STATE OF IOWA
DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP
DIVISION OF SOIL CONSERVATION AND WATER QUALITY

Sto842407B NUTRIENT REDUCTION WETLAND PROJECT

CONSTRUCTION CONTRACT
BID NO. 24-02

SECTION 07, TOWNSHIP 84 NORTH, RANGE 24 WEST
STORY COUNTY, IOWA

PREPARED FOR: IOWA DEPARTMENT OF AGRICULTURE & LAND STEWARDSHIP
DIVISION OF SOIL CONSERVATION AND WATER QUALITY
WALLACE STATE OFFICE BUILDING
502 EAST 9TH STREET
DES MOINES, IOWA 50319
515-281-4246

PREPARED BY: DUCKS UNLIMITED
209 EUGENE ST
RADCLIFFE, IA 50230
832-704-3286

March 2024

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APPENDIX I
ADDENDA & BID TAB

[Page intentionally left blank to serve as a placeholder for any addenda and for the Bid Tab which will be included after the bidding process]

APPENDIX II

CONSTRUCTION & ADMINISTRATION FORMS

March 15, 2024

Contractor name and address

Delivery via email: Contractor Email

RE: **NOTICE-OF-AWARD –** Sto842407B Nutrient Reduction Wetland Project, Contract 24-02

Dear,

This is to notify you that the Division of Soil Conservation and Water Quality has determined _____ is the successful bidder for the Sto842407B Nutrient Reduction Wetland Project. Award is being made for the base bid of _____.

In accordance with Item #9 of the Instructions to Bidders, Document BB, you have fourteen (14) calendar days from the date of receipt of this notice to obtain the Performance Bond (*Document NN*), submit your Construction Progress Schedule (*Document JJ*) for review, and execute the Contract (*Document DD*). In addition, the Division must be provided with a Certificate of Insurance pursuant to the General Conditions, Insurance and Related Provisions (*Document FF, Part 6-01*).

Please note that Iowa Code Section 91C.7, requires that all construction contractors awarded a contract to perform work for the state or an agency of the state must be registered with the Iowa Division of Labor. The Division of Soil Conservation and Water Quality cannot execute a contract with your firm unless you provide proof of this registration. Be sure to fill in the Division of Labor registration number blank on the Contract (*Document DD*).

Enclosed are the Contract (*Document DD*), Construction Progress Schedule form (*Document JJ*), and the Performance Bond (*Document NN*). Please complete, sign and return scanned electronic copies along with completed Performance Bond. In addition, we must have the Certificate of Insurance pursuant to the General Conditions and/or Special Conditions.

Congratulations on being the successful bidder. We look forward to working with your company on this project. If you have any questions, please contact Tracy Bruun, (515) 344-6279.

Sincerely,

Jake Hansen, Chief
Water Resources Bureau
Division of Soil Conservation and Water Quality

JH/tab
Enclosures
CC:

March 15, 2024

Contractor name and address

Delivery via email: Contractor Email

RE: **NOTICE-TO-PROCEED –** Sto842407B Nutrient Reduction Wetland Project, Contract 24-02

Dear _____,

The Division of Soil Conservation and Water Quality received the signed construction Contract (*Document DD*), the completed Performance Bond (*Document NN*), and the Certificate of Insurance from your company. These documents were found to be in order and the Division executed this contract with _____ dated _____. A scanned copy of the executed Contract and Performance Bond are enclosed.

The Division has accepted the Construction Progress Schedule (*Document JJ*) included here, with a Construction Start Date of _____ . A Preconstruction Conference, as required in Item 13 of the Instructions to Bidders (*Document BB*), must be held within seven (7) days prior to the Construction Start Date established in the Construction Progress Schedule, or earlier if mutually agreed. No work may commence on site prior to the Preconstruction Conference. If the Construction Start Date requires adjustment, that needs to be communicated to the Engineer and Division in a timely manner so as to facilitate scheduling of the Preconstruction Conference.

In accordance with the Contract, _____ must commence work under this contract for the Sto842407B Nutrient Reduction Wetland Project on or before the Construction Start Date scheduled in the Construction Progress Schedule, but not before the Preconstruction Conference. You have until November 1, 2024 to complete all of the work except for seeding, and until December 15, 2024 to complete the seeding.

Also attached is a scanned copy of the Iowa Construction Sales Tax Exempt Certificate and Authorization Letter for this project. Pursuant to Iowa Code Section 423.2(80), this allows you to purchase materials tax free for use on this project. Please read the information provided in the authorization letter. You are authorized with this Notice-to-Proceed to purchase necessary materials for this project and request reimbursement for those items that are stored prior to the Construction Start Date.

If you have any questions, please contact Tracy Bruun, (515) 344-6279.

Sincerely,

Jake Hansen, Chief
Water Resources Bureau
Division of Soil Conservation and Water Quality

JH/tab
Attachments
CC:

STATE OF IOWA
DIVISION OF SOIL CONSERVATION AND WATER QUALITY
CONSTRUCTION PROGRESS SCHEDULE

Project ID: Sto842407B Date: _____

Contractor: _____

Contract End Dates:

All Construction Work Except Seeding: November 1, 2024

Seeding: December 15, 2024

Scheduled Dates:

Anticipated Construction Start Date:

Preconstruction Conference Date Range*:

**Preconstruction Conference must be held prior to Construction Start Date, by no more than seven (7) days*

Estimated Completion Date of All Work Except Seeding:

Final Walkthrough should be held prior to Contract End Date for all construction work except seeding

Major Construction Work Item(s)	Order of Work	Estimated Duration of Work
(Items to be established/grouped by Division on an individual project basis)		

Dates established in this schedule may be adjusted as described in Document FF, Paragraph 3-21.

FOR THE CONTRACTOR

(Company Representative)

(Date)

(Name of Company)

(Address of Company)

(City, State, Zip code

FOR THE DIVISION

Mike Bourland, Water Resources Bureau
Division of Soil Conservation and Water Quality

(Date)

Accepted ☐

Adjustment Requested ☐

If adjustment is requested, describe below:

END OF DOCUMENT JJ

APPLICATION AND CERTIFICATE FOR PAYMENT

DOCUMENT SS

PAGE 1 OF 2

TO DIVISION:

Iowa Division of Soil Conservation and Water Quality
502 East 9th Street
Des Moines, IA 50319-0050

FROM CONTRACTOR:

Contractor Name
Contractor Address Line 1
Contractor Address Line 2

ENGINEER

Engineer Name
Engineer Address Line 1
Engineer Address Line 2

PROJECT:

Bid No.

Project I.D.

Date:

Period To:

DISTRIBUTION TO:
DIVISION
CONTRACTOR
ENGINEER

Summary of Approved Change Orders & Contract Amendments

Number	Addition	Deduction

Net change by Change Orders and Contract Amendments $ -

	PAYMENT #1 -Ret DATE	PAYMENT #2 -Ret DATE	PAYMENT #3 -Ret DATE	PAYMENT #4 -Ret DATE	PAYMENT #5 -Ret DATE	PAYMENT #6 - Ret DATE	RETAINAGE ONLY DATE
1. ORIGINAL CONTRACT SUM:	$ -						
2. Net Changes by Change Orders/Amendments (from table)	$ -						
3. Contract Sum to Date (Line 1+/-2)	$ -						
4. Total Completed & Stored to Date (Column G on Continuation Sheet)	$ -						
5. Retainage (5% of Line 4)	$ -						
6. Total Earned Less Retainage (Line 4 less Line 5)	$ -						
7. Previous Certificates For Payment (Line 6 from prior Certificate)	$ -						
8. Balance to Finish, Plus Retainage (Line 3 less Line 6)	$ -						
9. Current Payment Due (Line 6 less Line 7)	$ -						

The undersigned Contractor certifies that to the best of Contractor's knowledge, information, and belief, the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid to Contractor for which previous Certificates for Payment were issued and payments received from the Division and that current payment shown herein is now

By:_____ Date _____
CONTRACTOR

In accordance with the Contact Documents, based on on-site observations and the data comprising this application, Engineer certifies to the Division that to the best of the Engineer's knowledge, information, and belief, the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and Contractor is entitled to payment of the AMOUNT CERTIFIED.

By:_____ Date_____
ENGINEER'S CERTIFICATE FOR PAYMENT

AMOUNT CERTIFIED $_____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment, and acceptance of payment are without prejudice to any rights of Contracting Officer or Contractor under this Contract.

CONTINUATION SHEET FOR APPLICATION AND CERTIFICATE FOR PAYMENT **DOCUMENT SS**

PAGE 2 of 2

A	B	C	D	E	F	G	H	I
Item No.	Description of Work	Scheduled Value	Work From Previous Application (D+E)	Completed This Period	Materials Presently Stored Not in D or E	Total Completed & Stored (D+E+F)	% Complete (G/C)	Balance to Finish (C-G)
1	Bid Item 1	$ -	$ -	$ -		$ -	0%	$ -
2	Bid Item 2	$ -	$ -	$ -		$ -	0%	$ -
3	Bid Item 3	$ -	$ -	$ -		$ -	0%	$ -
4	Bid Item 4	$ -	$ -	$ -		$ -	0%	$ -
5	Bid Item 5	$ -	$ -	$ -		$ -	0%	$ -
6	Bid Item 6	$ -	$ -	$ -		$ -	0%	$ -
7	Bid Item 7	$ -	$ -	$ -		$ -	0%	$ -
8	Bid Item 8	$ -	$ -	$ -		$ -	0%	$ -
9	Bid Item 9	$ -	$ -	$ -		$ -	0%	$ -
10	Bid Item 10	$ -	$ -	$ -		$ -	0%	$ -
TOTALS FOR PAYMENT #1		$ -	$ -	$ -	$ -	$ -	0%	$ -

STATE OF IOWA
DIVISION OF SOIL CONSERVATION AND WATER QUALITY
CHANGE ORDER REQUEST

Change Order Request No. _____

Project ID: Sto842407B Date: _____

Name of Project: Sto842407B

Location of Project: Story County

Name of Contractor: _____

Architect/Engineer: Ducks Unlimited

Contract Plan and Detail Reference: _____

Change Order Request Drawing No. and Date: _____

Contract Specification Reference: _____

Description of Change: _____

BREAKDOWN OF CONTRACT COST:

