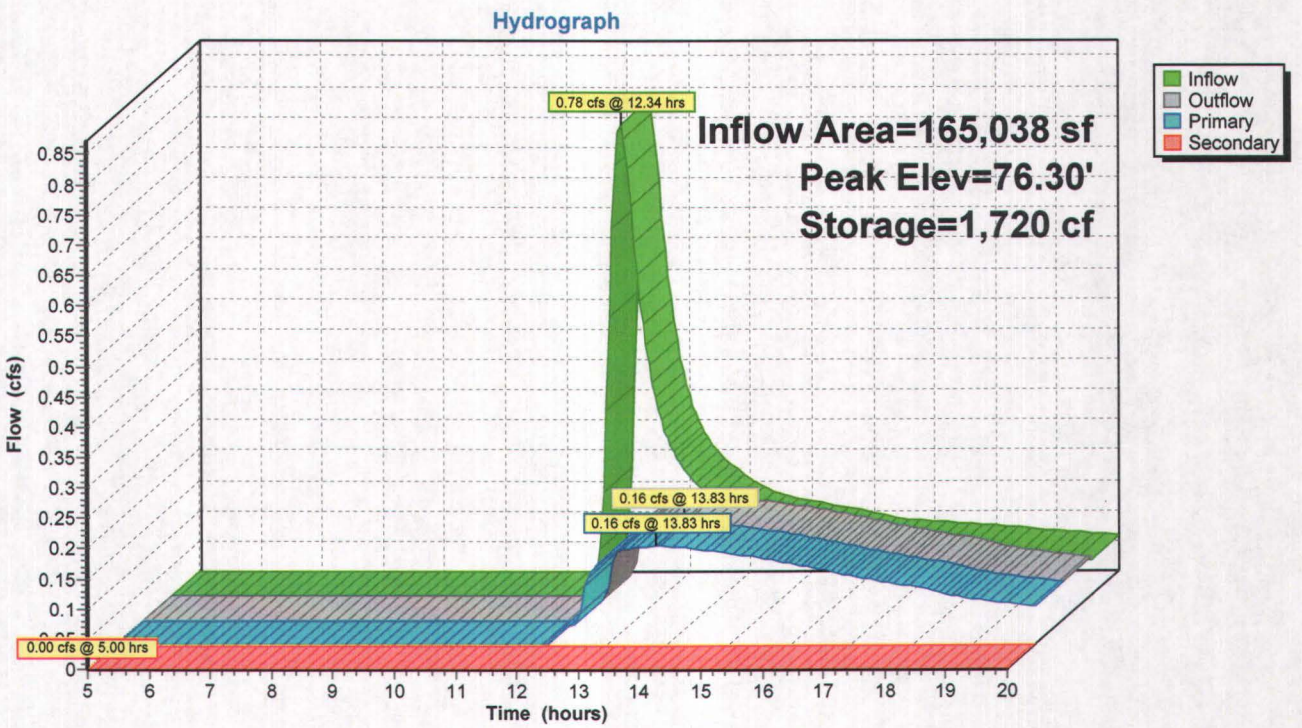
#3	Secondary	80.50'	**95.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#4	Primary	75.07'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.17 cfs @ 13.83 hrs HW=76.30' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.12 cfs @ 2.53 fps)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Orifice Controls 0.04 cfs @ 5.22 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=75.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: BASIN A



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Summary for Pond 2P: BASIN A

Inflow Area =	165,038 sf,	7.44% Impervious,	Inflow Depth >	0.61"	for 2 year event
Inflow =	1.78 cfs @	12.31 hrs, Volume=	8,409 cf		
Outflow =	0.29 cfs @	13.72 hrs, Volume=	6,735 cf,	Atten= 84%,	Lag= 84.9 min
Primary =	0.29 cfs @	13.72 hrs, Volume=	6,735 cf		
Secondary =	0.00 cfs @	5.00 hrs, Volume=	0 cf		

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 77.05' @ 13.72 hrs Surf.Area= 2,743 sf Storage= 3,624 cf

Plug-Flow detention time= 160.1 min calculated for 6,735 cf (80% of inflow)
Center-of-Mass det. time= 103.5 min (950.6 - 847.1)

Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	18,704 cf	**BASIN A Main Pond (Irregular)** Listed below (Recalc)
#2	77.00'	5,702 cf	**Storage Above Rip Rap Weir (Irregular)** Listed below (Recalc)
		24,406 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
75.00	235	61.8	0	0	235
76.00	2,194	189.5	1,049	1,049	2,792
77.00	2,714	213.4	2,449	3,498	3,584
78.00	3,236	235.2	2,971	6,470	4,394
79.00	3,781	257.2	3,505	9,975	5,291
80.00	4,353	277.5	4,064	14,038	6,195
81.00	4,986	294.0	4,666	18,704	6,998

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
77.00	2	6.3	0	0	2
78.00	582	132.2	206	206	1,391
79.00	1,457	231.7	987	1,193	4,278
80.00	2,309	267.4	1,867	3,059	5,718
81.00	2,991	280.2	2,643	5,702	6,339

Device	Routing	Invert	Outlet Devices
#1	Primary	76.02'	**3.0" Horiz. Orifice/Grate** C= 0.600
#2	Primary	79.50'	**9.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

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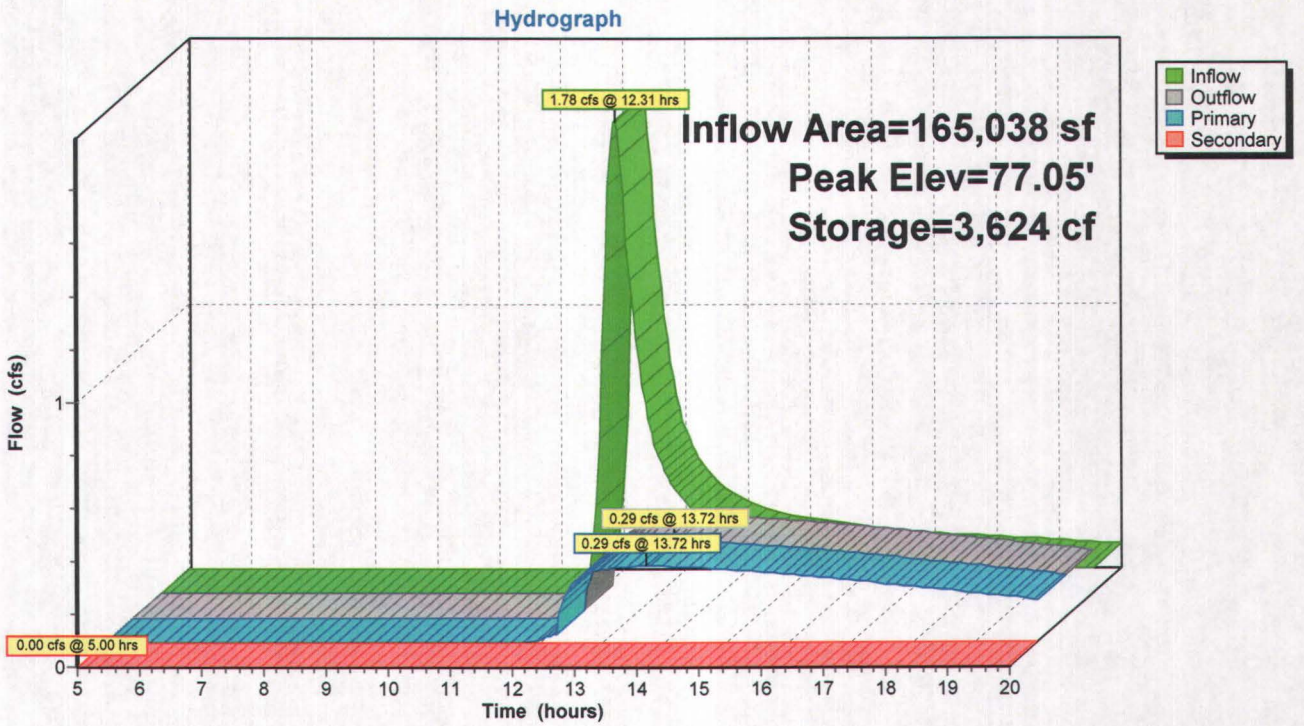
#3	Secondary	80.50'	**95.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#4	Primary	75.07'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.29 cfs @ 13.72 hrs HW=77.05' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.24 cfs @ 4.88 fps)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Orifice Controls 0.05 cfs @ 6.68 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=75.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: BASIN A



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Summary for Pond 2P: BASIN A

Inflow Area =	165,038 sf,	7.44% Impervious,	Inflow Depth >	1.90"	for 10 year event
Inflow =	6.51 cfs @	12.27 hrs, Volume=	26,189 cf		
Outflow =	0.90 cfs @	13.46 hrs, Volume=	15,639 cf,	Atten= 86%,	Lag= 71.2 min
Primary =	0.90 cfs @	13.46 hrs, Volume=	15,639 cf		
Secondary =	0.00 cfs @	5.00 hrs, Volume=	0 cf		

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 79.56' @ 13.46 hrs Surf.Area= 6,007 sf Storage= 14,317 cf

Plug-Flow detention time= 208.2 min calculated for 15,639 cf (60% of inflow)
Center-of-Mass det. time= 128.7 min (950.7 - 822.1)

Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	18,704 cf	**BASIN A Main Pond (Irregular)** Listed below (Recalc)
#2	77.00'	5,702 cf	**Storage Above Rip Rap Weir (Irregular)** Listed below (Recalc)
		24,406 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
75.00	235	61.8	0	0	235
76.00	2,194	189.5	1,049	1,049	2,792
77.00	2,714	213.4	2,449	3,498	3,584
78.00	3,236	235.2	2,971	6,470	4,394
79.00	3,781	257.2	3,505	9,975	5,291
80.00	4,353	277.5	4,064	14,038	6,195
81.00	4,986	294.0	4,666	18,704	6,998

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
77.00	2	6.3	0	0	2
78.00	582	132.2	206	206	1,391
79.00	1,457	231.7	987	1,193	4,278
80.00	2,309	267.4	1,867	3,059	5,718
81.00	2,991	280.2	2,643	5,702	6,339

Device	Routing	Invert	Outlet Devices
#1	Primary	76.02'	**3.0" Horiz. Orifice/Grate** C= 0.600
#2	Primary	79.50'	**9.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

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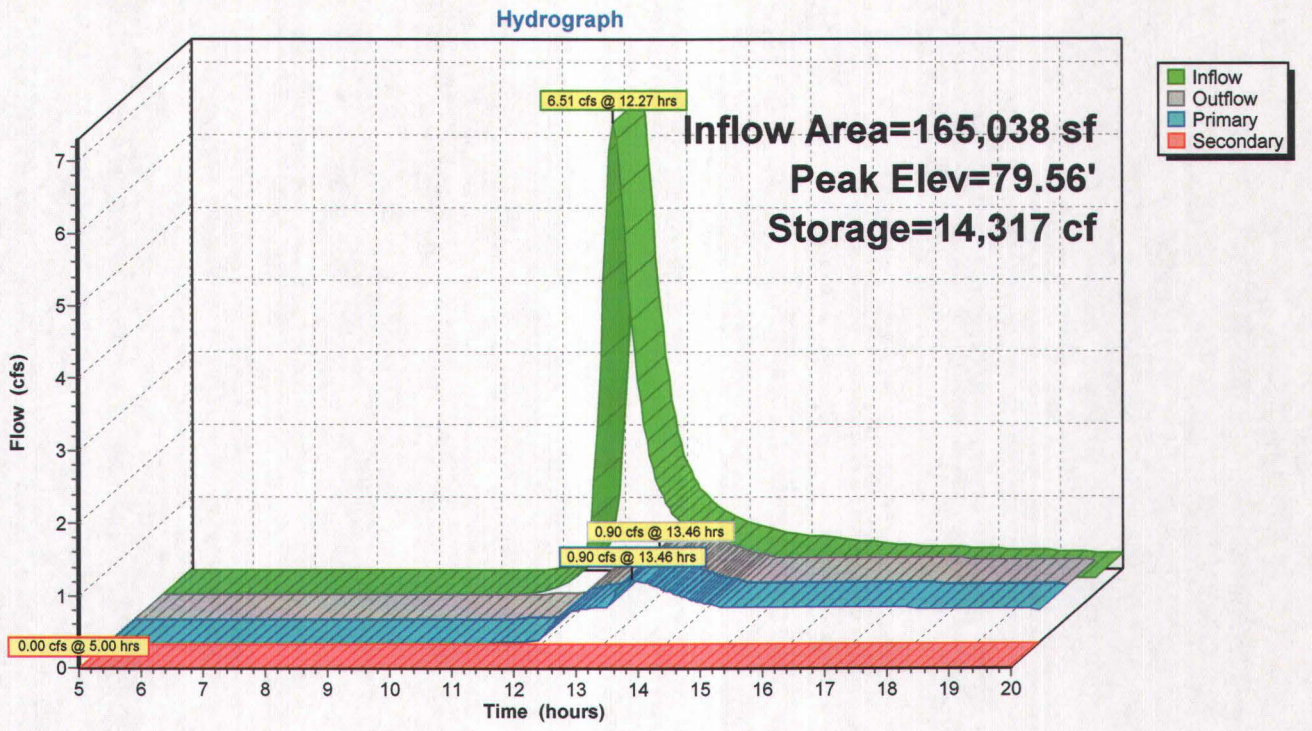
#3	Secondary	80.50'	**95.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#4	Primary	75.07'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.90 cfs @ 13.46 hrs HW=79.56' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.44 cfs @ 9.06 fps)
- **2=Broad-Crested Rectangular Weir** (Weir Controls 0.37 cfs @ 0.68 fps)
- **4=Orifice/Grate** (Orifice Controls 0.08 cfs @ 10.15 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=75.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: BASIN A



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Summary for Pond 2P: BASIN A

Inflow Area =	165,038 sf,	7.44% Impervious,	Inflow Depth >	3.44"	for 100 year event
Inflow =	12.03 cfs @	12.26 hrs,	Volume=	47,292 cf	
Outflow =	8.26 cfs @	12.48 hrs,	Volume=	34,329 cf,	Atten= 31%, Lag= 13.3 min
Primary =	8.26 cfs @	12.48 hrs,	Volume=	34,329 cf	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0 cf	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 79.95' @ 12.48 hrs Surf.Area= 6,582 sf Storage= 16,755 cf

Plug-Flow detention time= 114.2 min calculated for 34,214 cf (72% of inflow)
Center-of-Mass det. time= 50.7 min (860.8 - 810.1)

Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	18,704 cf	**BASIN A Main Pond (Irregular)** Listed below (Recalc)
#2	77.00'	5,702 cf	**Storage Above Rip Rap Weir (Irregular)** Listed below (Recalc)
		24,406 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
75.00	235	61.8	0	0	235
76.00	2,194	189.5	1,049	1,049	2,792
77.00	2,714	213.4	2,449	3,498	3,584
78.00	3,236	235.2	2,971	6,470	4,394
79.00	3,781	257.2	3,505	9,975	5,291
80.00	4,353	277.5	4,064	14,038	6,195
81.00	4,986	294.0	4,666	18,704	6,998

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
77.00	2	6.3	0	0	2
78.00	582	132.2	206	206	1,391
79.00	1,457	231.7	987	1,193	4,278
80.00	2,309	267.4	1,867	3,059	5,718
81.00	2,991	280.2	2,643	5,702	6,339

Device	Routing	Invert	Outlet Devices
#1	Primary	76.02'	**3.0" Horiz. Orifice/Grate** C= 0.600
#2	Primary	79.50'	**9.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

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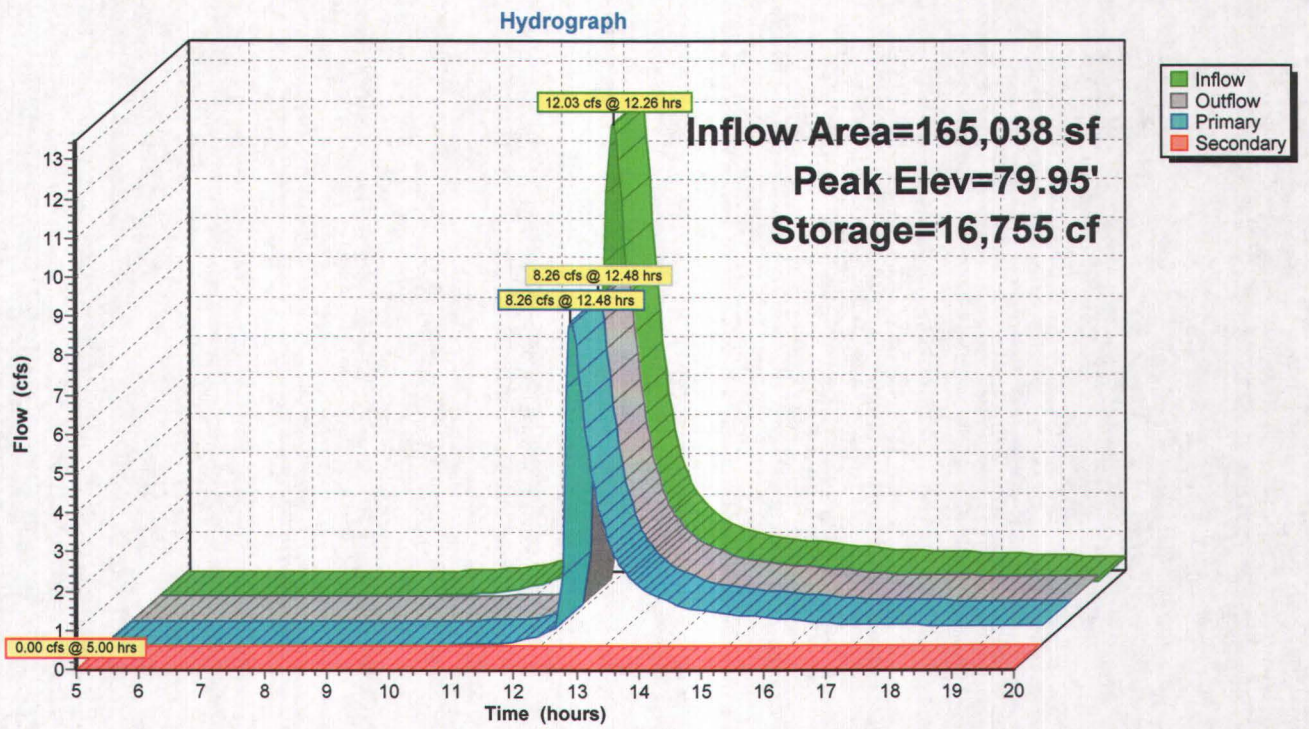
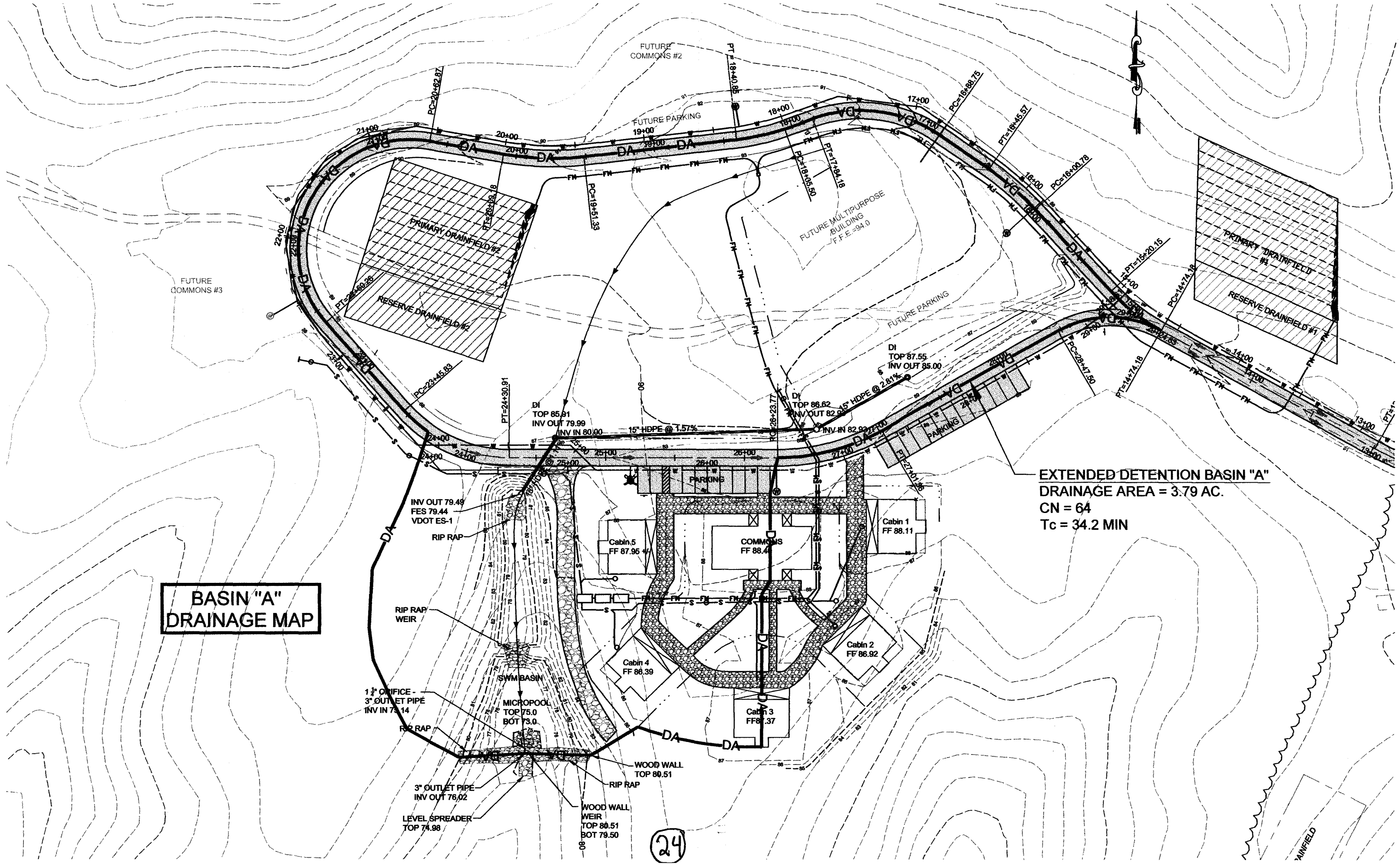
#3	Secondary	80.50'	**95.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#4	Primary	75.07'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=8.17 cfs @ 12.48 hrs HW=79.95' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.47 cfs @ 9.54 fps)
- **2=Broad-Crested Rectangular Weir** (Weir Controls 7.61 cfs @ 1.90 fps)
- **4=Orifice/Grate** (Orifice Controls 0.08 cfs @ 10.58 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=75.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: BASIN A




BASIN "A"
DRAINAGE MAP
EXTENDED DETENTION BASIN "A"
DRAINAGE AREA = 3.79 AC.
CN = 64
Tc = 34.2 MIN
FUTURE COMMONS #2
FUTURE COMMONS #3
FUTURE PARKING
FUTURE MULTIPURPOSE BUILDING
F.F.E.=94.0
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PRIMARY DRAINFIELD #1
RESERVE DRAINFIELD #1
PARKING
COMMONS
FF 88.47
Cabin 1
FF 88.11
Cabin 2
FF 86.92
Cabin 3
FF87.37
Cabin 4
FF 86.39
Cabin 5
FF 87.95
DI
TOP 85.91
INV OUT 79.99
INV IN 80.00
15" HDPE @ 1.57%
DI
TOP 87.55
INV OUT 85.00
15" HDPE @ 2.81%
DI
TOP 86.62
INV OUT 82.93
INV IN 82.93
INV OUT 79.49
FES 79.44
VDOT ES-1
RIP RAP
RIP RAP WEIR
SWM BASIN
1 1/4" ORIFICE -
3" OUTLET PIPE
INV IN 75.14
MICROPOOL
TOP 75.0
BOT 73.0
3" OUTLET PIPE
INV OUT 76.02
LEVEL SPREADER
TOP 74.98
WOOD WALL
TOP 80.51
WOOD WALL
WEIR
TOP 80.51
BOT 79.50
PC=20+62.87
PT=18+40.85
PC=19+51.33
PT=20+29.18
PT=22+69.26
PC=23+45.63
PT=24+30.91
PC=18+05.50
PT=17+84.18
PC=16+88.75
PT=16+45.57
PC=16+00.78
PT=15+20.15
PC=14+74.18
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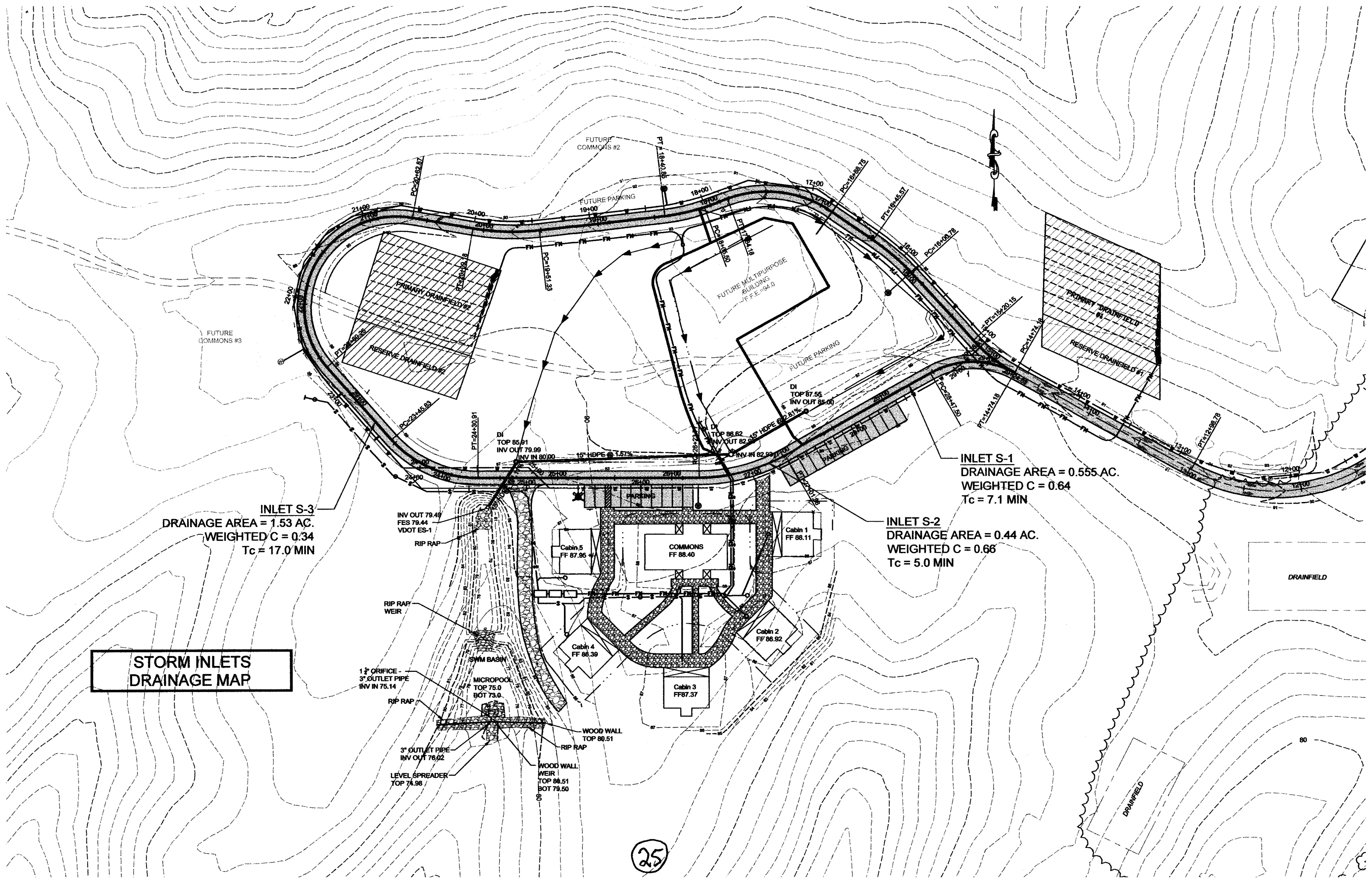
PC=28+47.50
PC=26+23.77
PT=22+01.36
DA
VC
FW
S
24