Original Project Contract Amount:	$_____
Approved Change Orders No. ___thru __:	$_____
Pending Recommended Change Order Requests Nos. ___:	$_____
This Change Order Request:	$_____
Resulting Total Recommended Amount:	$_____

Reason for Contract Change: _____

_____

Change Requested by: _____

_____ _____
(Signature) (Date)

CONTRACTOR APPROVAL

_____ By:_____
(Company) (Signature)

_____ _____
(Address) (Date)

_____

_____

IDALS PROJECT REPRESENTATIVE RECOMMENDATIONS

_____ Concur _____ Recommend Rejection (Attach Explanation)

IDALS Project Representative:_____ _____
(Signature) (Date)

DIVISION OF SOIL CONSERVATION AND WATER QUALITY AUTHORIZATION

Change Order required due to:

_____

_____

Immediate authorization to proceed granted: _____ Yes _____ No

APPROVED:

_____
Susan Kozak, Director
Division of Soil Conservation and Water Quality
Iowa Department of Agriculture
and Land Stewardship

_____
(Date)

DENIED:

_____
Susan Kozak, Director
Division of Soil Conservation and Water Quality
Iowa Department of Agriculture
and Land Stewardship

_____
(Date)

END OF DOCUMENT HH

State of Iowa
Iowa Department of Agriculture and Land Stewardship
DIVISION OF SOIL CONSERVATION AND WATER QUALITY
Sto842407B Nutrient Reduction Wetland Project Construction Contract Amendment

THIS AMENDMENT, made this _____ day of _____, 2024, by and between the State of Iowa, acting through:

Iowa Department of Agriculture and Land Stewardship
Division of Soil Conservation and Water Quality

hereinafter called the ***DIVISION***, and

_____
(Name of Company)

_____
(Address)

_____
(City, State, Zip)

hereinafter called the ***CONTRACTOR***.

WITNESSETH: That the ***DIVISION*** and the ***CONTRACTOR*** mutually agree to amend the agreement made the _____day of _____, 20_____, for the Story County Nutrient Reduction Wetland Project (Sto842407B – Bid No. 24-02) in this Amendment Number _____ as described below:

Description of Amendment:

_____
_____
_____

Contract Plan Sheet(s)
and Detail Reference(s): _____

Amendment No. _____
Drawing No. and Date: _____

Contract Specification
Reference(s): _____

Reason for Revision of
Contract Completion Date(s): _____
_____
_____

Original Contract Completion Date for All Work Except Seeding:	November 1, 2024
Original Contract Completion Date for Seeding:	December 15, 2024
Current Completion Date for All Work Except Seeding:	
Current Completion Date for Seeding:	
Revised Completion Date for All Work Except Seeding, This Amendment:	
Revised Completion Date for Seeding, This Amendment:	

BREAKDOWN OF AMENDMENT CONTRACT COST BY BID ITEM:

Item #	Description	Adjustment Quantity	Unit Cost	Total Cost Adjustment
			$	$
			TOTAL	**$**

Original Project Contract Amount:	$ 0.00
Approved Contract Amendments No. ____ through ____:	$ 0.00
Pending Recommended Change Order Requests No. ____ through ____:	$ 0.00
Approved Change Order Requests No. ____ through ____:	$ 0.00
This Amendment Request:	$ 0.00
Resulting Total Recommended Amount:	**$ 0.00**

IN WITNESS WHEREOF, the parties hereto have executed this Amendment, in the day and year first above mentioned.

FOR THE DIVISION

Grant D. Menke, Deputy Secretary
Iowa Department of Agriculture and Land Stewardship

(Date)

FOR THE CONTRACTOR

(Company Representative)

(Date)

(Name of Company)

(Address of Company)

(City, State, Zip Code)

Seal if by a corporation

CONSENT FROM SURETY

(Surety Representative)

(Name of Surety)

(Date)

END OF DOCUMENT II

IOWA
Department of Revenue
www.state.ia.us/tax

Designated Exempt Entity
Iowa Construction Sales Tax Exemption Certificate

This document may be completed by a designated exempt entity and given to their contractor and/or subcontractor along with an authorization letter. *Seller:* Keep this certificate in your files. *Contractor/Exempt Entity:* Keep a copy of this certificate for your records. **Do not send this to the Department of Revenue**

Designated Exempt Entity		
Division of Soil Conservation and Water Quality Iowa Department of Agriculture and Land Stewardship		
Address 1 **502 East 9th Street**		
Address 2		
City **Des Moines**	State **IA**	Zip Code **50319**
Construction Project Name **Sto842407B Nutrient Reduction Wetland Project**		
Construction Project Number (if used) **Job No. 24-02**		

General Contractor or Subcontractor Name		
Sample		
Address 1 **123 Construction Ave**		
Address 2		
City **Diggerville**	State **IA**	Zip Code **55555**

Description of contract/subcontract (please print/type clearly)

Construction of Nutrient Reduction Wetland.

The named contractor may purchase building materials used in the contract, exempt from sales tax. This exemption does NOT apply to materials, equipment and supplies consumed by the contractor or subcontractor.

Designated Exempt Entity Authorized Agent ._____ Date: _____

Authorization Letter From Division of Soil Conservation and Water Quality - Agriculture and Land Stewardship

Pursuant to Iowa Code Sections: 422.42 (16) & (17), and 422.47 (5), you are authorized to purchase construction materials tax free for the contract specified above.

The exemption certificate (or a copy of the certificate) may be provided to the suppliers of your construction materials and will authorize them to sell you the materials exempt from Iowa sales tax and any applicable local option sales tax and school infrastructure local option sales tax. Complete information on qualifying materials can be found at www.state.ia.us/tax, the Department of Revenue (IDR) website.

It is your responsibility to have records identifying the materials purchased and verifying they were used on this contract. Any materials purchased tax-free and not used on the construction project are subject to sales and applicable local option taxes. Should this occur, the tax must be paid directly by you to IDR in the same calendar quarter the project is completed. E-mail the department at: idrf@idrf.state.ia.us if you have questions on this requirement.

Contractors should be aware that use of the certificate to claim exemption from tax for items not used on this project or that do not qualify for exemption could result in civil or criminal penalties.

31-013 (12/10/02)

END OF DOCUMENT QQ

APPENDIX III

Reports

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(734) 623-2000
www.ducks.org

DESIGN REPORT

Sto842407B
Story County, Iowa
DU Project #IA-340-4

Prepared by:

Ducks Unlimited, Inc.
Great Lakes/Atlantic Region
In Cooperation with:
Iowa Department of Agriculture and Land Stewardship (IDALS)

February 2024

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

2-27-24

Andrew Schippers, P.E. Date
My license number is P26317.
My license renewal date is December 31, 2025
Pages of sheets covered by this seal: 1-162

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Table of Contents

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Introduction

This constructed wetland project is located in Story County, Iowa approximately 2.5 miles West of Gilbert, Iowa just North of Ioway (Squaw) Creek. The future wetland area is owned by Story County Conservation Board (SCCB), and currently exhibits native grasses throughout the bottom basin area. The future wetland area does not currently hold water except during significant rain events, which causes water to back onto the property from Ioway Creek (see Floodways, Floodplains, and Wetlands Section below). Based on topographic information and Google Earth Aerial Imagery, the future wetland area does not have a large direct watershed routing into the basin, however, there are two primary drainages that route on the West and East sides of the future wetland through ditches. Currently, SCCB does not use the site for any particular reason, however, it is our understanding that this future wetland site will be primarily for promoting water quality, as well as a potential recreational area.

The site was initially assessed by using remote digital desktop information to see if a wetland at this location was feasible. Information was presented by the Iowa Department of Agriculture and Land Stewardship (IDALS) to the landowner who expressed interest in participating with this project.

IDALS will submit permits for this project, which will include obtaining permits from The State Historic Preservation Office (SHPO), The Army Corps of Engineers, the Iowa DNR, as well as acceptance from the Boone-Story Joint Drainage District No. 8.

Ducks Unlimited is working in partnership with IDALS, Story County Conservation Board, and the associated Drainage District to construct the future wetland.

Proposed work includes:

- Provide pump system to pump tile water to wetland.
- Grade within the wetland area.
- Create berm to impound water within wetland area.
- Provide rock spillway within berm at natural outlet point of field.
- Provide outlet structure to provide water to neighboring wetland(s).
- Provide water control structure for water management.
- Seeding and restoration of disturbed areas.

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Project Location

Site Characteristics

Pre-Development Conditions

Pre-development conditions for the area include the uses described in the previous section, as well as a surrounding agricultural landscape. There is also a residential development that has been built just North of the future wetland site, which occurred during the design stages of this wetland project. The surrounding areas outside the complex are mostly grain production agricultural, row crops but also include pastures and some timber. Mild topography is predominant in the area with small waterways, drainage ditches, and culverts. The majority of ground cover is row crops during the growing season with a combination of row crop residue, tillage areas, and cover crop during non-growing season months. Soil types in the area vary with dominant hydrologic soil groups B and D. Hydrologic soil group D is known to have a slow infiltration rate resulting in high runoff potential when wet, while hydrologic soil group B exhibits moderate infiltration rates when wet. NRCS Soil Map for Hydrologic Soil Groups within the Area of Interest is located in the appendix of this report. The Area of Interest (AOI) shown on the NRCS Soil Map is broken into two watershed areas that were derived from StreamStats (Northwest and Northeast watersheds).

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Post-Development Conditions

Post-Development conditions will remain the same as pre-development for the basin tributary to the wetland area. This project includes grading within the wetland area itself and creating a berm to contain water within the wetland. None of the proposed work will change the tributary area or runoff characteristics of the basin.

It should be noted that the Stormwater Management Plan by Fox Engineering was reviewed and considered in the calculations for this wetland project. The Stormwater design for the neighborhood development just North of the future wetland site utilizes multiple dry retention basins in order to control the outflow to meet or reduce existing outflow to the associated drainage areas. Accordingly, the existing outflow conditions remain virtually unchanged with the constructed neighborhood, as well as the proposed wetland. A description narrative on the watershed characteristics is provided below on pages 5 and 6.

There is a proposed 18" diameter riser intake and 12" diameter CMP pipe that allows base flow from the proposed wetland to route to the existing wetlands to the South on the neighboring property (Kirk Coughlin). This feature was designed at the request of Kirk Coughlin and SCCB, and approved by IDALS, in order to provide additional water to the neighbor's wetland. Based on our conversations with the neighbor and SCCB, the landowner does not currently receive sufficient water to keep the wetland active. IDALS indicated that they would allow this feature to be included with the project, as long as a flowage easement was executed between SCCB and the landowner since this brings water from the Northwest watershed into their wetland, which is part of a different sub watershed. However, after water flows through the neighbor's wetland, it then routes back into Ioway Creek, which is where that water would have originally flowed from the Northwest watershed.

It should be noted that the primary design standard for this project is the NRCS Conservation Practice Standard (CPS), Constructed Wetland, Code 656 (September 2015). The definition of this standard is, "An artificial ecosystem with hydrophytic vegetation for water treatment." NRCS CPS, Grade Stabilization Structure, Code 410 (January 2023), was also used in the design of the embankment, spillway, and freeboard height.

Embankment Design

Table 1 – Design Criteria for Establishing Minimum Capacity of Full-Flow Open Structures of CPS Code 410 was utilized in the design of the embankment and spillway. The Classification used is Maximum drainage area of 450 acres with vertical drop 0-5 feet. This classification requires a Principal Spillway Capacity to withstand a 5-year, 24-hour duration storm and the total capacity to withstand a 10-year, 24-hour duration storm.

Accordingly, the rock spillway was designed to accommodate the 10-year design storm. The rock spillway is 50 feet wide with a crest elevation of 922.2 feet. The sides of the spillway slope up at a 10:1 ratio integrating with the embankment, which is designed at elevation 924.5 feet (top of topsoil re-spread after settlement). The remainder of the embankment is designed with 6:1 ratio sides slopes with the intent that the outer side slopes become 10:1 after topsoil respread.

During the design of the spillway and embankment, criteria from Full-Flow Open Structures on page 3 of CPS 410 was applied. Specifically, DU compared the storm bounce within the wetland for the

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5-year storm event plus 0.5' (Elevation 923.01' + 0.5' = 923.51') and 10-year storm event (923.17'). With 923.51' being the higher elevation of the two, DU set the top of riprap at the spillway side slopes to 923.5'. Then, the top of embankment was set 1-foot higher, which is 924.5'.

Several types of spillway configurations were considered for this site including sheet pile, or a combination of a sheet pile spillway, along with a riprap auxiliary spillway. Due to the hydrologic conditions/limitations of this site, and being within the floodplain, a single grouted riprap spillway (full-flow structure) was chosen to accommodate a 25-year design rain event to the wetland area. The slopes entering and exiting the riprap spillway are 6:1 in order to allow water to more freely route over the spillway from *both* directions. This was considered in order to allow flood waters from Ioway Creek to easily backflow into the wetland area during flood conditions. DU sized the riprap and erosion stone at the spillway to accommodate the peak flows through the wetland, which is shown in Appendix A-9. Also, the 100-year flood condition velocity for Ioway Creek were approximated (Appendix A-9), showing that the grouted riprap will be sufficient to resist displacement during flood events.

The 25-year rain event creates a storm bounce within the wetland to 923.39', which is below the top of embankment. Accordingly, this meets the general criteria from CPS 656.

It should be noted that the 18" diameter riser intake and 12" diameter CMP pipe has a rim elevation of 921.9', which allows all of the initial pump base flow to route to the neighboring property wetland *before* engaging the rock spillway and routing back into Ioway Creek. Accordingly, any direct rain events that increases the inflow beyond the base pump flow will then engage the rock spillway. The 921.9' rim elevation of the 18" diameter riser also sets the Normal Water Level (NWL) of the wetland to 921.9'.

Ducks Unlimited also obtained property boundary shapefiles from Story County during the design process, which were utilized in the design to ensure all structures were designed inside of the SCCB property.

Floodways, Floodplains, and Wetlands

FEMA Map Number 19169c0120F, located in the appendix of this report, shows the future wetland area and some areas surrounding the area of interest within Zone A. Zone A refers to areas within the Special Flood Hazard Area (SFHA) 1% annual chance flood that do not have listed Base Flood Elevation (BFE). Additionally, some areas in the vicinity of the project fall in Zone X, 0.2% annual chance flood. No portion of the project area is located within a Regulatory Floodway. Wetlands are identified South of the area of interest by the U.S. Fish and Wildlife Service National Wetlands Inventory map, which is located in the appendix of this report.

It should be noted that all of the material designated to construct the wetland berm is planned to come from the wetland graded areas and designated borrow areas within the floodplain immediate area, so that there is no material that will be brought from outside the floodplain area. DU analyzed cross sections through the proposed wetland area (berm and grading areas), which shows minimal impact in the cross-sectional capacity of the floodplain (perpendicular to the flow of Ioway Creek during flood stage). It should also be noted that the existing roadway is significantly higher than the wetland berm itself, which acts as a constricting point in the hydrology of Ioway Creek and the floodplain area. The FEMA 100-year surface elevation is above the top of berm height, and accordingly allows flows to continue within the floodplain area during significant storm events. It is

anticipated that the entire berm and wetland area will be submerged during 100-year flood events (and higher) of Ioway Creek.

Runoff Analysis

Watershed

Tributary area to the wetland area is determined to be 38 acres of direct watershed (16 acres land and 22 acres wetland). This basin was determined with the aid of StreamStats which is a web-based Geographic Information System (GIS) application made available by the United States Geological Survey (USGS). Also, DU compared the Post Development conditions from the adjacent neighborhood to determine the extent of direct watershed area to the wetland. Based on field observations, and review of the topographic data, there are two primary drainages (West and East) that route on each side of the future wetland area without directly routing into the wetland area. A deeper analysis was conducted in order to determine the rain event that would eventually overtop the embankments of the West and East ditches and cause water to then route to the wetland area. It was determined that in a 25-year rain event, which is the maximum design storm considered in the wetland design, that no water would contribute to the wetland area itself. However, it is likely that rain events higher than a 25-year event may cause additional water to overtop the West and East ditches and potentially cause contributing flows to the wetland. However, these higher rain events exceed the design capacities of the wetland. As a conservative approach, DU added 10% of the West watershed area and 10% of the East watershed area to the hydrology model to increase peak inflow to the wetland in order to add a factor of safety to the structure sizing.

Time of Concentration

Time of Concentration was calculated using the NRCS Lag Method which is appropriate for this watershed due to is rural character and long hydraulic length. Flow length of the watershed is shown on the watershed map in the appendix of this report, which was derived from StreamStats. NRCS Lag Method considers the flow length, average watershed slope, and maximum potential retention which is a factor of the SCS curve number (CN). Flow length, average watershed slope, and CN used for runoff analysis for this watershed are listed in the HydroCAD Report in the appendix. The average slope of the entire watershed taken from LiDAR data (3.78%) to calculate the peak flows in this analysis.

Precipitation Model

The rainfall events and intensities were obtained from the HydroCAD lookup table for Story County, Iowa, MSE, 24-hour, Storm Curve 3 (MSE3). These rainfall events were compared to the MSE 3 rainfall intensities provided by Title 210, National Engineering Handbook, Figure IA2-25, Story County, NOAA 14 Rainfall Type MSE3. The HydroCAD Report in the appendix reflects the precipitation model and rainfall intensities for MSE3.

Runoff Model

SCS TR-20 NRCS Peak Flow method was utilized as a runoff model. SCS methods combine land use and soil type into a single parameter known as the Curve Number (CN). Based on the various

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land uses and the hydrologic soil groups within the watershed discussed earlier in this report, a weighted CN of 84 was determined to be appropriate. Reference Appendix A-7 of this report.

Runoff Conveyance

Hydraulic Model

HydroCAD 10.20-2g was utilized to model the watershed. Input parameters include watershed size, SCS CN (determined by land use and soil types), time of concentration calculations, precipitation input, stage-storage, discharge, and outlet details. The wetland watershed was modeled with the proposed berm and rock spillway. The HydroCAD Hydrograph Report is included in the appendix.

Summary & Conclusions

This project does not affect the natural drainage area, drainage courses, runoff coefficients, or any other characteristics of the overall watershed. There is a minor amount of tile water being re-routed from the West watershed to the East watershed at the request of the landowner receiving the additional water. The wetland area will be graded down, and the removed material will be utilized in the general berm construction and as topsoil respread. The berm will be constructed to contain water in the wetland for water treatment. The spillway structure is designed to accommodate a 10-year storm event, while the top of embankment is designed to accommodate a 25-year design storm, in accordance with NRCS standards. Rain events larger than that will ultimately be controlled by Ioway Creek, which may cause flooding of the subject site, as well as neighboring properties, as it has historically done (being in a floodplain). Significant benefits to the wetland area and areas upstream of wetland area include the treatment of tile water (water quality), promotion of wildlife habitat, as well as other recreational benefits.