STORM INLETS
DRAINAGE MAP
INLET S-1
DRAINAGE AREA = 0.555 AC.
WEIGHTED C = 0.64
Tc = 7.1 MIN
INLET S-2
DRAINAGE AREA = 0.44 AC.
WEIGHTED C = 0.66
Tc = 5.0 MIN
INLET S-3
DRAINAGE AREA = 1.53 AC.
WEIGHTED C = 0.34
Tc = 17.0 MIN
FUTURE COMMONS #2
FUTURE PARKING
FUTURE COMMONS #3
FUTURE MULTIPURPOSE BUILDING
F.F.E.=94.0
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PRIMARY DRAINFIELD #1
RESERVE DRAINFIELD #1
DRAINFIELD
DI
TOP 87.55
INV OUT 85.00
DI
TOP 86.62
INV OUT 82.99
15" HDPE @ 2.81%
INV IN 82.99
DI
TOP 85.91
INV OUT 79.99
INV IN 80.00
15" HDPE @ 1.57%
PARKING
COMMONS
FF 88.40
Cabin 1
FF 88.11
Cabin 2
FF 86.92
Cabin 3
FF87.37
Cabin 4
FF 86.39
Cabin 5
FF 87.95
INV OUT 79.49
FES 79.44
VDOT ES-1
RIP RAP
RIP RAP
WEIR
SWM BASIN
MICROPOOL
TOP 75.0
BOT 73.0
1 1/2" ORIFICE -
3" OUTLET PIPE
INV IN 75.14
RIP RAP
3" OUTLET PIPE
INV OUT 76.02
LEVEL SPREADER
TOP 74.98
WOOD WALL
TOP 80.51
RIP RAP
WOOD WALL
WEIR
TOP 80.51
BOT 79.50
PC=20+62.87
PT=18+40.96
PC=19+51.33
PC=18+35.50
PT=17+84.18
PC=16+98.75
PT=16+45.57
PC=16+00.78
PT=15+20.15
PC=14+74.18
PT=14+74.18
PC=28+47.50
PT=12+98.78
PC=23+45.83
PT=24+30.91
PC=23+03.18
PT=22+98.26
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19+00
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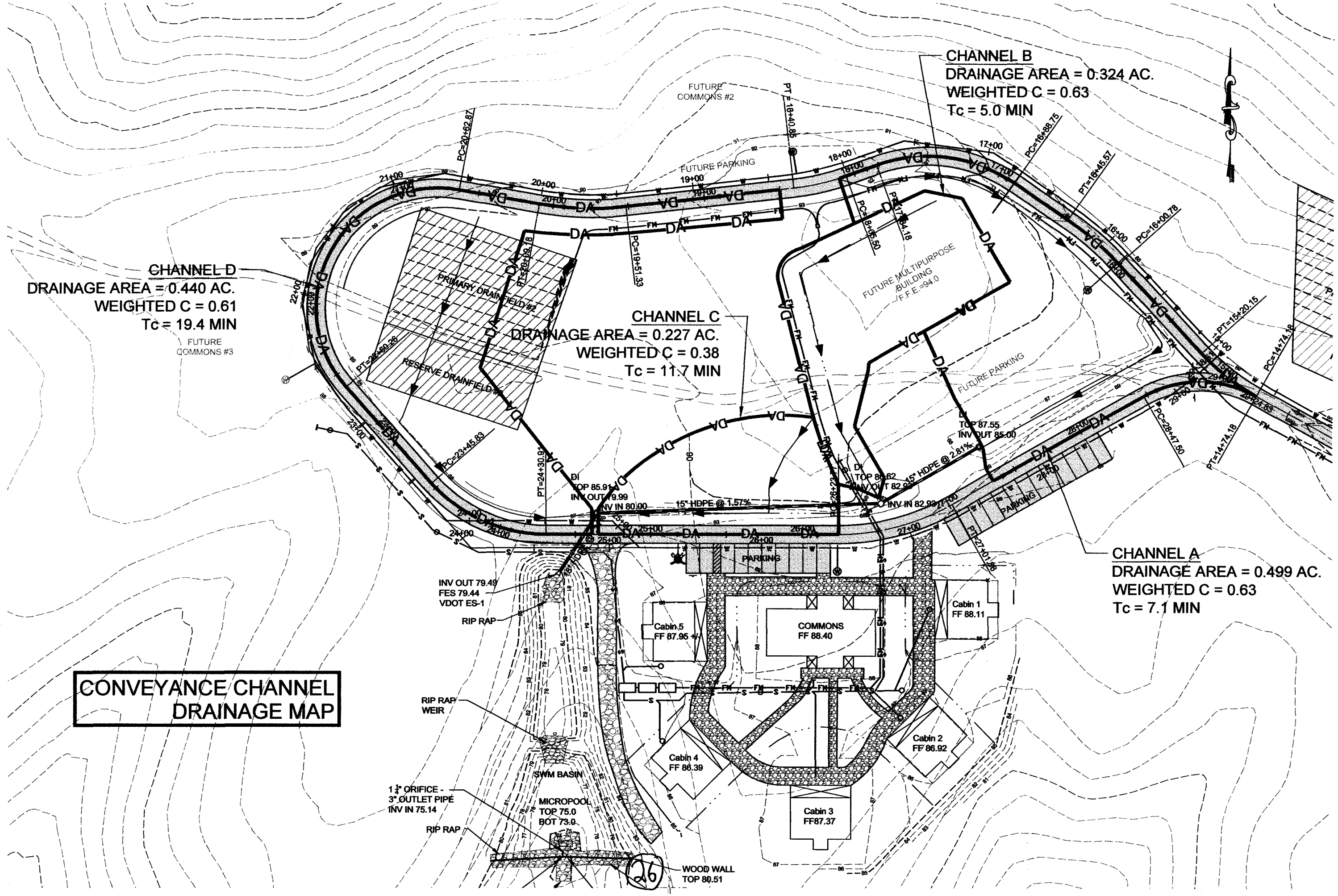
13+00
12+00
14+00
80


CHANNEL B
DRAINAGE AREA = 0.324 AC.
WEIGHTED C = 0.63
Tc = 5.0 MIN
CHANNEL D
DRAINAGE AREA = 0.440 AC.
WEIGHTED C = 0.61
Tc = 19.4 MIN
CHANNEL C
DRAINAGE AREA = 0.227 AC.
WEIGHTED C = 0.38
Tc = 11.7 MIN
CHANNEL A
DRAINAGE AREA = 0.499 AC.
WEIGHTED C = 0.63
Tc = 7.1 MIN
FUTURE COMMONS #2
FUTURE PARKING
FUTURE COMMONS #3
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
FUTURE MULTIPURPOSE BUILDING F.F.E.=94.0
PARKING
COMMONS FF 88.40
Cabin 1 FF 88.11
Cabin 2 FF 86.92
Cabin 3 FF87.37
Cabin 4 FF 86.39
Cabin 5 FF 87.95
15" HDPE @ 1.57%
15" HDPE @ 2.81%
INV OUT 79.49
FES 79.44
VDOT ES-1
RIP RAP
RIP RAP WEIR
SWM BASIN
1 1/4" ORIFICE - 3" OUTLET PIPE INV IN 75.14
MICROPOOL TOP 75.0 BOT 73.0
WOOD WALL TOP 80.51
CONVEYANCE CHANNEL DRAINAGE MAP

TERRA ENGINEERING
AND
LAND SOLUTIONS, PC

2374 STUARTS DRAFT HIGHWAY, STUARTS DRAFT, VA 24477
PH. (540) 337-4591 FAX (540) 337-5291

Williamsburg Christian Retreat Center

James City County, Virginia

Stormwater Management Report
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23 March 2012
Revised 6 September 2012

NOV 07 2012

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WILLIAMSBURG CHRISTIAN RETREAT CENTER YOUTH FACILITY

James City County, Virginia

Stormwater Management Computations Summary

September 6, 2012

This narrative is intended for detailed descriptions concerning the adequacy of the design of storm water management (SWM) facility for Williamsburg Christian Retreat Center Youth Facility. Based on the as-built plans and recent field inspection a few items were noted that could affect the adequacy of the system. First, there is an earthen berm and rip rap weir located in the detention basin that will reduce available storage. Second, originally there was one three inch outlet pipe with a 1 ¼" orifice plate. That pipe has since lost the orifice plate to damage and now operates as a 3" orifice. Additionally, another pipe with a 1 ¼" inside diameter plate was added approximately one foot below the original pipe.

The extended dry detention basin, a permanent water quantity facility will capture roughly 3.79 acres of the project area and maintain the 2 and 10 year existing flows. The extended detention basin will not be used for any erosion control measures but currently has a temporary sediment trap created by an earthen berm and riprap weir. The berm will decrease the amount of available pond storage until it is removed. This SWM facility has been designed to release the 1-year storm event over a 24-hour period in order to satisfy stream protection volume requirements. The 1-year and 2-year storm events are released through two orifice holes located near the bottom of the timber weir wall. The 10-year and 100-year storm events are released through a 9 foot wide broad crested weir. Extensive erosion control measures are installed downstream of the timber wall in order to significantly reduce channel erosion possibilities.

Pre-development runoff was acquired employing revised stormwater calculations dated 6/6/08, see runoff summary table below. Post development runoff calculations were then performed for the detention basin as it is currently built. Since the earthen berm and riprap weir will not account for significant storage, the basin was broken into two storage areas. Those areas are: (1) storage above the sediment trap and (2) storage of the main basin between the sediment trap and timber wall. The drainage area for the basin was determined to be 3.79 acres. Time of concentration was then calculated; the calculated Tc confirmed Tc used in previous calculations. Therefore the same rainfall parameters were used in the TR-55 calculations. As a result of the added outlet pipe when compared to original design, 1 and 2 year storm events will see an increase in runoff. On the other hand 10 and 100 year storm events will have a decrease in runoff because the two outlet pipes allow more water to discharge before the water level riser high enough to flow over the weir. Overall the basin and timber wall outflow structure were determined to be adequate since the post-development 10-year runoff was subjacent to the pre-development 10-year runoff.

Runoff Summary Table for Detention Basin Outfall

(See attached hydrographs)

Pre-development Runoff (cfs)			Post-development Runoff (cfs)	
Q_1	0.10		Q_1	0.16
Q_2	0.27		Q_2	0.29
Q_{10}	1.82		Q_{10}	0.90
Q_{100}	3.88		Q_{100}	8.26

WCRC Youth Facility

Drainage Areas

Terra Engineering and Land Solutions
March 1, 2012

Revised:
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Area ID	Area Description	Area SF	Area Ac.	Wtd. C	Area CA	Up ID 1	Up ID 2	Σ CA	Area Tc	2 year I	10 year I	25 year I	100 year I	2 year Q	10 year Q	25 year Q	100 year Q
1	Drainage Area Inlet 1	24169	0.555	0.64	0.36			0.36	7.1	5.2	6.8	7.7	9.0	1.89	2.45	3.05	4.05
2	Drainage Area Inlet 2	19169	0.440	0.66	0.29	1		0.65	5.0	5.8	7.5	8.5	10.0	3.76	4.87	6.07	8.12
3	Drainage Area Inlet 3	66465	1.526	0.34	0.52	2		1.17	17.0	3.7	4.9	5.5	6.5	4.32	5.68	7.13	9.46
4	Drainage Area Channel A	21738	0.499	0.63	0.31			0.31	7.1	5.2	6.8	7.7	9.0	1.63	2.11	2.63	3.49
5	Drainage Area Channel B	14126	0.324	0.63	0.20			0.20	5.0	5.8	7.5	8.5	10.0	1.16	1.50	1.87	2.50
6	Drainage Area Channel C	9899	0.227	0.38	0.09			0.09	11.7	4.4	5.7	6.5	7.5	0.39	0.51	0.64	0.85
7	Drainage Area Channel D	26584	0.610	0.41	0.25			0.25	16.5	3.7	4.9	5.6	6.6	0.94	1.23	1.54	2.05
8	Drainage Area Culvert A	6627	0.152	0.47	0.07			0.07	5.0	5.8	7.5	8.5	10.0	0.40	0.52	0.65	0.87

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Composite C values

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March 1, 2012

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Area ID	Area SF	Area in C value = (SF)															Weighted C	Area Check SF	Wtd. C Check
		0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90			
1	24169			9607						1948						12613	0.64	24169	OK
2	19169			7089						1387						10693	0.66	19169	OK
3	66465		28111	29129						4247						4978	0.34	66465	OK
4	21738			8731						1948						11059	0.63	21738	OK
5	14126			5774						1387						6965	0.63	14126	OK
6	9899			8062						887						950	0.38	9899	OK
7	26584		3760	15852						3360						3612	0.41	26584	OK
8	6627			4198						1050						1379	0.47	6627	OK

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Time of Concentration Calculator (VDOT methods)

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March 1, 2012

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Subarea Computations

Area ID	Sheet Flow 1 L (ft)	Sheet Flow 1 S (%)	Sheet Flow 1 C	Sheet Flow 1 T (min)	Sheet Flow 2 L (ft)	Sheet Flow 2 S (%)	Sheet Flow 2 C	Sheet Flow 2 T (min)	Shallow Flow 1 L (ft)	Shallow Flow 1 S (%)	Shallow Flow 1 C	Shallow Flow 1 T (min)	Shallow Flow 2 L (ft)	Shallow Flow 2 S (%)	Shallow Flow 2 C	Shallow Flow 2 T (min)	Channel Flow L (ft)	Channel Flow H (ft)	Channel Flow T (min)	Sub Tc	Up ID 1	Up ID 2	Up ID 3	Up ID 4	Max. US Tc	Area Tc	Use Tc
1	19	5.00	0.85	1.6																7.1						7.1	7.1
2																	261	5.4	2.7	2.7						2.7	5.0
3	200	2.60	0.25	16.7					58	3.60	0.30	0.3								17.0						17.0	17.0
4	19	5.00	0.85	1.6																7.1						7.1	7.1
5																	261	5.4	2.7	2.7						2.7	5.0
6	61	2.47	0.30	8.5	12	33.33	0.60	1.3									111	1.1	1.9	11.7						11.7	17.4
7	143	1.75	0.25	15.6	5	33.33	0.60	0.9									150	0.8	2.9	19.4						19.4	19.4
8																	175	1.0	3.2	3.2						3.2	5.0
												#####															

Inlet 1: Sheet flow to ditch Tc1:1.6 Tc=1.6+1.8+.6+3.1=7.1

+ Channel flow to entrace culvert Tc2:1.8	175	4.8	1.8
+ Pipe flow Tc3:0.6	38	1.0	0.6
+ Channel flow to Inlet S-1 Tc4:3.1	157	0.8	3.1

Channel A: Sheet flow to ditch Tc1:1.6 Tc=1.6+1.8+.6+3.1=7.1

+ Channel flow to entrace culvert Tc2:1.8
+ Pipe flow Tc3:0.6
+ Channel flow to Inlet S-1 Tc4:3.1

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Storm Drain Pipes

Terra Engineering and Land Solutions **Revised:**

March 1, 2012

Struct ID	Struct Type	Area 1 ID	Area 2 ID	Σ CA	Tc	I 25 yr	Q 25 yr	Top	Inv Upper	Inv Lower	Length ft	Slope ft/ft	Diam. in.	n	Cap'y cfs	Vel fps	Flow t min.	Remarks
S-1	DI-7	1	2	1.01	7.1	7.7	3.05	87.55	85.00	82.93	75.51	0.0274	15	0.013	10.70	8.72	0.1	15" HDPE
S-2	DI-7	2		0.65	5.0	8.5	6.07	86.62	82.93	80.00	187.66	0.0156	15	0.013	8.07	6.58	0.5	15" HDPE
S-3	DI-7	3		1.17	17.0	5.5	7.13	85.91	79.99	79.49	48.36	0.0103	18	0.013	10.68	6.04	0.1	15" HDPE

Notes:

LD-347 Rev. 3/20/07

HYDRAULIC GRADE LINE

PROJECT: 0716 WCRC

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INLET STATION	Outlet Water Surface Elev. ft	D_o in.	Q_o cfs	L_o ft.	S_{f_o} %	H_f	JUNCTION LOSS V_o	H_o	Q_i	V_i	Q_iV_i	$\frac{V_i^2}{2g}$	H_i	Angle	H_d	H_t	1.3 H_t	0.5 H_t	Final H	Inlet Water Surface Elev.	Rim Elev.
1+00	80.69	18	5.68	48.36	2.9×10^{-3}	0.14	6.04	0.14	4.87	6.58	32.04	0.67	0.24	55°	0.36	0.74			0.88	81.57	85.91
2+87.66	81.57	15	4.87	187.66	5.65×10^{-3}	1.06	6.58	0.17	2.45	8.72	21.36	1.18	0.413	28°	0.39	0.97			2.03	83.60	86.62
3+63.17	83.60	15	2.45	75.51	1.43×10^{-3}	0.11	8.72	0.30								0.30			0.41	84.01	87.55

FINAL H = $H_f + H_t$

$H_i = 0.35\ V_i^2 / 2g$; $H_o = 0.25\ V_o^2 / 2g$; $H_d = K\ V_i^2 / 2g$; $H_t = H_o + H_i + H_d$

90° K = 0.70	50° K = 0.50	20° K = 0.25
80° K = 0.66	40° K = 0.43	15° K = 0.19
70° K = 0.61	30° K = 0.35	10° K = 0.13
60° K = 0.56	25° K = 0.30	5° K = 0.06

* Pipes Assumed to flow full

Outlet Water ELEV.