GREAT LAKES/ATLANTIC REGION
7322 Newman Blvd., Bldg. 2
Dexter, MI 48130
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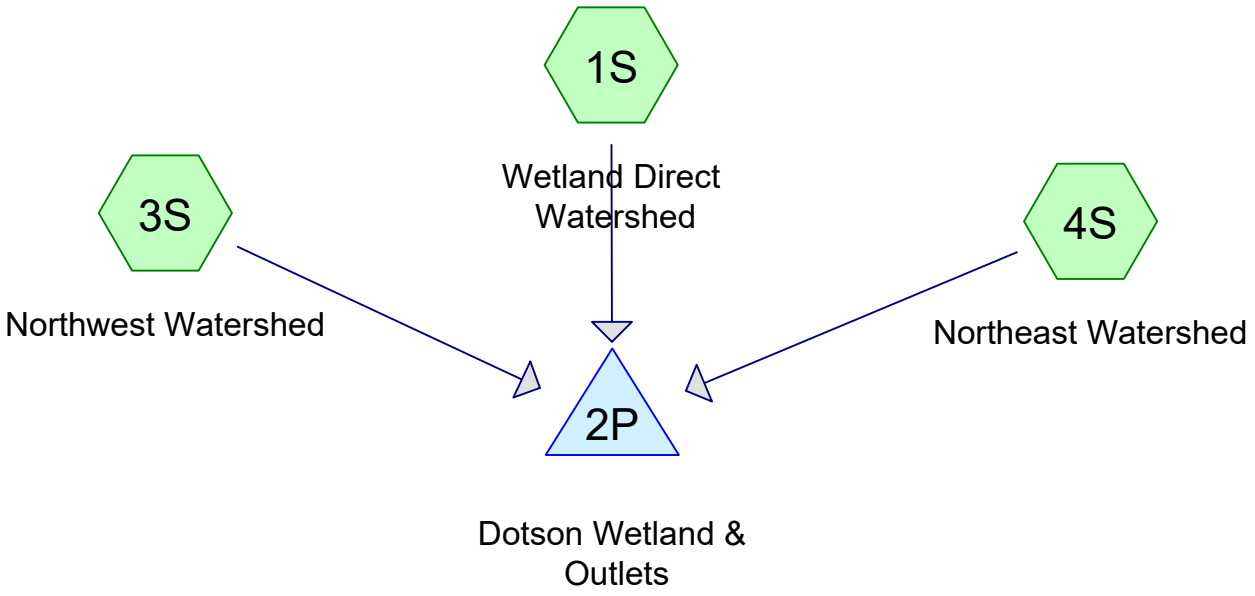
Appendix A-1

HydroCAD Report



Subcat Reach Pond Link

Routing Diagram for Dotson - Wetland Model - Revised 9-26-23 - 10% AND 50' SPILLWAY AT 923.3'

Prepared by Ducks Unlimited

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 1484 IA Story

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	5-Year	MSE 24-hr	3	Default	24.00	1	3.86	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.50	2
3	25-Year	MSE 24-hr	3	Default	24.00	1	5.42	2
4	100-Year	MSE 24-hr	3	Default	24.00	1	6.98	2
5	Custom	MSE 24-hr	3	Default	24.00	1	0.04	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
16.900	78	Meadow, non-grazed, HSG D (1S)
22.000	98	Water Surface, HSG A (1S)
268.800	84	Weighted Average of Hydrologic Soil Groups (3S, 4S)
307.700	**85**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
22.000	HSG A	1S
0.000	HSG B	
0.000	HSG C	
16.900	HSG D	1S
268.800	Other	3S, 4S
307.700		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover
0.000	0.000	0.000	16.900	0.000	16.900	Meadow, non-grazed
22.000	0.000	0.000	0.000	0.000	22.000	Water Surface
0.000	0.000	0.000	0.000	268.800	268.800	Weighted Average of Hydrologic Soil Groups
22.000	**0.000**	**0.000**	**16.900**	**268.800**	**307.700**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	2P	920.25	920.25	50.0	0.0000	0.025	0.0	12.0	0.0

Notes Listing (all nodes)

Line#	Node Number	Notes
1	Project	Rainfall events imported from "NRCS-Rain.txt" for 1484 IA Story
2	1S	This watershed area is the wetland (water) area itself, and the hillside that drains surface water directly to the wetland.
3	3S	This watershed area was computed as 10% of the total watershed area routing through the West Ditch (1,932.8 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the West ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.
4	4S	This watershed area was computed as 10% of the total watershed area routing through the East Ditch (755.2 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the East ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Wetland Direct Runoff Area=38.900 ac 56.56% Impervious Runoff Depth=2.69"
Flow Length=1,665' Slope=0.1300 '/' Tc=11.9 min CN=89 Runoff=146.04 cfs 8.726 af

Subcatchment 3S: Northwest Runoff Area=193.300 ac 0.00% Impervious Runoff Depth=2.25"
Flow Length=20,555' Slope=0.0378 '/' Tc=161.1 min CN=84 Runoff=123.63 cfs 36.214 af

Subcatchment 4S: Northeast Watershed Runoff Area=75.500 ac 0.00% Impervious Runoff Depth=2.25"
Flow Length=17,536' Slope=0.0378 '/' Tc=141.8 min CN=84 Runoff=53.10 cfs 14.145 af

Pond 2P: Dotson Wetland & Outlets Peak Elev=923.01' Storage=53.076 af Inflow=182.63 cfs 67.028 af
Primary=3.10 cfs 7.572 af Secondary=110.36 cfs 52.727 af Outflow=113.46 cfs 60.299 af

Total Runoff Area = 307.700 ac Runoff Volume = 59.085 af Average Runoff Depth = 2.30"
92.85% Pervious = 285.700 ac 7.15% Impervious = 22.000 ac

Summary for Subcatchment 1S: Wetland Direct Watershed

This watershed area is the wetland (water) area itself, and the hillside that drains surface water directly to the wetland.

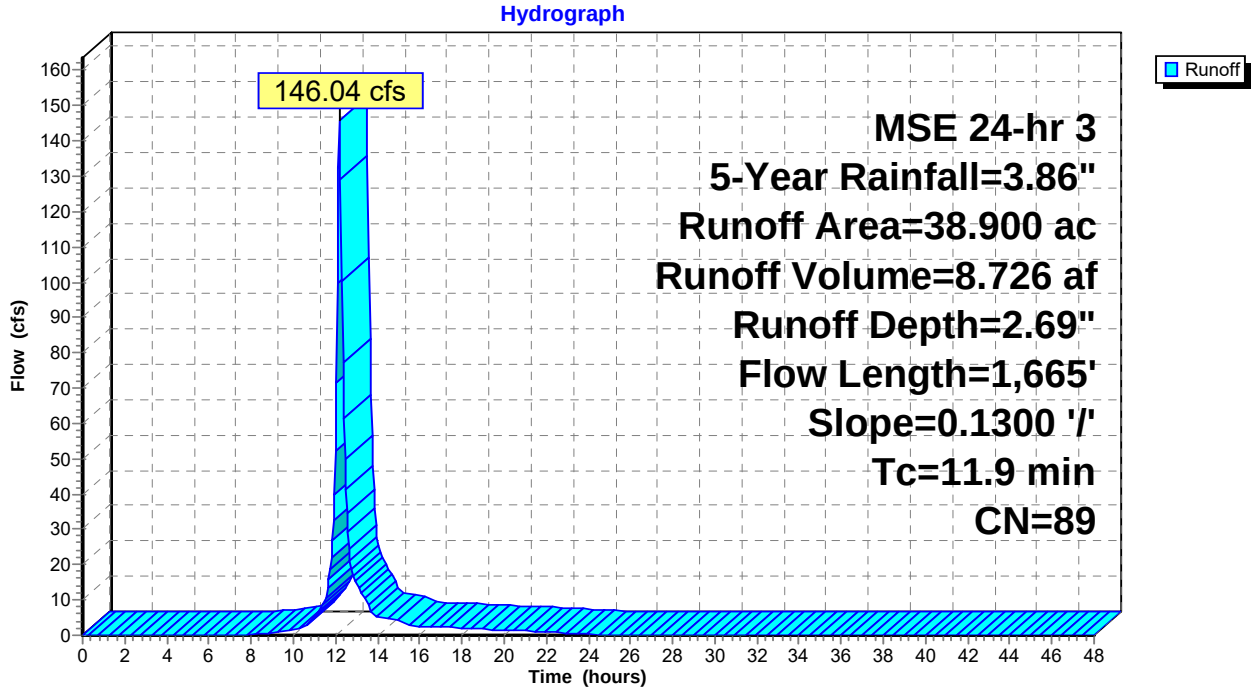
Runoff = 146.04 cfs @ 12.20 hrs, Volume= 8.726 af, Depth= 2.69"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 5-Year Rainfall=3.86"

Area (ac)	CN	Description
16.900	78	Meadow, non-grazed, HSG D
22.000	98	Water Surface, HSG A
38.900	89	Weighted Average
16.900		43.44% Pervious Area
22.000		56.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	300	0.1300	0.67		**Sheet Flow, Hillside Initial Sheet Flow** Grass: Short n= 0.150 P2= 7.11"
1.2	175	0.1300	2.52		**Shallow Concentrated Flow, Hillside Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.2	1,190		6.16		**Lake or Reservoir, Wetland** Mean Depth= 1.18'
11.9	1,665	Total			