$TW = 0.8D = 0.8(1.5) = 1.2'$

$1.2 + 79.49 = 80.69'$

STAT. 1+00

$S_f = \frac{Q^2 n^2}{z^2 A^2 R^{4/3}}$

$Q = 5.68$ cfs $n = 0.013$

$z = 1.486$ $A = 1.77\ ft^2$ $R = 0.376$ ft

$R = \frac{A}{P_w}$ $P_w = 4.71$ ft

$= 0.002904$

$H_f = S_f L = 2.9 \times 10^{-3} \times 4836$

$= 0.14$ ft

$H_o = \frac{0.25(6.04)^2}{2(32.2)} = 0.1416$ ft

$H_i = \frac{0.35(6.58)^2}{2(32.2)} = 0.2353$ ft

$H_d = \frac{0.53(6.58^2)}{2(32.2)} = 0.3563$ ft

$H_t = 0.74$

STAT. 2+87.66

$Q = 4.87$ cfs $A = 1.23\ ft^2$

$P_w = 3.93$ ft $R = 0.313$ ft

$S_f = \frac{4.87^2 \times 0.013^2}{1.486^2 \times 1.23^2 (0.313)^{4/3}}$

$= 0.005645$

$H_o = \frac{0.25(6.58^2)}{2(32.2)} = 0.168$ ft

$H_f = 5.65 \times 10^{-3} \times 187.66 = 1.06$ ft

$H_i = \frac{0.35(8.72)^2}{2(32.2)} = 0.413$ ft

$H_d = \frac{0.33(8.72)^2}{2(32.2)} = 0.389$

$H_t = 0.168 + 0.413 + 0.389$

$= 0.97$ ft

STAT. 3+63.17

$Q = 2.45$ cfs

$S_f = \frac{2.45^2 \times 0.013^2}{1.486^2 \times 1.23^2 (0.313)^{4/3}}$

$= 0.001428$

$H_o = \frac{0.25(8.72^2)}{2(32.2)}$

$= 0.295$ ft

$H_f = 1.43 \times 10^{-3} \cdot 75.51$

$= 0.1079$

Subcatchment 3PO: Channel A

Runoff = 1.65 cfs @ 0.12 hrs, Volume= 0.020 af, Depth= 0.49"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Rainfall Duration=9 min, Inten=5.20 in/hr

Area (sf)	C	Description
21,738	0.63	Channel A

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

Reach 7R: Channel A 2 YR

Inflow Area = 0.499 ac, Inflow Depth = 0.49"
Inflow = 1.65 cfs @ 0.12 hrs, Volume= 0.020 af
Outflow = 1.42 cfs @ 0.22 hrs, Volume= 0.020 af, Atten= 14%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 6.7 min

Peak Depth= 0.48' @ 0.17 hrs
Capacity at bank full= 29.15 cfs
Inlet Invert= 92.00', Outlet Invert= 87.55'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 372.0' Slope= 0.0120 '/'

Subcatchment 3PO: Channel A

Runoff = 2.16 cfs @ 0.12 hrs, Volume= 0.027 af, Depth= 0.64"

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Rainfall Duration=9 min, Inten=6.80 in/hr

Area (sf)	C	Description
21,738	0.63	Channel A

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

Reach 7R: Channel A 2 YR

Inflow Area = 0.499 ac, Inflow Depth = 0.64"
Inflow = 2.16 cfs @ 0.12 hrs, Volume= 0.027 af
Outflow = 1.89 cfs @ 0.21 hrs, Volume= 0.027 af, Atten= 12%, Lag= 5.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.2 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 6.4 min

Peak Depth= 0.54' @ 0.16 hrs
Capacity at bank full= 29.15 cfs
Inlet Invert= 92.00', Outlet Invert= 87.55'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 372.0' Slope= 0.0120 '/'

Reach 7R: Channel B 2 YR

Inflow Area =	0.324 ac,	Inflow Depth =	0.43"		
Inflow =	1.19 cfs @	0.09 hrs,	Volume=	0.011 af	
Outflow =	1.13 cfs @	0.15 hrs,	Volume=	0.011 af,	Atten= 6%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.5 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 4.7 min

Peak Depth= 0.39' @ 0.12 hrs
Capacity at bank full= 40.76 cfs
Inlet Invert= 92.00', Outlet Invert= 86.62'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 230.0' Slope= 0.0234 '/'

Reach 7R: Channel B 10 YR

Inflow Area =	0.324 ac,	Inflow Depth =	0.55"		
Inflow =	1.55 cfs @	0.09 hrs,	Volume=	0.015 af	
Outflow =	1.47 cfs @	0.14 hrs,	Volume=	0.015 af,	Atten= 5%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 4.5 min

Peak Depth= 0.43' @ 0.12 hrs
Capacity at bank full= 40.76 cfs
Inlet Invert= 92.00', Outlet Invert= 86.62'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 230.0' Slope= 0.0234 '/'

Reach 7R: Channel C 2 YR

Inflow Area =	0.227 ac,	Inflow Depth =	0.33"		
Inflow =	0.38 cfs @	0.20 hrs,	Volume=	0.006 af	
Outflow =	0.34 cfs @	0.27 hrs,	Volume=	0.006 af,	Atten= 12%, Lag= 4.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.1 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 5.3 min

Peak Depth= 0.32' @ 0.22 hrs
Capacity at bank full= 20.91 cfs
Inlet Invert= 87.00', Outlet Invert= 85.91'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 177.0' Slope= 0.0062 '/'

Reach 7R: Channel C 10 YR

Inflow Area =	0.227 ac,	Inflow Depth =	0.43"		
Inflow =	0.50 cfs @	0.20 hrs,	Volume=	0.008 af	
Outflow =	0.44 cfs @	0.26 hrs,	Volume=	0.008 af,	Atten= 11%, Lag= 3.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 5.0 min

Peak Depth= 0.35' @ 0.22 hrs
Capacity at bank full= 20.91 cfs
Inlet Invert= 87.00', Outlet Invert= 85.91'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 177.0' Slope= 0.0062 '/'

Reach 7R: Channel D 2 YR

Inflow Area =	0.610 ac,	Inflow Depth =	0.46"		
Inflow =	0.93 cfs @	0.28 hrs,	Volume=	0.023 af	
Outflow =	0.84 cfs @	0.40 hrs,	Volume=	0.023 af,	Atten= 10%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 6.5 min

Peak Depth= 0.39' @ 0.33 hrs
Capacity at bank full= 30.59 cfs
Inlet Invert= 92.00', Outlet Invert= 85.91'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 462.0' Slope= 0.0132 '/'

Reach 7R: Channel D 10 YR

Inflow Area =	0.610 ac,	Inflow Depth =	0.60"		
Inflow =	1.24 cfs @	0.28 hrs,	Volume=	0.031 af	
Outflow =	1.12 cfs @	0.39 hrs,	Volume=	0.030 af,	Atten= 9%, Lag= 6.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-1.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 6.1 min

Peak Depth= 0.43' @ 0.33 hrs
Capacity at bank full= 30.59 cfs
Inlet Invert= 92.00', Outlet Invert= 85.91'
0.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 462.0' Slope= 0.0132 '/'

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Summary for Pond 2P: BASIN A

Inflow Area =	165,038 sf,	7.44% Impervious,	Inflow Depth >	0.32"	for 1 year event
Inflow =	0.78 cfs @	12.34 hrs, Volume=	4,464 cf		
Outflow =	0.16 cfs @	13.83 hrs, Volume=	3,308 cf,	Atten= 79%,	Lag= 89.0 min
Primary =	0.16 cfs @	13.83 hrs, Volume=	3,308 cf		
Secondary =	0.00 cfs @	5.00 hrs, Volume=	0 cf		

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 76.30' @ 13.83 hrs Surf.Area= 2,342 sf Storage= 1,720 cf

Plug-Flow detention time= 148.5 min calculated for 3,297 cf (74% of inflow)
Center-of-Mass det. time= 79.1 min (943.6 - 864.5)

Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	18,704 cf	**BASIN A Main Pond (Irregular)** Listed below (Recalc)
#2	77.00'	5,702 cf	**Storage Above Rip Rap Weir (Irregular)** Listed below (Recalc)
		24,406 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
75.00	235	61.8	0	0	235
76.00	2,194	189.5	1,049	1,049	2,792
77.00	2,714	213.4	2,449	3,498	3,584
78.00	3,236	235.2	2,971	6,470	4,394
79.00	3,781	257.2	3,505	9,975	5,291
80.00	4,353	277.5	4,064	14,038	6,195
81.00	4,986	294.0	4,666	18,704	6,998

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
77.00	2	6.3	0	0	2
78.00	582	132.2	206	206	1,391
79.00	1,457	231.7	987	1,193	4,278
80.00	2,309	267.4	1,867	3,059	5,718
81.00	2,991	280.2	2,643	5,702	6,339

Device	Routing	Invert	Outlet Devices
#1	Primary	76.02'	**3.0" Horiz. Orifice/Grate** C= 0.600
#2	Primary	79.50'	**9.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

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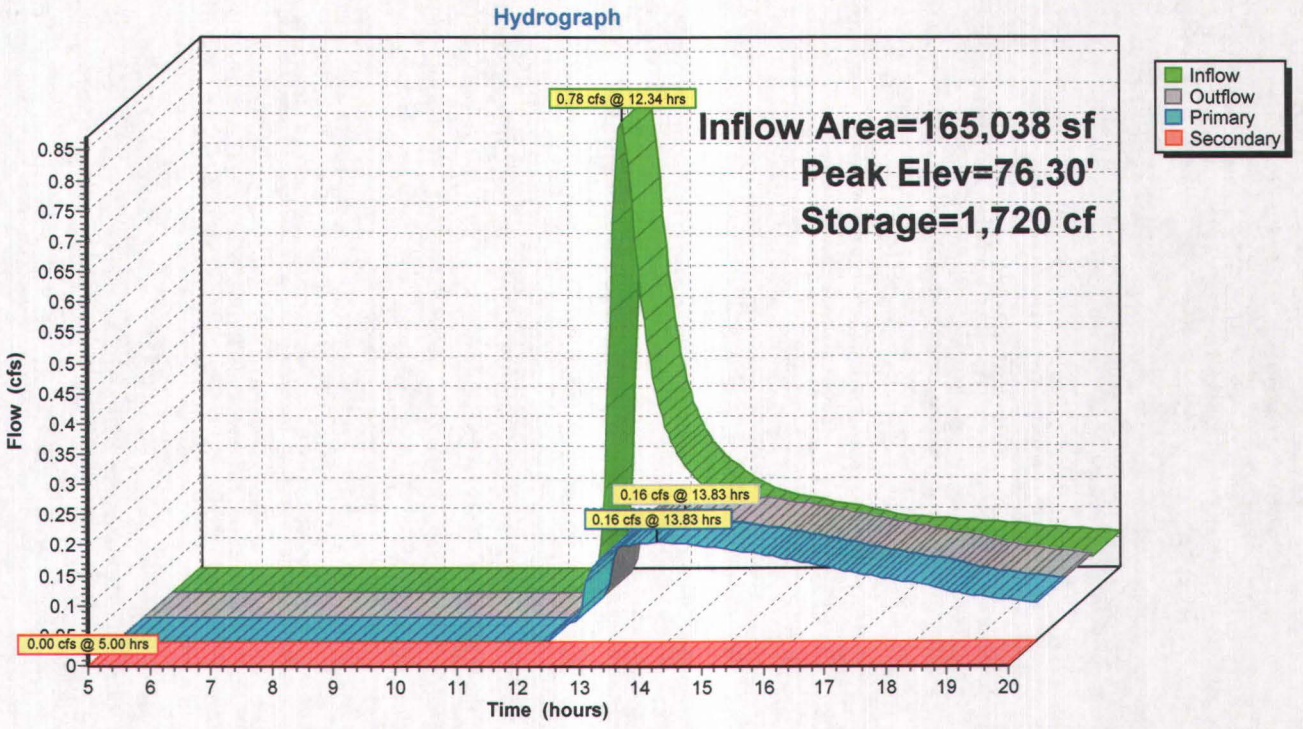
#3	Secondary	80.50'	**95.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#4	Primary	75.07'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.17 cfs @ 13.83 hrs HW=76.30' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.12 cfs @ 2.53 fps)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Orifice Controls 0.04 cfs @ 5.22 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=75.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: BASIN A



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Summary for Pond 2P: BASIN A

Inflow Area =	165,038 sf,	7.44% Impervious,	Inflow Depth >	0.61"	for 2 year event
Inflow =	1.78 cfs @	12.31 hrs, Volume=	8,409 cf		
Outflow =	0.29 cfs @	13.72 hrs, Volume=	6,735 cf,	Atten= 84%,	Lag= 84.9 min
Primary =	0.29 cfs @	13.72 hrs, Volume=	6,735 cf		
Secondary =	0.00 cfs @	5.00 hrs, Volume=	0 cf		

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 77.05' @ 13.72 hrs Surf.Area= 2,743 sf Storage= 3,624 cf

Plug-Flow detention time= 160.1 min calculated for 6,735 cf (80% of inflow)
Center-of-Mass det. time= 103.5 min (950.6 - 847.1)

Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	18,704 cf	**BASIN A Main Pond (Irregular)** Listed below (Recalc)
#2	77.00'	5,702 cf	**Storage Above Rip Rap Weir (Irregular)** Listed below (Recalc)
		24,406 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
75.00	235	61.8	0	0	235
76.00	2,194	189.5	1,049	1,049	2,792
77.00	2,714	213.4	2,449	3,498	3,584
78.00	3,236	235.2	2,971	6,470	4,394
79.00	3,781	257.2	3,505	9,975	5,291
80.00	4,353	277.5	4,064	14,038	6,195
81.00	4,986	294.0	4,666	18,704	6,998

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
77.00	2	6.3	0	0	2
78.00	582	132.2	206	206	1,391
79.00	1,457	231.7	987	1,193	4,278
80.00	2,309	267.4	1,867	3,059	5,718
81.00	2,991	280.2	2,643	5,702	6,339

Device	Routing	Invert	Outlet Devices
#1	Primary	76.02'	**3.0" Horiz. Orifice/Grate** C= 0.600
#2	Primary	79.50'	**9.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

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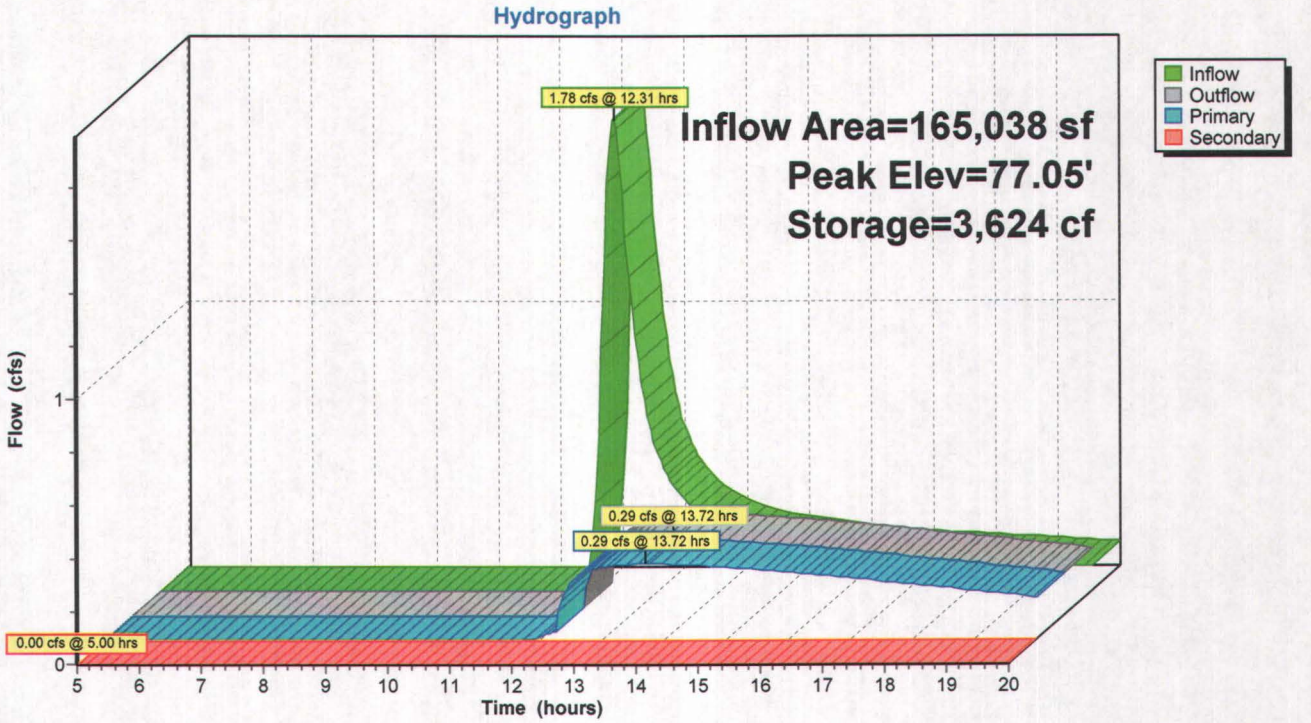
#3	Secondary	80.50'	**95.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#4	Primary	75.07'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.29 cfs @ 13.72 hrs HW=77.05' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.24 cfs @ 4.88 fps)
- **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **4=Orifice/Grate** (Orifice Controls 0.05 cfs @ 6.68 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=75.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: BASIN A



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Summary for Pond 2P: BASIN A

Inflow Area =	165,038 sf,	7.44% Impervious,	Inflow Depth >	1.90"	for 10 year event
Inflow =	6.51 cfs @	12.27 hrs, Volume=	26,189 cf		
Outflow =	0.90 cfs @	13.46 hrs, Volume=	15,639 cf,	Atten= 86%,	Lag= 71.2 min
Primary =	0.90 cfs @	13.46 hrs, Volume=	15,639 cf		
Secondary =	0.00 cfs @	5.00 hrs, Volume=	0 cf		

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 79.56' @ 13.46 hrs Surf.Area= 6,007 sf Storage= 14,317 cf

Plug-Flow detention time= 208.2 min calculated for 15,639 cf (60% of inflow)
Center-of-Mass det. time= 128.7 min (950.7 - 822.1)

Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	18,704 cf	**BASIN A Main Pond (Irregular)** Listed below (Recalc)
#2	77.00'	5,702 cf	**Storage Above Rip Rap Weir (Irregular)** Listed below (Recalc)
		24,406 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
75.00	235	61.8	0	0	235
76.00	2,194	189.5	1,049	1,049	2,792
77.00	2,714	213.4	2,449	3,498	3,584
78.00	3,236	235.2	2,971	6,470	4,394
79.00	3,781	257.2	3,505	9,975	5,291
80.00	4,353	277.5	4,064	14,038	6,195
81.00	4,986	294.0	4,666	18,704	6,998

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
77.00	2	6.3	0	0	2
78.00	582	132.2	206	206	1,391
79.00	1,457	231.7	987	1,193	4,278
80.00	2,309	267.4	1,867	3,059	5,718
81.00	2,991	280.2	2,643	5,702	6,339

Device	Routing	Invert	Outlet Devices
#1	Primary	76.02'	**3.0" Horiz. Orifice/Grate** C= 0.600
#2	Primary	79.50'	**9.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

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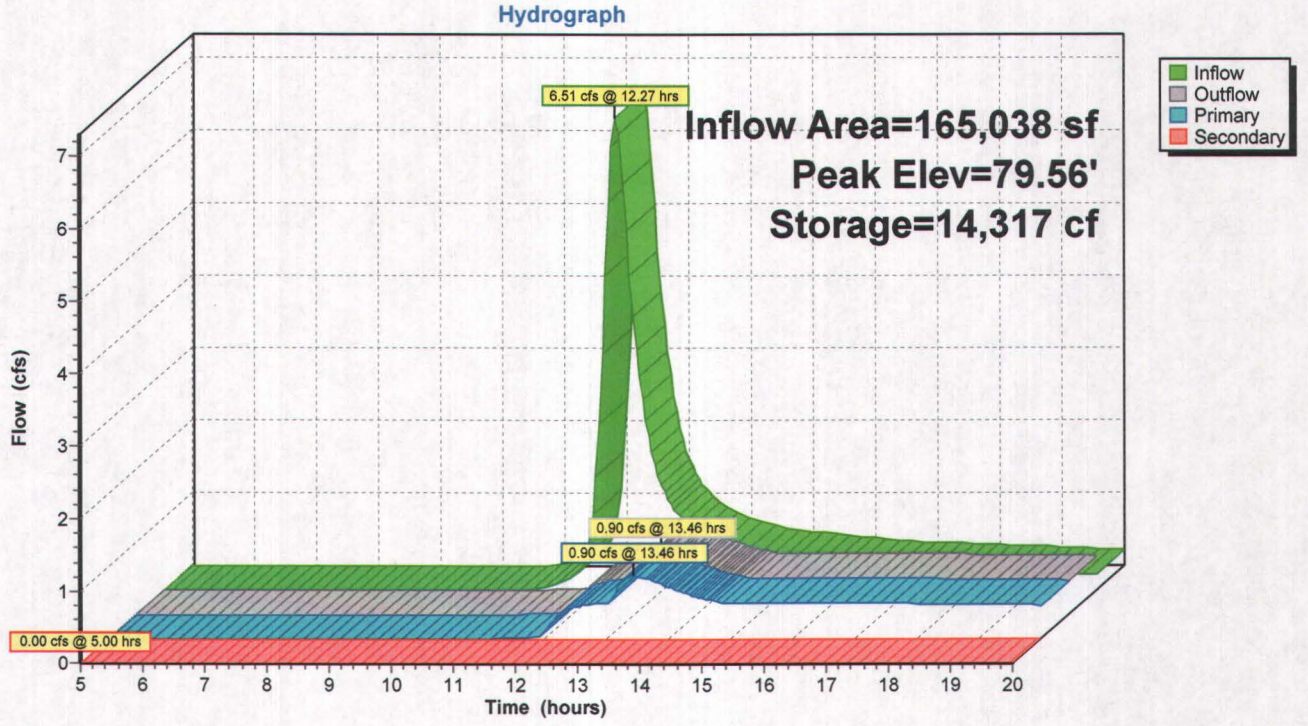
#3	Secondary	80.50'	**95.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#4	Primary	75.07'	**1.2" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.90 cfs @ 13.46 hrs HW=79.56' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.44 cfs @ 9.06 fps)
- **2=Broad-Crested Rectangular Weir** (Weir Controls 0.37 cfs @ 0.68 fps)
- **4=Orifice/Grate** (Orifice Controls 0.08 cfs @ 10.15 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=75.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: BASIN A



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Summary for Pond 2P: BASIN A

Inflow Area =	165,038 sf,	7.44% Impervious,	Inflow Depth >	3.44"	for 100 year event
Inflow =	12.03 cfs @	12.26 hrs,	Volume=	47,292 cf	
Outflow =	8.26 cfs @	12.48 hrs,	Volume=	34,329 cf,	Atten= 31%, Lag= 13.3 min
Primary =	8.26 cfs @	12.48 hrs,	Volume=	34,329 cf	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0 cf	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 79.95' @ 12.48 hrs Surf.Area= 6,582 sf Storage= 16,755 cf

Plug-Flow detention time= 114.2 min calculated for 34,214 cf (72% of inflow)
Center-of-Mass det. time= 50.7 min (860.8 - 810.1)

Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	18,704 cf	**BASIN A Main Pond (Irregular)** Listed below (Recalc)
#2	77.00'	5,702 cf	**Storage Above Rip Rap Weir (Irregular)** Listed below (Recalc)
		24,406 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
75.00	235	61.8	0	0	235
76.00	2,194	189.5	1,049	1,049	2,792
77.00	2,714	213.4	2,449	3,498	3,584
78.00	3,236	235.2	2,971	6,470	4,394
79.00	3,781	257.2	3,505	9,975	5,291
80.00	4,353	277.5	4,064	14,038	6,195
81.00	4,986	294.0	4,666	18,704	6,998

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
77.00	2	6.3	0	0	2
78.00	582	132.2	206	206	1,391
79.00	1,457	231.7	987	1,193	4,278
80.00	2,309	267.4	1,867	3,059	5,718
81.00	2,991	280.2	2,643	5,702	6,339

Device	Routing	Invert	Outlet Devices
#1	Primary	76.02'	**3.0" Horiz. Orifice/Grate** C= 0.600
#2	Primary	79.50'	**9.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