Subcatchment 1S: Wetland Direct Watershed



Hydrograph for Subcatchment 1S: Wetland Direct Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.01	0.00	0.00
1.50	0.02	0.00	0.00
2.00	0.04	0.00	0.00
2.50	0.05	0.00	0.00
3.00	0.06	0.00	0.00
3.50	0.08	0.00	0.00
4.00	0.10	0.00	0.00
4.50	0.12	0.00	0.00
5.00	0.14	0.00	0.00
5.50	0.17	0.00	0.00
6.00	0.20	0.00	0.00
6.50	0.23	0.00	0.00
7.00	0.26	0.00	0.00
7.50	0.29	0.00	0.12
8.00	0.32	0.00	0.26
8.50	0.36	0.01	0.41
9.00	0.40	0.02	0.57
9.50	0.46	0.03	1.26
10.00	0.53	0.05	1.71
10.50	0.60	0.08	2.17
11.00	0.74	0.14	5.36
11.50	0.96	0.26	9.78
12.00	1.79	0.85	**52.21**
12.50	2.90	1.81	**41.26**
13.00	3.12	2.01	14.54
13.50	3.26	2.13	9.36
14.00	3.33	2.20	5.23
14.50	3.40	2.26	4.90
15.00	3.46	2.32	4.60
15.50	3.50	2.36	2.77
16.00	3.54	2.39	2.62
16.50	3.57	2.42	2.49
17.00	3.60	2.45	2.35
17.50	3.63	2.48	2.22
18.00	3.66	2.51	2.08
18.50	3.69	2.53	1.94
19.00	3.72	2.56	1.81
19.50	3.74	2.58	1.67
20.00	3.76	2.60	1.53
20.50	3.78	2.62	1.39
21.00	3.80	2.63	1.25
21.50	3.81	2.65	1.11
22.00	3.82	2.66	0.97
22.50	3.84	2.67	0.83
23.00	3.85	2.68	0.69
23.50	3.85	2.69	0.56
24.00	**3.86**	**2.69**	0.42
24.50	3.86	2.69	0.00
25.00	3.86	2.69	0.00
25.50	3.86	2.69	0.00
26.00	3.86	2.69	0.00
26.50	3.86	2.69	0.00
27.00	3.86	2.69	0.00
27.50	3.86	2.69	0.00
28.00	3.86	2.69	0.00
28.50	3.86	2.69	0.00
29.00	3.86	2.69	0.00
29.50	3.86	2.69	0.00
30.00	3.86	2.69	0.00
30.50	3.86	2.69	0.00
31.00	3.86	2.69	0.00
31.50	3.86	2.69	0.00
32.00	3.86	2.69	0.00
32.50	3.86	2.69	0.00
33.00	3.86	2.69	0.00
33.50	3.86	2.69	0.00
34.00	3.86	2.69	0.00
34.50	3.86	2.69	0.00
35.00	3.86	2.69	0.00
35.50	3.86	2.69	0.00
36.00	3.86	2.69	0.00
36.50	3.86	2.69	0.00
37.00	3.86	2.69	0.00
37.50	3.86	2.69	0.00
38.00	3.86	2.69	0.00
38.50	3.86	2.69	0.00
39.00	3.86	2.69	0.00
39.50	3.86	2.69	0.00
40.00	3.86	2.69	0.00
40.50	3.86	2.69	0.00
41.00	3.86	2.69	0.00
41.50	3.86	2.69	0.00
42.00	3.86	2.69	0.00
42.50	3.86	2.69	0.00
43.00	3.86	2.69	0.00
43.50	3.86	2.69	0.00
44.00	3.86	2.69	0.00
44.50	3.86	2.69	0.00
45.00	3.86	2.69	0.00
45.50	3.86	2.69	0.00
46.00	3.86	2.69	0.00
46.50	3.86	2.69	0.00
47.00	3.86	2.69	0.00
47.50	3.86	2.69	0.00
48.00	3.86	2.69	0.00

Summary for Subcatchment 3S: Northwest Watershed

This watershed area was computed as 10% of the total watershed area routing through the West Ditch (1,932.8 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the West ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

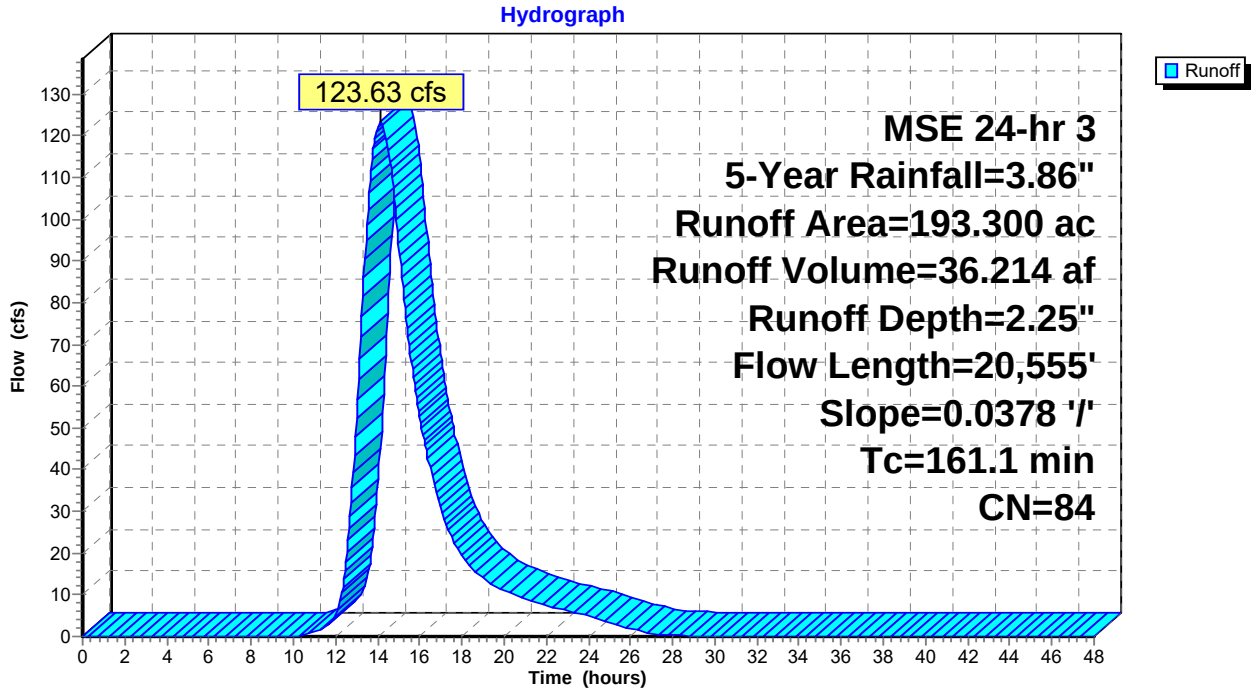
Runoff = 123.63 cfs @ 14.14 hrs, Volume= 36.214 af, Depth= 2.25"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 5-Year Rainfall=3.86"

	Area (ac)	CN	Description
*	193.300	84	Weighted Average of Hydrologic Soil Groups
	193.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
161.1	20,555	0.0378	2.13		**Lag/CN Method,**

Subcatchment 3S: Northwest Watershed



Hydrograph for Subcatchment 3S: Northwest Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.01	0.00	0.00
1.50	0.02	0.00	0.00
2.00	0.04	0.00	0.00
2.50	0.05	0.00	0.00
3.00	0.06	0.00	0.00
3.50	0.08	0.00	0.00
4.00	0.10	0.00	0.00
4.50	0.12	0.00	0.00
5.00	0.14	0.00	0.00
5.50	0.17	0.00	0.00
6.00	0.20	0.00	0.00
6.50	0.23	0.00	0.00
7.00	0.26	0.00	0.00
7.50	0.29	0.00	0.00
8.00	0.32	0.00	0.00
8.50	0.36	0.00	0.00
9.00	0.40	0.00	0.00
9.50	0.46	0.00	0.01
10.00	0.53	0.01	0.07
10.50	0.60	0.02	0.32
11.00	0.74	0.06	0.92
11.50	0.96	0.13	2.20
12.00	1.79	0.60	5.24
12.50	2.90	1.44	18.04
13.00	3.12	1.61	52.27
13.50	3.26	1.73	98.75
14.00	3.33	1.79	**121.85**
14.50	3.40	1.85	**117.32**
15.00	3.46	1.90	94.30
15.50	3.50	1.94	69.88
16.00	3.54	1.97	52.69
16.50	3.57	2.00	39.94
17.00	3.60	2.03	30.78
17.50	3.63	2.05	24.09
18.00	3.66	2.08	19.45
18.50	3.69	2.10	16.31
19.00	3.72	2.12	14.04
19.50	3.74	2.14	12.40
20.00	3.76	2.16	11.14
20.50	3.78	2.18	10.05
21.00	3.80	2.19	9.04
21.50	3.81	2.21	8.21
22.00	3.82	2.22	7.53
22.50	3.84	2.23	6.85
23.00	3.85	2.24	6.20
23.50	3.85	2.24	5.56
24.00	**3.86**	**2.25**	4.90
24.50	3.86	2.25	4.26
25.00	3.86	2.25	3.55
25.50	3.86	2.25	2.75
26.00	3.86	2.25	1.95
26.50	3.86	2.25	1.28
27.00	3.86	2.25	0.80
27.50	3.86	2.25	0.50
28.00	3.86	2.25	0.32
28.50	3.86	2.25	0.20
29.00	3.86	2.25	0.12
29.50	3.86	2.25	0.07
30.00	3.86	2.25	0.04
30.50	3.86	2.25	0.03
31.00	3.86	2.25	0.01
31.50	3.86	2.25	0.01
32.00	3.86	2.25	0.00
32.50	3.86	2.25	0.00
33.00	3.86	2.25	0.00
33.50	3.86	2.25	0.00
34.00	3.86	2.25	0.00
34.50	3.86	2.25	0.00
35.00	3.86	2.25	0.00
35.50	3.86	2.25	0.00
36.00	3.86	2.25	0.00
36.50	3.86	2.25	0.00
37.00	3.86	2.25	0.00
37.50	3.86	2.25	0.00
38.00	3.86	2.25	0.00
38.50	3.86	2.25	0.00
39.00	3.86	2.25	0.00
39.50	3.86	2.25	0.00
40.00	3.86	2.25	0.00
40.50	3.86	2.25	0.00
41.00	3.86	2.25	0.00
41.50	3.86	2.25	0.00
42.00	3.86	2.25	0.00
42.50	3.86	2.25	0.00
43.00	3.86	2.25	0.00
43.50	3.86	2.25	0.00
44.00	3.86	2.25	0.00
44.50	3.86	2.25	0.00
45.00	3.86	2.25	0.00
45.50	3.86	2.25	0.00
46.00	3.86	2.25	0.00
46.50	3.86	2.25	0.00
47.00	3.86	2.25	0.00
47.50	3.86	2.25	0.00
48.00	3.86	2.25	0.00

Summary for Subcatchment 4S: Northeast Watershed

This watershed area was computed as 10% of the total watershed area routing through the East Ditch (755.2 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the East ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