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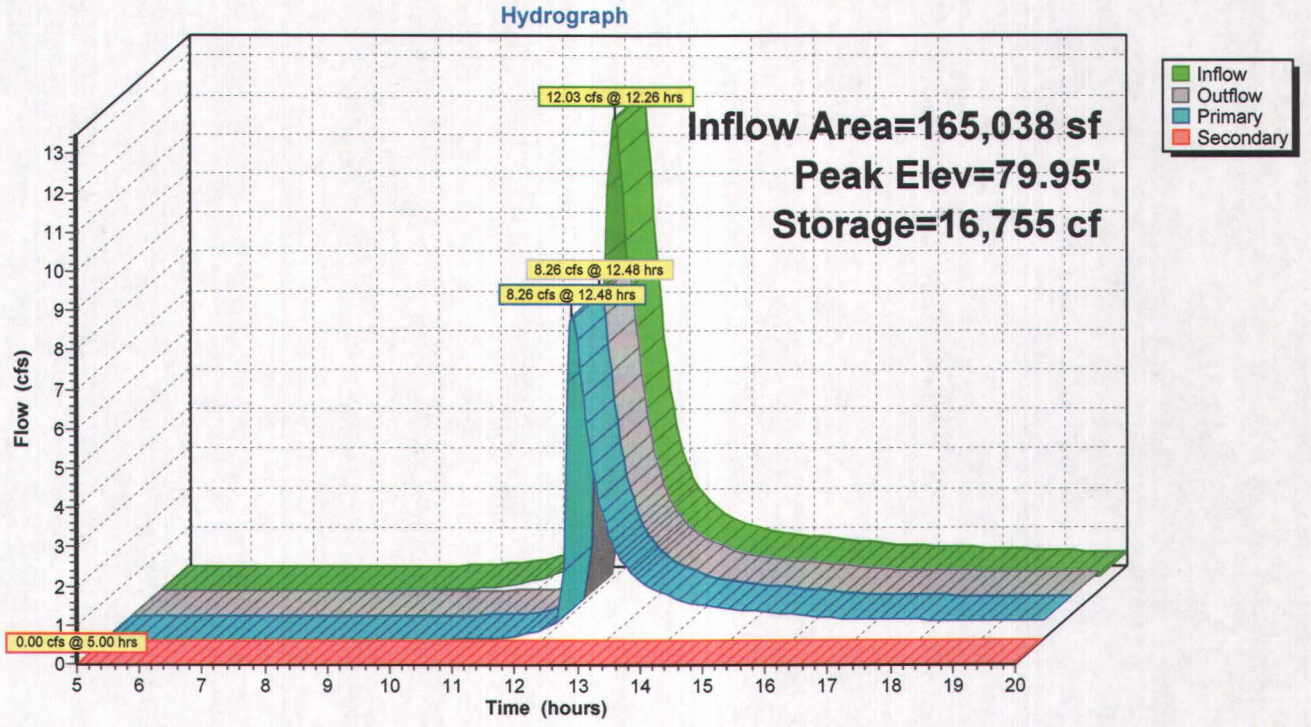
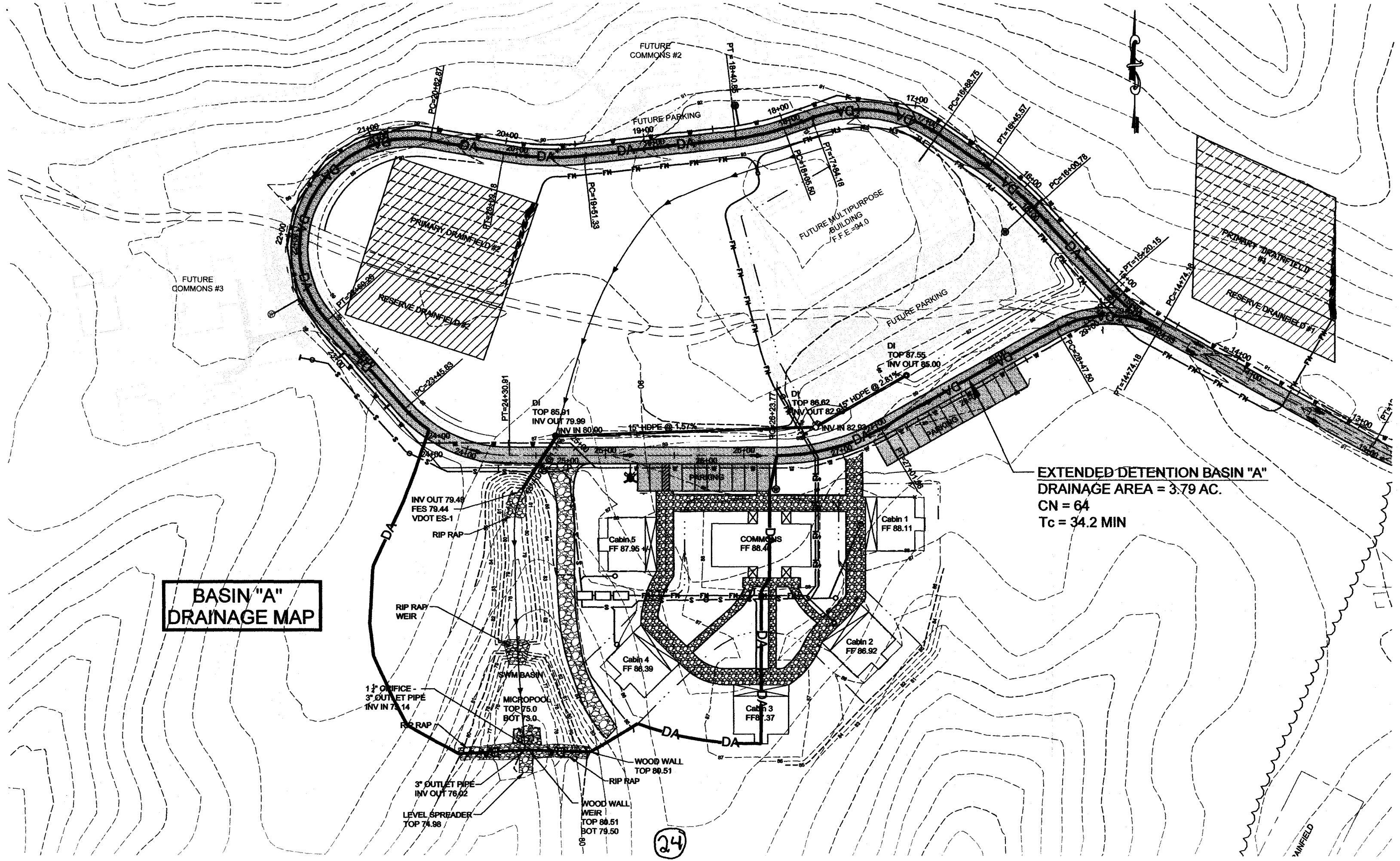
#3	Secondary	80.50'	**95.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32
#4	Primary	75.07'	**1.2" Vert. Orifice/Grate** C= 0.600

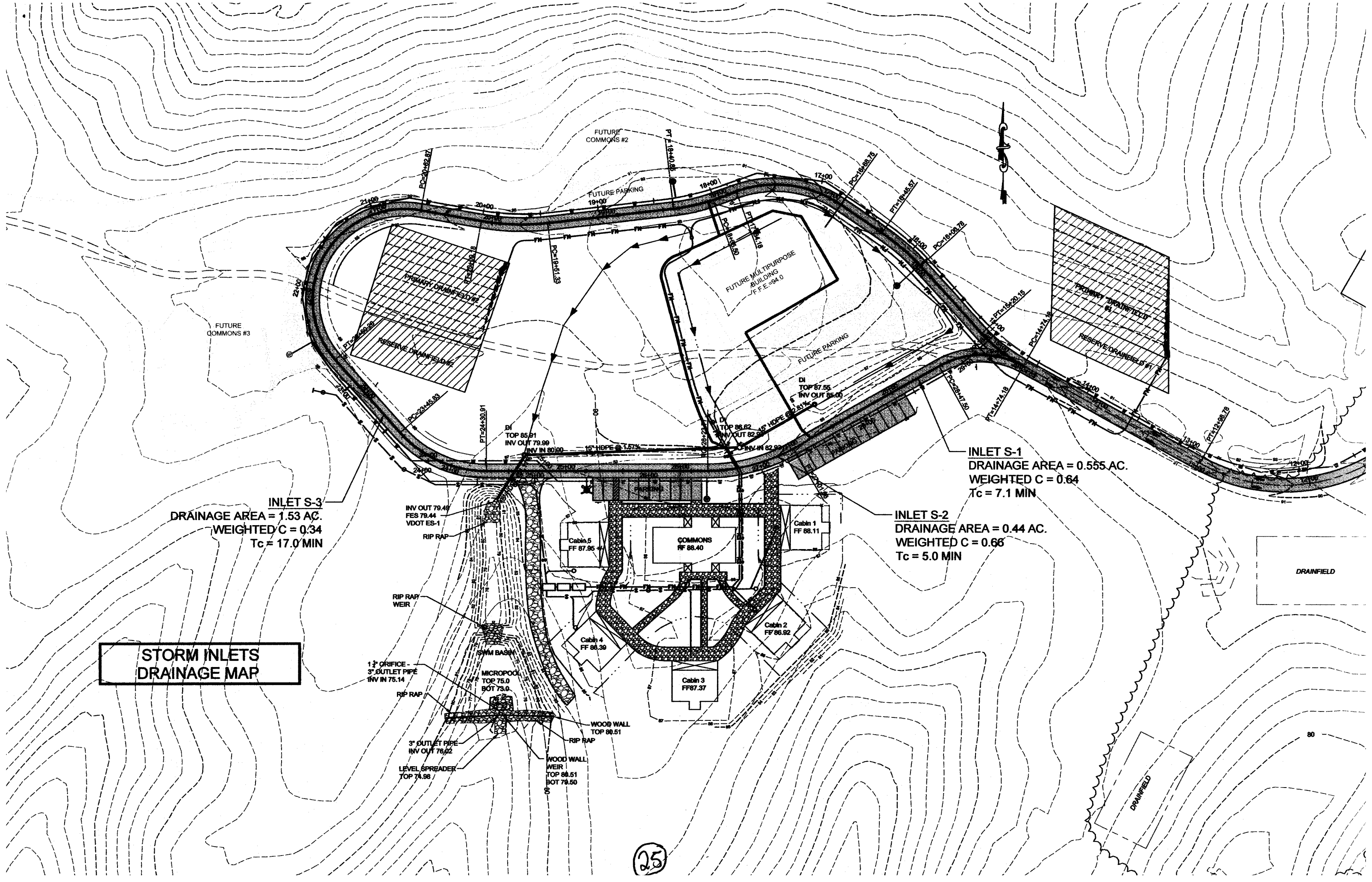
Primary OutFlow Max=8.17 cfs @ 12.48 hrs HW=79.95' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 0.47 cfs @ 9.54 fps)
- **2=Broad-Crested Rectangular Weir** (Weir Controls 7.61 cfs @ 1.90 fps)
- **4=Orifice/Grate** (Orifice Controls 0.08 cfs @ 10.58 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=75.00' (Free Discharge)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: BASIN A




BASIN "A"
DRAINAGE MAP
EXTENDED DETENTION BASIN "A"
DRAINAGE AREA = 3.79 AC.
CN = 64
Tc = 34.2 MIN
FUTURE COMMONS #2
FUTURE COMMONS #3
FUTURE PARKING
FUTURE MULTIPURPOSE BUILDING
F.F.E.=94.0
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PRIMARY DRAINFIELD #1
RESERVE DRAINFIELD #1
DI
TOP 87.55
INV OUT 85.00
15" HDPE @ 2.81%
DI
TOP 86.62
INV OUT 82.95
INV IN 82.92
DI
TOP 85.91
INV OUT 79.99
INV IN 80.00
15" HDPE @ 1.57%
PARKING
COMMONS
FF 88.4
Cabin 1
FF 88.11
Cabin 2
FF 86.92
Cabin 3
FF87.37
Cabin 4
FF 86.39
Cabin 5
FF 87.95
INV OUT 79.49
FES 79.44
VDOT ES-1
RIP RAP
RIP RAP WEIR
SWM BASIN
1 1/2" ORIFICE -
3" OUTLET PIPE
INV IN 75.14
MICROPOOL
TOP 75.0
BOT 73.0
WOOD WALL
TOP 80.51
3" OUTLET PIPE
INV OUT 76.02
LEVEL SPREADER
TOP 74.98
WOOD WALL
WEIR
TOP 80.51
BOT 79.50
24


STORM INLETS
DRAINAGE MAP
INLET S-1
DRAINAGE AREA = 0.555 AC.
WEIGHTED C = 0.64
Tc = 7.1 MIN
INLET S-2
DRAINAGE AREA = 0.44 AC.
WEIGHTED C = 0.66
Tc = 5.0 MIN
INLET S-3
DRAINAGE AREA = 1.53 AC.
WEIGHTED C = 0.34
Tc = 17.0 MIN
FUTURE COMMONS #2
FUTURE COMMONS #3
FUTURE PARKING
FUTURE MULTIPURPOSE BUILDING
F.F.E.=94.0
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PRIMARY DRAINFIELD #1
RESERVE DRAINFIELD #1
DRAINFIELD
COMMONS
FF 88.40
Cabin 1
FF 88.11
Cabin 2
FF 86.92
Cabin 3
FF87.37
Cabin 4
FF 86.39
Cabin 5
FF 87.95
DI
TOP 87.55
INV OUT 85.00
DI
TOP 86.62
INV OUT 82.93
INV IN 82.93
DI
TOP 85.91
INV OUT 79.99
INV IN 80.60
15" HDPE @ 1.57%
18" HDPE @ 2.81%
INV OUT 79.49
FES 79.44
VDOT ES-1
RIP RAP
RIP RAP WEIR
SWM BASIN
1 1/2" ORIFICE -
3" OUTLET PIPE
INV IN 75.14
MICROPOOL
TOP 75.0
BOT 73.0
RIP RAP
3" OUTLET PIPE
INV OUT 76.02
LEVEL SPREADER
TOP 74.98
WOOD WALL
TOP 80.51
RIP RAP
WOOD WALL
WEIR
TOP 80.51
BOT 79.50
PC=20+92.87
PT=18+40.85
PC=19+51.83
PT=23+19.18
PC=23+45.83
PT=24+30.91
PC=16+88.78
PT=16+45.57
PC=16+00.78
PT=15+20.15
PC=14+74.18
PT=14+74.18
PC=26+47.50
PT=12+98.78
22+00
21+00
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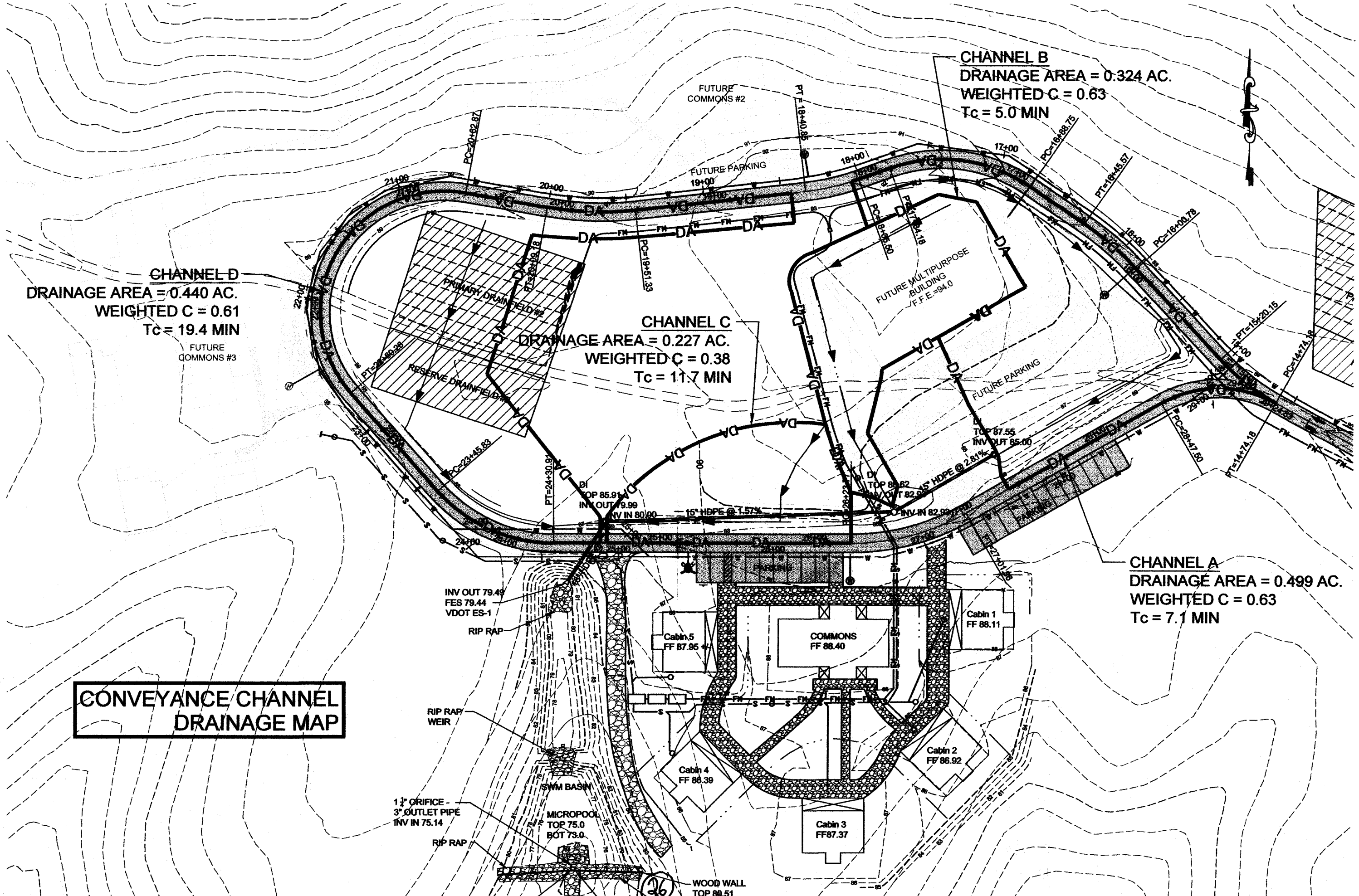
12+00
24+00
23+00
80