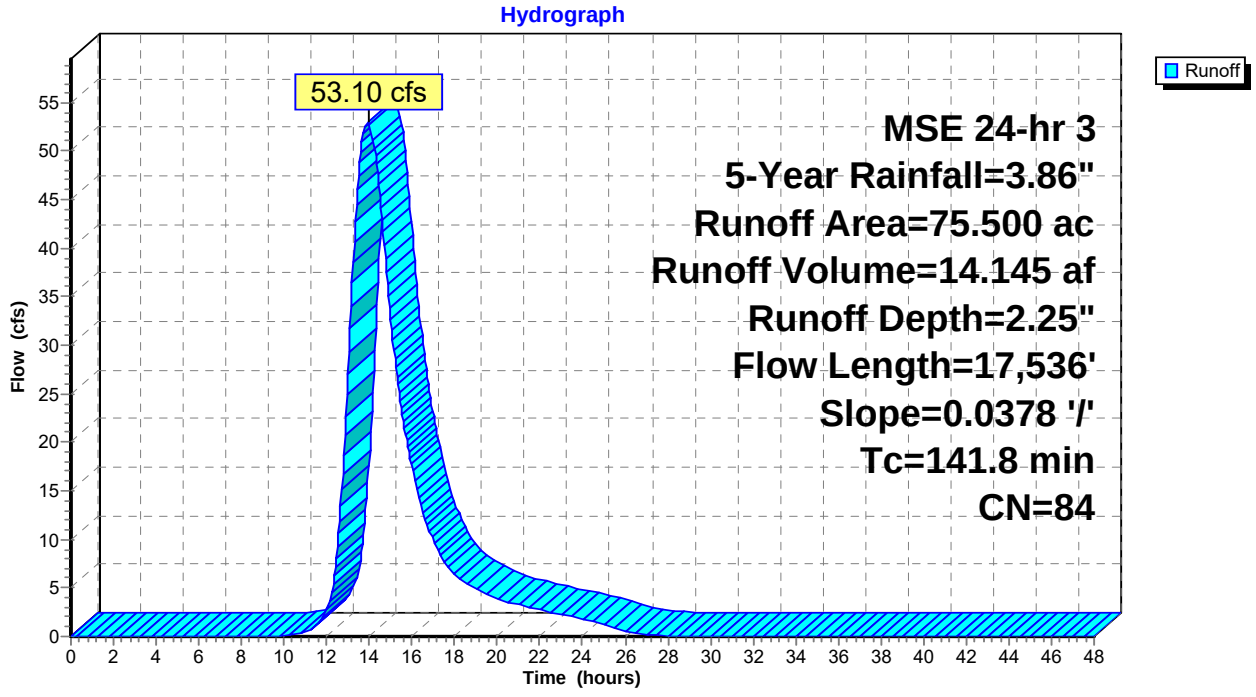
Runoff = 53.10 cfs @ 13.98 hrs, Volume= 14.145 af, Depth= 2.25"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 5-Year Rainfall=3.86"

	Area (ac)	CN	Description
*	75.500	84	Weighted Average of Hydrologic Soil Groups
	75.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
141.8	17,536	0.0378	2.06		**Lag/CN Method,**

Subcatchment 4S: Northeast Watershed



Hydrograph for Subcatchment 4S: Northeast Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.01	0.00	0.00
1.50	0.02	0.00	0.00
2.00	0.04	0.00	0.00
2.50	0.05	0.00	0.00
3.00	0.06	0.00	0.00
3.50	0.08	0.00	0.00
4.00	0.10	0.00	0.00
4.50	0.12	0.00	0.00
5.00	0.14	0.00	0.00
5.50	0.17	0.00	0.00
6.00	0.20	0.00	0.00
6.50	0.23	0.00	0.00
7.00	0.26	0.00	0.00
7.50	0.29	0.00	0.00
8.00	0.32	0.00	0.00
8.50	0.36	0.00	0.00
9.00	0.40	0.00	0.00
9.50	0.46	0.00	0.00
10.00	0.53	0.01	0.04
10.50	0.60	0.02	0.18
11.00	0.74	0.06	0.49
11.50	0.96	0.13	1.14
12.00	1.79	0.60	2.72
12.50	2.90	1.44	9.27
13.00	3.12	1.61	27.11
13.50	3.26	1.73	47.51
14.00	3.33	1.79	**53.07**
14.50	3.40	1.85	45.39
15.00	3.46	1.90	32.64
15.50	3.50	1.94	23.55
16.00	3.54	1.97	17.32
16.50	3.57	2.00	12.99
17.00	3.60	2.03	9.87
17.50	3.63	2.05	7.78
18.00	3.66	2.08	6.40
18.50	3.69	2.10	5.49
19.00	3.72	2.12	4.85
19.50	3.74	2.14	4.34
20.00	3.76	2.16	3.90
20.50	3.78	2.18	3.56
21.00	3.80	2.19	3.29
21.50	3.81	2.21	3.03
22.00	3.82	2.22	2.77
22.50	3.84	2.23	2.52
23.00	3.85	2.24	2.27
23.50	3.85	2.24	2.02
24.00	**3.86**	**2.25**	1.77
24.50	3.86	2.25	1.51
25.00	3.86	2.25	1.22
25.50	3.86	2.25	0.89
26.00	3.86	2.25	0.58
26.50	3.86	2.25	0.34
27.00	3.86	2.25	0.20
27.50	3.86	2.25	0.12
28.00	3.86	2.25	0.07
28.50	3.86	2.25	0.04
29.00	3.86	2.25	0.02
29.50	3.86	2.25	0.01
30.00	3.86	2.25	0.01
30.50	3.86	2.25	0.00
31.00	3.86	2.25	0.00
31.50	3.86	2.25	0.00
32.00	3.86	2.25	0.00
32.50	3.86	2.25	0.00
33.00	3.86	2.25	0.00
33.50	3.86	2.25	0.00
34.00	3.86	2.25	0.00
34.50	3.86	2.25	0.00
35.00	3.86	2.25	0.00
35.50	3.86	2.25	0.00
36.00	3.86	2.25	0.00
36.50	3.86	2.25	0.00
37.00	3.86	2.25	0.00
37.50	3.86	2.25	0.00
38.00	3.86	2.25	0.00
38.50	3.86	2.25	0.00
39.00	3.86	2.25	0.00
39.50	3.86	2.25	0.00
40.00	3.86	2.25	0.00
40.50	3.86	2.25	0.00
41.00	3.86	2.25	0.00
41.50	3.86	2.25	0.00
42.00	3.86	2.25	0.00
42.50	3.86	2.25	0.00
43.00	3.86	2.25	0.00
43.50	3.86	2.25	0.00
44.00	3.86	2.25	0.00
44.50	3.86	2.25	0.00
45.00	3.86	2.25	0.00
45.50	3.86	2.25	0.00
46.00	3.86	2.25	0.00
46.50	3.86	2.25	0.00
47.00	3.86	2.25	0.00
47.50	3.86	2.25	0.00
48.00	3.86	2.25	0.00

Summary for Pond 2P: Dotson Wetland & Outlets

Inflow Area = 307.700 ac, 7.15% Impervious, Inflow Depth > 2.61" for 5-Year event
Inflow = 182.63 cfs @ 14.09 hrs, Volume= 67.028 af, Incl. 2.00 cfs Base Flow
Outflow = 113.46 cfs @ 15.26 hrs, Volume= 60.299 af, Atten= 38%, Lag= 69.8 min
Primary = 3.10 cfs @ 15.26 hrs, Volume= 7.572 af
Secondary = 110.36 cfs @ 15.26 hrs, Volume= 52.727 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 921.90' Surf.Area= 20.817 ac Storage= 26.525 af
Peak Elev= 923.01' @ 15.26 hrs Surf.Area= 26.216 ac Storage= 53.076 af (26.551 af above start)

Plug-Flow detention time= 612.5 min calculated for 33.735 af (50% of inflow)
Center-of-Mass det. time= 199.7 min (1,178.0 - 978.3)

Volume	Invert	Avail.Storage	Storage Description
#1	919.00'	93.642 af	**Storage to Top of Berm (Prismatic)**Listed below (Recalc)

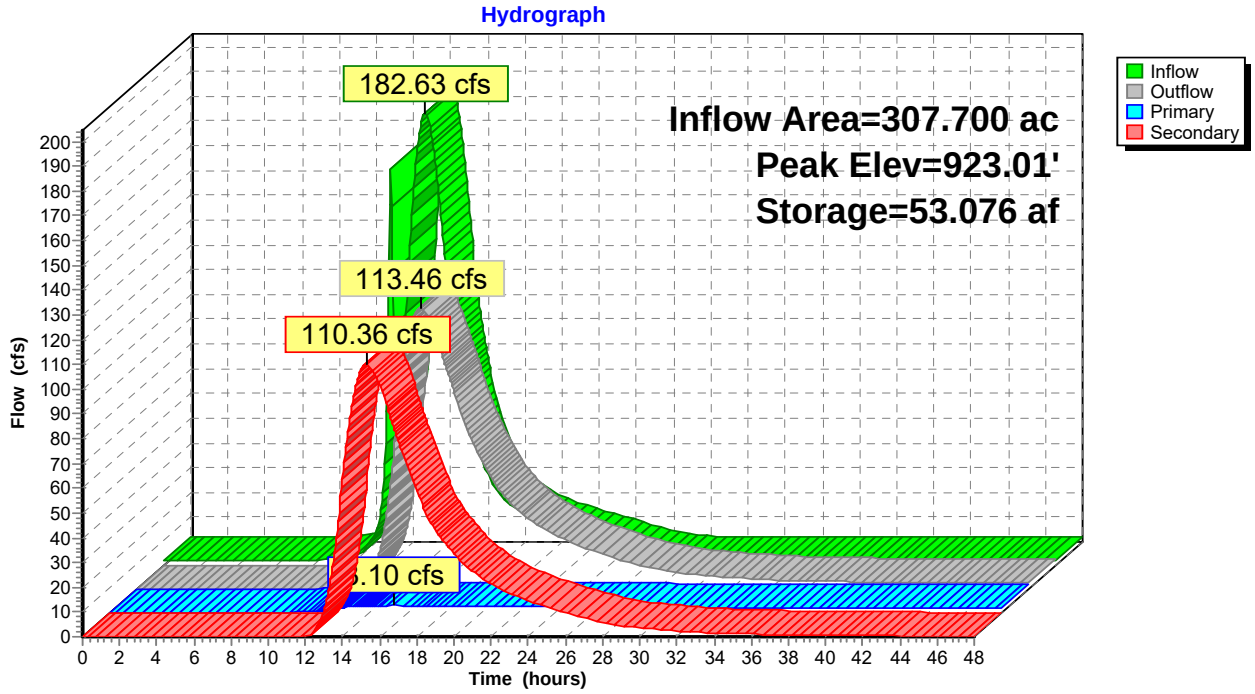
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
919.00	0.034	0.000	0.000
920.00	7.420	3.727	3.727
921.00	10.232	8.826	12.553
922.00	21.993	16.112	28.665
923.00	26.197	24.095	52.760
924.00	27.783	26.990	79.750
924.50	27.783	13.891	93.642

Device	Routing	Invert	Outlet Devices
#1	Device 2	921.90'	**18.0" Horiz. 18" Riser Inlet** C= 0.600 Limited to weir flow at low heads
#2	Primary	920.25'	**12.0" Round CMP_Round 12"** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 920.25' / 920.25' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#3	Secondary	922.20'	**50.0' long + 10.0 '/' SideZ x 12.0' breadth 50' Rock Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

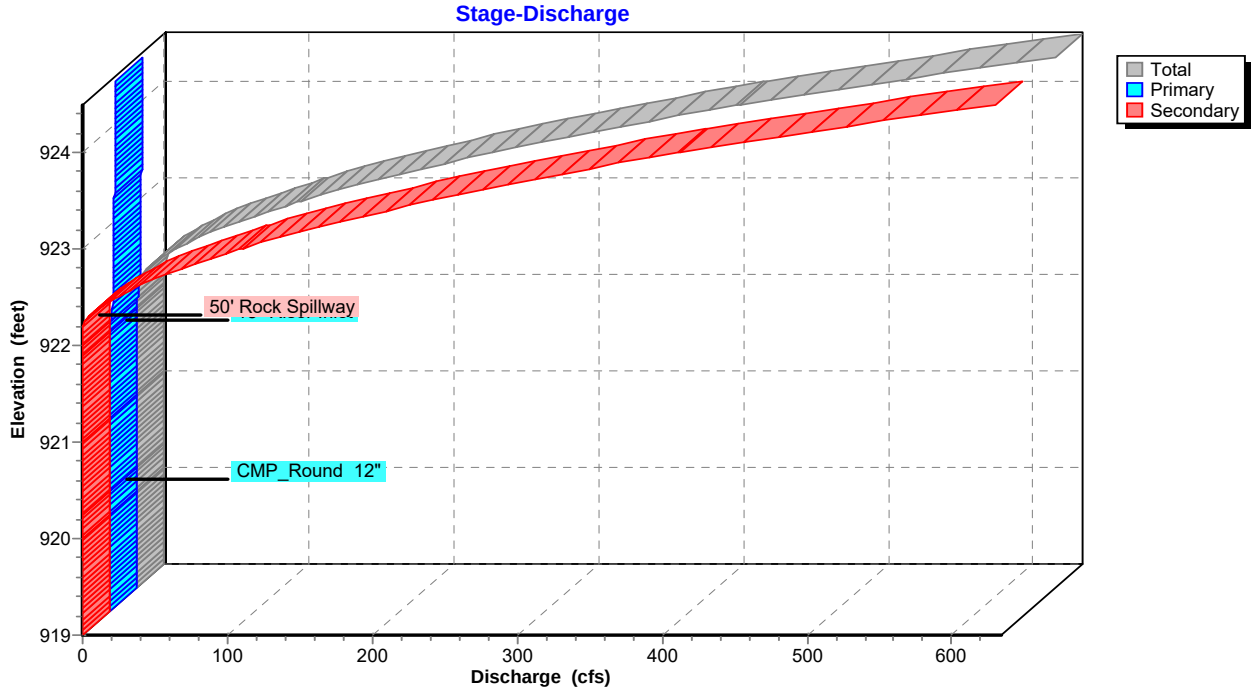
Primary OutFlow Max=3.10 cfs @ 15.26 hrs HW=923.01' (Free Discharge)
└**2=CMP_Round 12"** (Barrel Controls 3.10 cfs @ 3.94 fps)
└**1=18" Riser Inlet** (Passes 3.10 cfs of 8.97 cfs potential flow)

Secondary OutFlow Max=110.35 cfs @ 15.26 hrs HW=923.01' (Free Discharge)
└**3=50' Rock Spillway** (Weir Controls 110.35 cfs @ 2.34 fps)

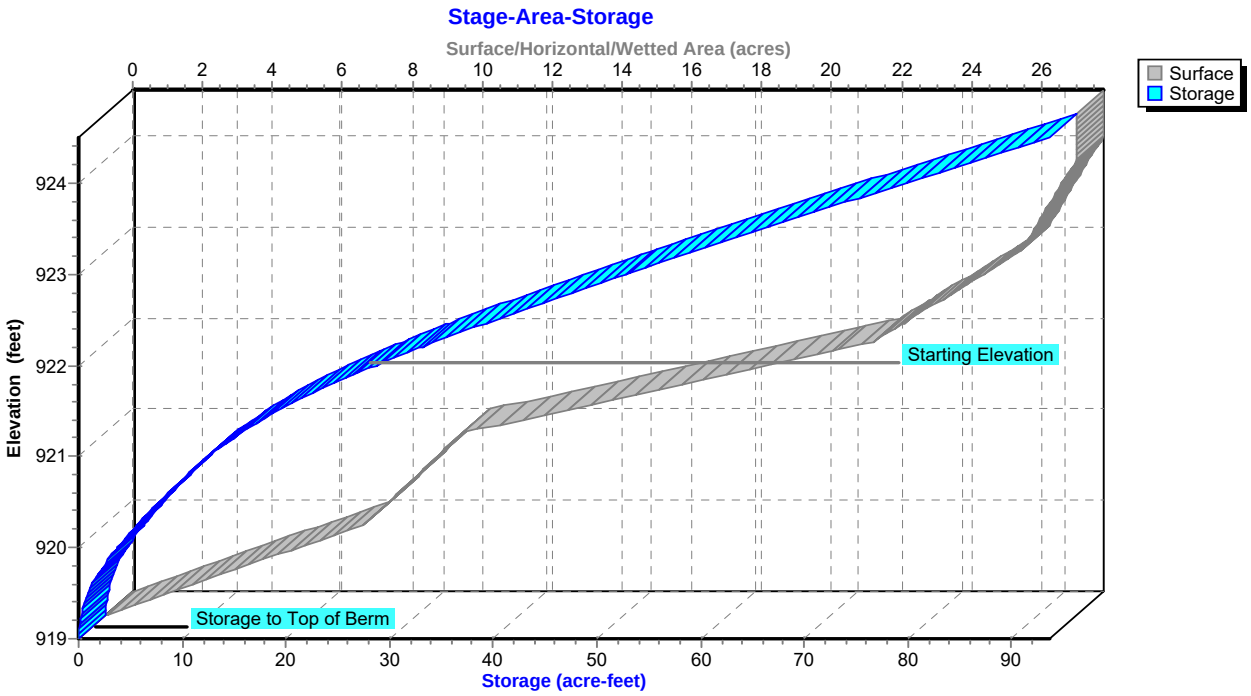
Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Hydrograph for Pond 2P: Dotson Wetland & Outlets

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	2.00	26.529	921.90	0.00	0.00	0.00
1.00	2.00	26.694	921.91	0.02	0.02	0.00
2.00	2.00	26.857	921.92	0.03	0.03	0.00
3.00	2.00	27.018	921.92	0.07	0.07	0.00
4.00	2.00	27.177	921.93	0.10	0.10	0.00
5.00	2.00	27.332	921.94	0.14	0.14	0.00
6.00	2.00	27.485	921.95	0.17	0.17	0.00
7.00	2.00	27.635	921.95	0.20	0.20	0.00
8.00	2.26	27.792	921.96	0.24	0.24	0.00
9.00	2.57	27.970	921.97	0.28	0.28	0.00
10.00	3.82	28.212	921.98	0.35	0.35	0.00
11.00	8.77	28.620	922.00	0.47	0.47	0.00
12.00	62.17	30.266	922.07	1.11	1.11	0.00
13.00	95.92	37.400	922.38	12.94	2.48	10.46
14.00	**182.16**	46.911	922.77	66.54	2.88	63.67
15.00	**133.54**	**52.855**	**923.00**	**111.62**	**3.09**	**108.53**
16.00	74.63	**51.971**	**922.97**	**104.52**	**3.06**	**101.46**
17.00	45.01	49.052	922.86	82.14	2.96	79.18
18.00	29.92	46.176	922.74	61.15	2.85	58.30
19.00	22.69	43.930	922.65	46.07	2.76	43.30
20.00	18.57	42.261	922.59	35.99	2.69	33.29
21.00	15.59	40.995	922.53	29.10	2.64	26.46
22.00	13.27	39.997	922.49	24.10	2.60	21.51
23.00	11.16	39.181	922.46	20.24	2.56	17.68
24.00	9.09	38.474	922.43	17.19	2.53	14.66
25.00	6.77	37.816	922.40	14.49	2.50	11.99
26.00	4.52	37.182	922.37	12.14	2.47	9.66
27.00	3.00	36.576	922.35	9.99	2.44	7.54
28.00	2.39	36.040	922.33	8.33	2.42	5.91
29.00	2.14	35.595	922.31	6.96	2.40	4.56
30.00	2.05	35.236	922.29	6.01	2.38	3.64
31.00	2.02	34.936	922.28	5.32	2.36	2.96
32.00	2.00	34.687	922.27	4.74	2.35	2.39
33.00	2.00	34.481	922.26	4.26	2.34	1.92
34.00	2.00	34.311	922.25	3.87	2.33	1.53
35.00	2.00	34.171	922.24	3.55	2.33	1.22
36.00	2.00	34.049	922.24	3.40	2.32	1.08
37.00	2.00	33.939	922.23	3.26	2.31	0.95
38.00	2.00	33.840	922.23	3.14	2.31	0.83
39.00	2.00	33.751	922.23	3.03	2.30	0.72
40.00	2.00	33.671	922.22	2.93	2.30	0.63
41.00	2.00	33.598	922.22	2.83	2.30	0.54
42.00	2.00	33.532	922.22	2.75	2.29	0.46
43.00	2.00	33.473	922.21	2.68	2.29	0.39
44.00	2.00	33.420	922.21	2.61	2.29	0.33
45.00	2.00	33.372	922.21	2.55	2.28	0.27
46.00	2.00	33.329	922.21	2.50	2.28	0.22
47.00	2.00	33.289	922.21	2.45	2.28	0.17
48.00	2.00	33.254	922.20	2.41	2.28	0.13