CHANNEL B
DRAINAGE AREA = 0.324 AC.
WEIGHTED C = 0.63
Tc = 5.0 MIN
CHANNEL D
DRAINAGE AREA = 0.440 AC.
WEIGHTED C = 0.61
Tc = 19.4 MIN
CHANNEL C
DRAINAGE AREA = 0.227 AC.
WEIGHTED C = 0.38
Tc = 11.7 MIN
CHANNEL A
DRAINAGE AREA = 0.499 AC.
WEIGHTED C = 0.63
Tc = 7.1 MIN
FUTURE COMMONS #2
FUTURE PARKING
FUTURE COMMONS #3
FUTURE MULTIPURPOSE BUILDING F.F.E.=94.0
PRIMARY DRAINFIELD #2
RESERVE DRAINFIELD #2
PC=20+92.87
PT=18+40.85
PC=19+51.33
PC=16+88.75
PT=16+45.57
PC=16+00.78
PT=15+20.15
PC=14+74.18
PT=14+74.18
PC=28+47.50
PT=24+30.91
PC=23+45.83
PT=20+99.18
PT=20+90.28
DI
TOP 85.91
INV OUT 79.99
INV IN 80.00
15" HDPE @ 1.57%
TOP 87.55
INV OUT 85.00
15" HDPE @ 2.81%
INV IN 82.93
PARKING
INV OUT 79.49
FES 79.44
VDOT ES-1
RIP RAP
RIP RAP/ WEIR
SWM BASIN
1 1/4" ORIFICE - 3" OUTLET PIPE INV IN 75.14
MICROPOOL TOP 75.0 BOT 73.0
WOOD WALL TOP 80.51
Cabin 5 FF 87.95 +/-
COMMONS FF 88.40
Cabin 1 FF 88.11
Cabin 2 FF 86.92
Cabin 3 FF87.37
Cabin 4 FF 86.39
CONVEYANCE CHANNEL DRAINAGE MAP

WATERSHED	DC	MAINTENANCE PLAN	No	CTRL STRUC DESC	BCCMP Rise
BMP ID NO	009	SITE AREA acre	149.17	CTRL STRUC SIZE inches	30
PLAN NO	SP-58-92	LAND USE	Gen Agricultural	OTLT BARRL DESC	BCCMP Barr
TAX PARCEL	(03-04)(01-3D)	old BMP TYP	Dry Pond	OTLT BARRL SIZE inch	15
PIN NO	0340100003D	JCC BMP CODE			
CONSTRUCTION DATE	4/1/1992	POINT VALUE	4	EMERG SPILLWAY	Yes
PROJECT NAME	Williamsburg Christian Retreat			DESIGN HW ELEV	80
FACILITY LOCATION	9275 Barnes Road			PERM POOL ELE	na
CITY-STATE	Toano, Va. 23168	SVC DRAIN AREA acres	8.1	2-YR OUTFLOW cfs	0.00
CURRENT OWNER	Williamsburg Christian Retreat Assoc., Inc.			10-YR OUTFLOW cfs	0.00
OWNER ADDRESS	9275 Barnes Road			REC DRAWING	No
OWNER ADDRESS 2		SERVICE AREA DESCRI	Bldg, Paved, Gravel & OS areas		
CITY-STATE-ZIP CODE	Toano, Va. 23168-8908	IMPERV AREA acres	1.78	CONSTR CERTI	No
OWNER PHONE		RECV STREAM	UT of Diascund Creek		
MAINT AGREEMENT	No	EXT DET-WQ-CTRL	No	LAST INSP DATE	11/15/2000
EMERG ACTION PLAN	No	WTR QUAL VOL acre-ft	0	INTERNAL RATING	4
		CHAN PROT CTRL	No	MISC/COMMENTS	
		CHAN PROT VOL acre-ft	0	Includes new building & park. CN=75 postdev.	
		SW/FLOOD CONTROL	Yes		
		GEOTECH REPORT	No		

Get Last BMP No

Return to Menu

DC009_WILLIAMSBURG_CHRISTIAN_RETREAT - 014

Verbatim
CD-RW
WMSBRG CHRISTIAN
RETREAT BMP
AS-QUILTS
PC-009

reason by a court of competent jurisdiction, the invalidity or unenforceability of such condition or part thereof shall not invalidate any other remaining condition contained in these Proffers.

WITNESS the following signatures and seals:

POWHATAN CROSSING, INC.

By: _____

Title: _____

STATE OF VIRGINIA
CITY/COUNTY OF JAMES CITY, to-wit:

The foregoing instrument was acknowledged before me this 26 day of NOVEMBER, 2003 by C. LEWIS WALDROP, JR. as PRESIDENT of Powhatan Crossing, Inc.

_____
NOTARY PUBLIC

My commission expires:
9/30/07

VIRGINIA: CITY OF WILLIAMSBURG & COUNTY OF JAMES CITY
This document was admitted to record on 21 Jan 04
at 11:34 AM/PM. The taxes imposed by Virginia Code Section 58.1-801, 58.1-802 & 58.1-814 have been paid.

STATE TAX	LOCAL TAX	ADDITIONAL TAX
$ —	$ —	$ —

TESTE: BETSY B. WOOLRIDGE, CLERK
BY: Betsy B. Woolridge Clerk

POOR QUALITY

ORIGINAL(S) FOLLOW

THIS IS THE BEST COPY AVAILABLE

VCE DOCUMENT CONVERSION

COMMONWEALTH OF VIRGINIA

DC-18 (10/02)

TRANSMITTAL SHEET

ENGINEERING & RESOURCE PROTECTION → STORMWATER

Project: Williamsburg Christian Retreat

County Plan No. SP-12-08

Assigned BMP No.: DC009

BMP Type: Dry Pond

Information Enclosed:

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

RECEIVED ON
FEB 14 '13
Stormwater Division

Name: Mike Majdeski / Barry Moses

Date:

Signature:

040 002149

SECOND AMENDED AND RESTATED

HIDEN PROPERTY PROFFERS

THESE AMENDED AND RESTATED PROFFERS are made as of this 26th day of November, 2003, by POWHATAN CROSSING, INC., a Virginia corporation, (together with its successors and assigns, the "Owner").

RECITALS

A. Owner is the present or former owner of certain real property (the "Property") in James City County, Virginia consisting of approximately 403.7 acres more particularly described on Exhibit A attached hereto and made a part hereof.

B. In 1997 the Owner applied for and James City County (the "County") granted a rezoning of the Property from R-8, Rural Residential District, to PUD-R, Planned Unit Development-Residential District, with proffered conditions as set forth in Hiden Property Proffers dated October 29, 1997 and recorded in the Clerk's Office for the Circuit Court for the City of Williamsburg and County of James City as Instrument No. 97019406 (the "Original Proffers"). In connection with the rezoning, Owner submitted and the County approved a Master Plan in accordance with the County Zoning Ordinance entitled "Master Plan Hiden Property" and dated September 10, 1997 and revised October

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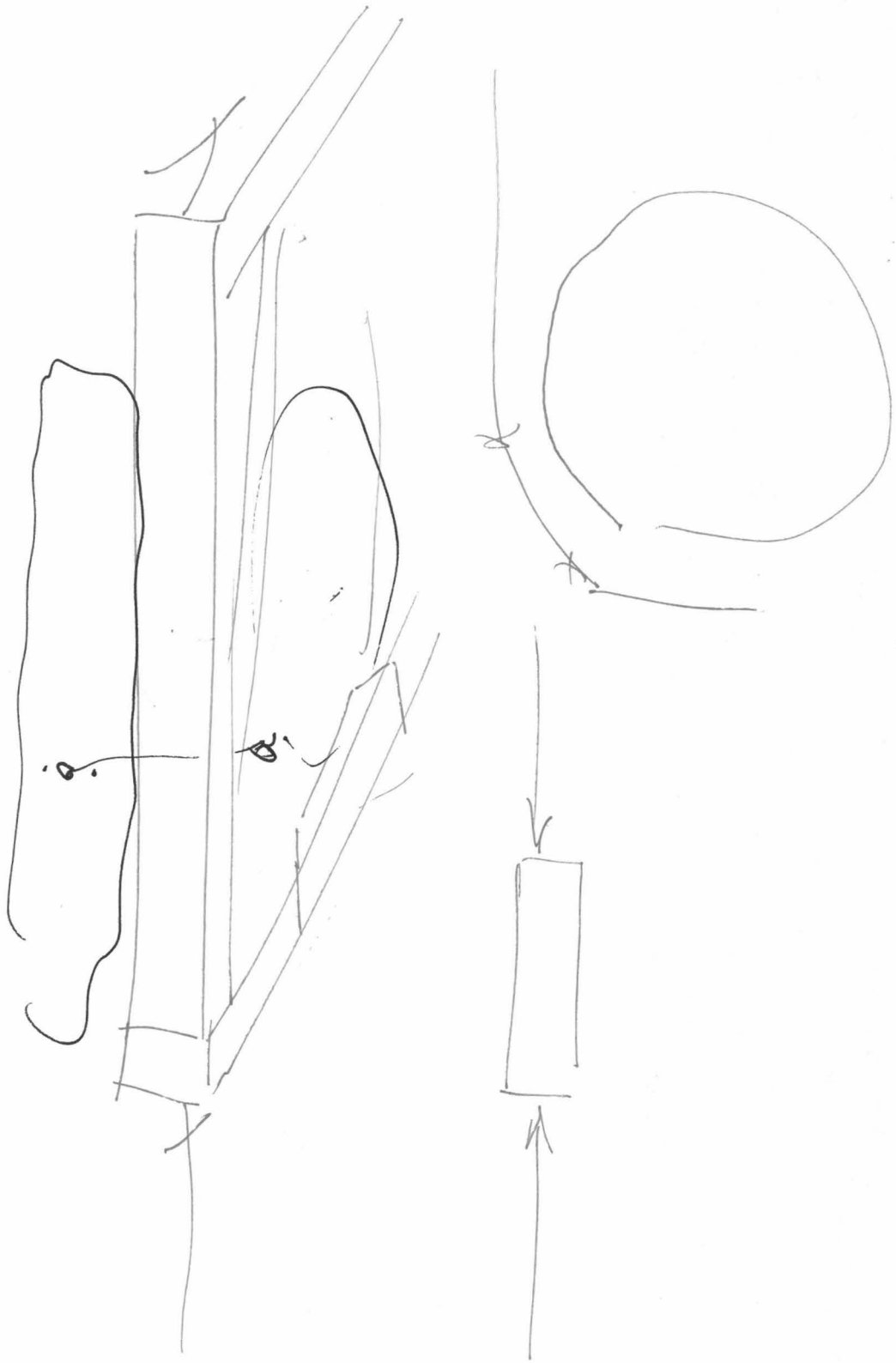

15, 1997 (the "Original Master Plan").

C. In 2003 the Owner applied for and the County granted approval of a master plan and proffer amendment for the Property. In connection therewith, Owner submitted and the County approved an amended Master Plan in accordance with the County Zoning Ordinance entitled "Master Plan Amendment for Hiden Property for Jamestown, LLC" made by AES Consulting Engineers, Project No. 9254, dated 2/24/03, revised 4/25/03 (the "Approved Master Plan") and Amended and Restated Proffers dated July 8, 2003 and recorded in the Clerk's Office for the Circuit Court for the City of Williamsburg and County of James City as Instrument No. 030021212 (the "Approved Proffers").

D. Owner has now applied for an amendment to the Approved Master Plan for the Property pursuant to the County Zoning Ordinance and, in connection therewith, desires to amend and restate the Approved Proffers.

NOW, THEREFORE, for and in consideration of the approval by the Board of Supervisors of James City County of the applied for amendment to the Original Master Plan and the Original Proffers and pursuant to Section 15.2-2297, et seq. of the Code of Virginia, 1950, as amended, and Section 24-16, et seq. of Chapter 20 of the Code of James City County, Virginia in accordance with

Section 24-497(d) of the Code of James City County, Owner agrees that it shall meet and comply with all of the following conditions in developing the Property. If the applied for amendments are not granted by the County, these Amended and Restated Proffers shall thereupon be null and void and the Original Proffers and Original Master Plan shall remain in full force and effect.

CONDITIONS

1. Owners Association. All owners of lots or units within the Property by virtue of ownership of their lot or unit shall be members of a property owners association with the power to levy mandatory assessments. The articles of incorporation, bylaws and restrictive covenants (together, the "Governing Documents") creating and governing the association(s) shall be submitted to and reviewed by the County Attorney. The Governing Documents shall require that the association adopt an annual maintenance budget, which shall include a reserve for maintenance of stormwater management BMPs, private roads and parking areas, if applicable, and shall require that the association (i) assess all members for the maintenance of all properties owned or maintained by the association and (ii) file liens on members' properties for non-payment of such assessments and for the cost of remedying

violations of, or otherwise enforcing, the Governing Documents.

2. Density. (a) There shall be no more than 150 single family lots permitted in Area 1 on the Property.

(b) There shall be no more than 400 dwelling units permitted in Area 2 on the Property. All dwelling units developed in Area 2 shall be age restricted to persons fifty-five (55) years of age or older ("Restricted Units") in accordance with the following parameters:

(i) It is the intent of the parties that Restricted Units shall be occupied by persons fifty-five (55) years of age or older and that no Restricted Units shall be occupied by a person under the age of eighteen (18). In some instances, persons under the age of fifty-five (55) but over the age of eighteen (18) shall be entitled to occupy Restricted Units, subject, at all times, to the laws and regulations governing age fifty-five (55) and over restricted housing as more particularly set forth and described in subparagraph (ii) below.

(ii) Each Restricted Unit within the Property shall be developed and operated in compliance with applicable federal and state laws and regulations regarding housing intended for occupancy by persons fifty five (55) years of age or older, including but not limited to: the Fair Housing Act, 42 U.S.C.

§3601 et seq. and the exemption therefrom provided by 42 U.S.C. §3607(b)(2)(C) regarding discrimination based on familial status; the Housing for Older Persons Act of 1995, 46 U.S.C. §3601 et seq.; the Virginia Fair Housing Law Va. Code §36-96.1 et seq.; any regulations adopted pursuant to the foregoing; any judicial decisions arising thereunder; any exemptions and/or qualifications thereunder; and any amendments to the foregoing as now or may hereafter exist. Specific provisions of the age restriction described above and provisions for enforcement of same shall be set forth in a declaration of restrictive covenants and property owners' association documents applicable to the Restricted Units and each deed to a Restricted Unit shall make reference to such provisions.

(c) Any accessory commercial uses located in Area 2, such as bank offices, beauty salons and barbershops, shall be located and designed to serve residents of Area 2. Commercial uses shall not be advertised from any public right-of-way.

3. Road Improvements. (a) Monticello Avenue. (i) Owner shall make a contribution of $2,800.00 to the County for each of the first 250 lots or units shown on subdivision plats or site plans of the Property. Such contributions shall be made available by the County for use by the District for the

construction of Monticello Avenue or used by the County for any other project included in the County's capital improvement program, the need for which is generated in whole or in part by the development of the Property. Such contributions shall be made at the time of final subdivision plat or site plan approval for such lots or units.

(ii) There shall be no more than two entrances into the Property from Monticello Avenue, one into the portion of the property south of Monticello Avenue and one into the portion of the property north of Monticello Avenue. The two entrances shall be aligned. Owner shall construct right and left turn lanes on both approaches at the entrances to the Property from Monticello Avenue at the time such entrances are constructed.

(iii) At the request of the County, Owner shall install a traffic signal at the intersection of Monticello Avenue and the entrances to the Property at the earlier of (i) when Virginia Department of Transportation ("VDOT") signal warrants are met or (ii) when development has commenced on either side of Monticello Avenue and the County has issued certificates of occupancy for more than 55 lots or dwelling units utilizing the entrances onto Monticello Avenue; provided that VDOT and the County approves the installation of the traffic signal at that time. When

certificates of occupancy for 412 dwelling units on the Property have been issued and if the traffic signal has not been installed at that time, Owner shall cause an updated traffic signal warrant analysis using actual traffic counts shall be submited to VDOT and the County.

(b) All road improvements proffered hereby shall be constructed in accordance with VDOT standards.

(c) Unless otherwise approved by the Director of Planning, Owner shall reserve a public right-of-way to provide a pedestrian connection from the Powhatan Secondary development to the Property and shall dedicate such right-of-way to the County upon the written request of the County Administrator.

4. Monticello Avenue Greenbelt. At the time of the conveyance of the Monticello Avenue right-of-way to the County or the District, the Owner shall designate 150-foot greenbelt buffers along the Property's Monticello Avenue frontage measured from a right-of-way line assuming a 120 foot right-of-way for Monticello Avenue (measured 60 feet on either side of the centerline of the right-of-way). The greenbelt buffers shall be exclusive of any lots or units and, except as permitted below, shall be undisturbed. With the prior approval of the Development Review Committee, utilities, drainage improvements, community

entrance roads as shown generally on the Master Plan, pedestrian/bicycle trails, lighting, entrance features and signs may be located in the greenbelt buffer. A landscaping plan for the greenbelt buffer which may include, without limitation, select hand clearing and trimming of trees and other plants, planting of new landscaping, including trees and shrubs, and installation of landscaped berms, submitted to and approved by the Director of Planning may be implemented.

5. Archaeology. A Phase I Archaeological Study for Master Plan area shall be submitted to the Director of Planning for his review and approval prior to land disturbance. A treatment plan shall be submitted to, and approved by, the Director of Planning for all sites in the Phase I study that are recommended for a Phase II evaluation, and/or identified as being eligible for inclusion on the National Register of Historic Places. If a Phase II study is undertaken, such a study shall be approved by the Director of Planning and a treatment plan for said sites shall be submitted to, and approved by, the Director of Planning for sites that are determined to be eligible for inclusion on the National Register of Historic Places and/or those sites that require a Phase III study. If in the Phase II study, a site is determined eligible for nomination to the National Register of Historic

Places and said site is to be preserved in place, the treatment plan shall include nomination of the site to the National Register of Historic Places. If a Phase III study is undertaken for said sites, such studies shall be approved by the Director of Planning prior to land disturbance within the study area. All Phase 1, Phase II and Phase III studies shall meet the Virginia Department of Historic Resources' Guidelines for Preparing Archaeological Resource Management Reports and the Secretary of the Interior's Standard and Guidelines for Archaeological Documentation, as applicable, and shall be conducted under the supervision of a qualified archaeologist who meets the qualifications set forth in the Secretary of the Interior's Professional Qualification Standards. All approved treatment plans shall be incorporated into the plan of development for the site and shall be adhered to during the clearing, grading and construction activities thereon.

6. Environmental Protections. (a) The Owner and/or the owners association shall grant, free of charge, to the Williamsburg Land Conservancy, another County approved land conservation entity and/or the County a conservation easement with terms consistent with these Proffers over the area designated on the Master Plan as Conservation Area generally in

the locations shown on the Master Plan. The exact boundaries of the Conservation Area shall be shown on subdivision plats and/or site plans of the Property based on the buffer line and Conservation Area shown and set out on the map entitled "Master Plan Amendment for Hiden Property for Jamestown, LLC" made by AES Consulting Engineers, Project No. 9254, dated 2/24/03, revised 4/25/03. The conservation easement over the Conservation Area shown on each individual subdivision plat or site plan shall be granted at the time of final approval thereof by the County. The Conservation Area shall remain undisturbed and in its natural state, preserving indigenous vegetation except as set forth below. With the prior approval of the County Engineer or his designee on a case by case basis, (i) dead, diseased and dying trees or shrubbery and invasive or poisonous plants may be removed from the Conservation Area; (ii) select hand clearing and pruning of trees shall be permitted in the Conservation Area to permit sight lines or vistas, and (iii) utilities, roads, pedestrian paths, trails and bridges may intrude into or cross the Conservation Area. No stormwater best management practices ("BMPs") shall be permitted in the 100 foot Resource Protection Area ("RPA") imposed by County ordinance along the main stem of Powhatan Creek. With the prior approval of the County

Environmental Division on a case by case basis, BMPs may be located in other RPAs and elsewhere in the Conservation Area, including RPA extensions shown on the Master Plan, but shall not be located in nor impact the channel flow unless specifically approved by the Environmental Division. The greenway proffered in Proffer 7 below and County trails and passive recreational facilities and structures located therein shall be permitted within the Conservation Area. If vegetation is removed from the Conservation Area it shall be replaced by indigenous vegetation that is equally or more effective in retarding runoff, preventing erosion and filtering nonpoint source pollution. Owner, at the request of the County, shall retain an environmental consultant acceptable to the County to prepare a three tiered restoration plan for the areas indicated on the "Revised Environmental Constraints Map Hiden Property" made by Williamsburg Environmental Group, Inc. and dated 8/1/97 and revised 9/16/97 where timbering operations resulted in the removal of trees from or land disturbance within the Conservation Area to provide for the restoration of ground cover, shrubs and trees for that portion of the Conservation Area as determined to be necessary by the consultant. If temporary stormwater BMP's are located in the Conservation Area, the restoration plan shall include a

replanting plan for such BMP areas. The restoration plan shall include a phasing plan to ensure areas of the Conservation Area being restored have been stabilized prior to the commencement of development on adjacent developable areas. The restoration plan shall be submitted to the Environmental Division for review and approval. Owner shall implement the recommendations of the approved restoration plan. Road and utility crossings shall be generally perpendicular through the Conservation Area and Owner shall endeavor to design utility systems that do not intrude into the Conservation Area. The Conservation Area shall be maintained by Owner unless the Williamsburg Land Conservancy, the other County approved land conservation entity or the County assumes responsibility therefor under its easement or the Conservation Area is conveyed to an owners association, at which time the association shall assume responsibility for its maintenance. The Conservation Area shall be exclusive of Lots.

(b) All stormwater runoff from paved parking areas or roads and from all building structures over 150 square feet in Area 2 of the Property shall be directed into BMPs unless otherwise approved by the Environmental Division

7. Greenway. Owner shall grant the County an easement within the Conservation Area for a greenway through the Property

in the general location shown on the Master Plan as "James City County Greenway Trail" as subdivision plats or site plans for adjacent Property are approved and/or recorded. The County shall be entitled to construct a trail with a minimum 10' wide travel path (which will be open to the general public during daylight hours only), including necessary bridges, if any, through the James City County Greenway Trail and to install passive amenities such as benches, tables, gazebos, educational or descriptive markers or individual fitness stations. The location of the "James City County Greenway Trail" shall be varied within the Conservation Area by the Environmental Division to ensure the ability to construct a viable trail network. Owner shall grant the County suitable parking opportunities (through shared use of parking facilities required by site improvements) to the general public using the trail.

8. Recreation. (a) Owner shall provide the recreational facilities listed below in Area 1 shown on the Master Plan and make the cash contributions to the County described below before the County is obligated to approve final subdivision plats for more than 100 lots in Area 1:

- Parkland, including one playground of at least 1.9 acres.
- Cash contribution of $9,900 in lieu of multi-purpose courts.

- Cash contribution of $4,300 in lieu of playing fields.

(b) Owner shall provide the recreational facilities listed below in Area 2 shown on the Master Plan and make the cash contributions described below to the County before the County is obligated to approve final subdivision plats or site plans for more than 235 dwelling units in Area 2:

- Recreation areas of at total of least 2.5 acres.
- Cash contribution of $13,650 in lieu of multi-purpose court.
- Cash contribution of $5,950 in lieu of playing fields.

The recreational facilities in Area 2 may be open only to owners in Area 2.

(c) All cash contributions proffered by this Proffer 8 shall be used by the County for recreation capital improvements, which may include trails within the greenway proffered in Proffer 7. The exact locations of the facilities proffered hereby and the equipment to be provided at such facilities shall be subject to the approval of the Development Review Committee. All recreational facilities proffered hereby shall be conveyed to and maintained by the owners association and shall be open to all members of the association in good standing.

(d) Owner shall construct a shoulder lane bikeway in accordance with VDOT standards along both sides of the main

public collector roads within the Property north of Monticello Avenue.

9. Entrance Signs. The entrance signs, lighting, landscaping and entrance features at the entrances to the Property from Monticello Avenue shall be subject to the review and approval of the Director of Planning before a sign permit for such signs is issued. The entrance signs shall be monument type signs.

10. Powhatan Crossing Buffer. The Owner shall maintain a buffer along the Property's common boundary line with the Powhatan Crossing subdivision with the width and in the locations shown on the Master Plan. This buffer shall be exclusive of any lots and shall be undisturbed, except for, with the approval of the Development Review Committee, berms, landscape features, walls or fences or utility easements.

11. Cash Contributions for Community Impacts. (a) A contribution of $750.00 for each of the first 50 dwelling units developed on Area 2 of the Property shall be made to the James City Service Authority ("JCSA") in order to mitigate impacts on the County from the physical development and operation of Area 2 of the Property. The JCSA may use these funds for development of alternative water sources or any project related to improvements

to the JCSA water system, the need for which is generated by the physical development and operation of Area 2 of the Property.

(b) A contribution of $700.00 for each of the first 50 dwelling units developed on Area 2 of the Property shall be made to the County in order to mitigate impacts on the County from the physical development and operation of Area 2 of the Property. The County may use these funds for any project in the County's capital improvement plan, the need for which is generated by the physical development and operation of Area 2 of the Property, including, without limitation, for emergency services equipment replacement and supply, traffic signal preemption equipment, library uses, and public use sites.

(c) A contribution of $500.00 for each of the first 50 dwelling units developed on Area 2 of the Property shall be made to the County in order to mitigate impacts on the County from the physical development and operation of Area 2 of the Property. The County may use these funds for any project in the County's capital improvement plan, the need for which is generated by the physical development and operation of Area 2 of the Property, including, without limitation, stream stabilization or other stormwater management projects in the Powhatan Creek watershed.

(d) The contributions described above, unless otherwise

specified, shall be payable for each of the dwelling units developed within Area 2 of the Property at the time of final subdivision plat or final site plan approval by the County for the particular phase or section of dwelling units.

(e) The per unit contribution(s) paid in each year pursuant to this Section shall be adjusted annually beginning January 1, 2004 to reflect any increase or decrease for the preceding year in the Consumer Price Index, U.S. City Average, All Urban Consumers (CPI-U) All Items (1982-84 = 100) (the "CPI") prepared and reported monthly by the U.S. Bureau of Labor Statistics of the United States Department of Labor. In no event shall the per unit contribution be adjusted to a sum less than the amounts set forth in paragraphs (a) and (b) of this Section. The adjustment shall be made by multiplying the per unit contribution for the preceding year by a fraction, the numerator of which shall be the CPI as of December 1 in the year preceding the calendar year most currently expired, and the denominator of which shall be the CPI as of December 1 in the preceding year, In the event a substantial change is made in the method of establishing the CPI, then the per unit contribution shall be adjusted based upon the figure that would have resulted had no change occurred in the manner of computing CPI. In the event that the CPI is not

available, a reliable government or other independent publication evaluating information heretofore used in determining the CPI (approved in advance by the County Manager of Financial Management Services) shall be relied upon in establishing an inflationary factor for purposes of increasing the per unit contribution to approximate the rate of annual inflation in the County.

12. No Access to Powhatan Crossing. Prior to final approval of the first subdivision plat or site plan for development on the Property, Owner shall (i) convey to the Powhatan Crossing Homeowners Association by quitclaim deed all its right, title and interest in and to the access easement from Powhatan Crossing Drive to the Property adjacent to the recreational lot in Powhatan Crossing, (ii) install a permanent cul de sac at the end of Powhatan Crossing Drive, and (iii) convey to the Powhatan Crossing Homeowners Association by quitclaim deed a strip of land between the permanent cul de sac and the Property such that the public road and the Property are no longer adjacent.

13. Water Conservation. The Owner and/or the owners association shall be responsible for developing water conservation standards to be submitted to and approved by the

JCSA and subsequently for enforcing these standards. The standards shall address such water conservation measures as limitations on the installation and use of irrigation systems and irrigation wells, the use of approved landscaping materials and the use of water conserving fixtures and appliances to promote water conservation and minimize the use of public water resources, including groundwater. The standards shall be approved by the JCSA prior to final subdivision or site plan approval.

14. Height Limitation. There shall be no building greater than two and one-half stories in height located within 300 feet of the Powhatan Crossing subdivision.

15. Private Streets. All streets (as defined by the County Code) within Area 2 of the Property shall be private and shall conform to VDOT construction standards. All private streets shall be certified to the satisfaction of the County Engineer as required by Section 19-49 of the County Code.

16. Headings. All section and subsection headings of Conditions herein are for convenience only and are not a part of these Proffers.

17. Severability. If any condition or part thereof set forth herein shall be held invalid or unenforceable for any