Stage-Discharge for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
919.00	0.00	0.00	0.00
919.05	0.00	0.00	0.00
919.10	0.00	0.00	0.00
919.15	0.00	0.00	0.00
919.20	0.00	0.00	0.00
919.25	0.00	0.00	0.00
919.30	0.00	0.00	0.00
919.35	0.00	0.00	0.00
919.40	0.00	0.00	0.00
919.45	0.00	0.00	0.00
919.50	0.00	0.00	0.00
919.55	0.00	0.00	0.00
919.60	0.00	0.00	0.00
919.65	0.00	0.00	0.00
919.70	0.00	0.00	0.00
919.75	0.00	0.00	0.00
919.80	0.00	0.00	0.00
919.85	0.00	0.00	0.00
919.90	0.00	0.00	0.00
919.95	0.00	0.00	0.00
920.00	0.00	0.00	0.00
920.05	0.00	0.00	0.00
920.10	0.00	0.00	0.00
920.15	0.00	0.00	0.00
920.20	0.00	0.00	0.00
920.25	0.00	0.00	0.00
920.30	0.00	0.00	0.00
920.35	0.00	0.00	0.00
920.40	0.00	0.00	0.00
920.45	0.00	0.00	0.00
920.50	0.00	0.00	0.00
920.55	0.00	0.00	0.00
920.60	0.00	0.00	0.00
920.65	0.00	0.00	0.00
920.70	0.00	0.00	0.00
920.75	0.00	0.00	0.00
920.80	0.00	0.00	0.00
920.85	0.00	0.00	0.00
920.90	0.00	0.00	0.00
920.95	0.00	0.00	0.00
921.00	0.00	0.00	0.00
921.05	0.00	0.00	0.00
921.10	0.00	0.00	0.00
921.15	0.00	0.00	0.00
921.20	0.00	0.00	0.00
921.25	0.00	0.00	0.00
921.30	0.00	0.00	0.00
921.35	0.00	0.00	0.00
921.40	0.00	0.00	0.00
921.45	0.00	0.00	0.00
921.50	0.00	0.00	0.00
921.55	0.00	0.00	0.00
921.60	0.00	0.00	0.00
921.65	0.00	0.00	0.00
921.70	0.00	0.00	0.00
921.75	0.00	0.00	0.00
921.80	0.00	0.00	0.00
921.85	0.00	0.00	0.00
921.90	0.00	0.00	0.00
921.95	0.17	0.17	0.00
922.00	0.49	0.49	0.00
922.05	0.90	0.90	0.00
922.10	1.38	1.38	0.00
922.15	1.93	1.93	0.00
922.20	2.27	2.27	0.00
922.25	3.78	2.33	1.45
922.30	6.52	2.39	4.13
922.35	10.09	2.45	7.64
922.40	14.36	2.50	11.86
922.45	19.34	2.55	16.79
922.50	24.95	2.61	22.34
922.55	31.17	2.66	28.51
922.60	37.97	2.71	35.26
922.65	45.47	2.76	42.72
922.70	53.59	2.81	50.78
922.75	62.32	2.86	59.47
922.80	71.67	2.90	68.77
922.85	80.84	2.95	77.89
922.90	90.43	3.00	87.43
922.95	100.43	3.04	97.39
923.00	110.84	3.08	107.75
923.05	121.86	3.13	118.74
923.10	133.33	3.17	130.15
923.15	145.22	3.21	142.00
923.20	157.54	3.26	154.28
923.25	170.59	3.30	167.30
923.30	184.12	3.34	180.79
923.35	198.13	3.38	194.75
923.40	212.60	3.42	209.18
923.45	227.14	3.46	223.68
923.50	242.09	3.50	238.59
923.55	257.45	3.54	253.92
923.60	273.24	3.57	269.67
923.65	289.17	3.61	285.56
923.70	305.49	3.65	301.84
923.75	322.19	3.69	318.50
923.80	339.26	3.72	335.54
923.85	357.39	3.76	353.63
923.90	375.96	3.80	372.16
923.95	394.98	3.83	391.15
924.00	414.45	3.87	410.58
924.05	434.37	3.90	430.46
924.10	454.73	3.94	450.80
924.15	475.56	3.97	471.58
924.20	496.83	4.01	492.83
924.25	518.56	4.04	514.52
924.30	540.74	4.07	536.67
924.35	563.39	4.11	559.28
924.40	586.49	4.14	582.35
924.45	610.05	4.17	605.88
924.50	**634.08**	**4.20**	**629.87**

Stage-Area-Storage for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Surface (acres)	Storage (acre-feet)
919.00	0.034	0.000
919.05	0.403	0.011
919.10	0.773	0.040
919.15	1.142	0.088
919.20	1.511	0.155
919.25	1.880	0.239
919.30	2.250	0.343
919.35	2.619	0.464
919.40	2.988	0.604
919.45	3.358	0.763
919.50	3.727	0.940
919.55	4.096	1.136
919.60	4.466	1.350
919.65	4.835	1.582
919.70	5.204	1.833
919.75	5.573	2.103
919.80	5.943	2.391
919.85	6.312	2.697
919.90	6.681	3.022
919.95	7.051	3.365
920.00	7.420	3.727
920.05	7.561	4.102
920.10	7.701	4.483
920.15	7.842	4.872
920.20	7.982	5.267
920.25	8.123	5.670
920.30	8.264	6.080
920.35	8.404	6.496
920.40	8.545	6.920
920.45	8.685	7.351
920.50	8.826	7.788
920.55	8.967	8.233
920.60	9.107	8.685
920.65	9.248	9.144
920.70	9.388	9.610
920.75	9.529	10.083
920.80	9.670	10.563
920.85	9.810	11.050
920.90	9.951	11.544
920.95	10.091	12.045
921.00	10.232	12.553
921.05	10.820	13.079
921.10	11.408	13.635
921.15	11.996	14.220
921.20	12.584	14.835
921.25	13.172	15.479
921.30	13.760	16.152
921.35	14.348	16.855
921.40	14.936	17.587
921.45	15.524	18.348
921.50	16.112	19.139
921.55	16.701	19.959
921.60	17.289	20.809
921.65	17.877	21.688
921.70	18.465	22.597
921.75	19.053	23.535
921.80	19.641	24.502
921.85	20.229	25.499
921.90	20.817	26.525
921.95	21.405	27.581
922.00	21.993	28.665
922.05	22.203	29.770
922.10	22.413	30.886
922.15	22.624	32.012
922.20	22.834	33.148
922.25	23.044	34.295
922.30	23.254	35.453
922.35	23.464	36.621
922.40	23.675	37.799
922.45	23.885	38.988
922.50	24.095	40.187
922.55	24.305	41.398
922.60	24.515	42.618
922.65	24.726	43.849
922.70	24.936	45.091
922.75	25.146	46.343
922.80	25.356	47.605
922.85	25.566	48.878
922.90	25.777	50.162
922.95	25.987	51.456
923.00	26.197	52.760
923.05	26.276	54.072
923.10	26.356	55.388
923.15	26.435	56.708
923.20	26.514	58.032
923.25	26.594	59.359
923.30	26.673	60.691
923.35	26.752	62.027
923.40	26.831	63.366
923.45	26.911	64.710
923.50	26.990	66.057
923.55	27.069	67.409
923.60	27.149	68.764
923.65	27.228	70.124
923.70	27.307	71.487
923.75	27.386	72.854
923.80	27.466	74.226
923.85	27.545	75.601
923.90	27.624	76.980
923.95	27.704	78.363
924.00	**27.783**	79.750
924.05	27.783	81.140
924.10	27.783	82.529
924.15	27.783	83.918
924.20	27.783	85.307
924.25	27.783	86.696
924.30	27.783	88.085
924.35	27.783	89.475
924.40	27.783	90.864
924.45	27.783	92.253
924.50	27.783	**93.642**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Wetland Direct Runoff Area=38.900 ac 56.56% Impervious Runoff Depth=3.30"
Flow Length=1,665' Slope=0.1300 '/' Tc=11.9 min CN=89 Runoff=177.08 cfs 10.682 af

Subcatchment 3S: Northwest Runoff Area=193.300 ac 0.00% Impervious Runoff Depth=2.82"
Flow Length=20,555' Slope=0.0378 '/' Tc=161.1 min CN=84 Runoff=155.32 cfs 45.370 af

Subcatchment 4S: Northeast Watershed Runoff Area=75.500 ac 0.00% Impervious Runoff Depth=2.82"
Flow Length=17,536' Slope=0.0378 '/' Tc=141.8 min CN=84 Runoff=66.58 cfs 17.721 af

Pond 2P: Dotson Wetland & Outlets Peak Elev=923.17' Storage=57.328 af Inflow=228.47 cfs 81.715 af
Primary=3.23 cfs 7.689 af Secondary=147.74 cfs 67.283 af Outflow=150.97 cfs 74.972 af

Total Runoff Area = 307.700 ac Runoff Volume = 73.773 af Average Runoff Depth = 2.88"
92.85% Pervious = 285.700 ac 7.15% Impervious = 22.000 ac

Summary for Subcatchment 1S: Wetland Direct Watershed

This watershed area is the wetland (water) area itself, and the hillside that drains surface water directly to the wetland.

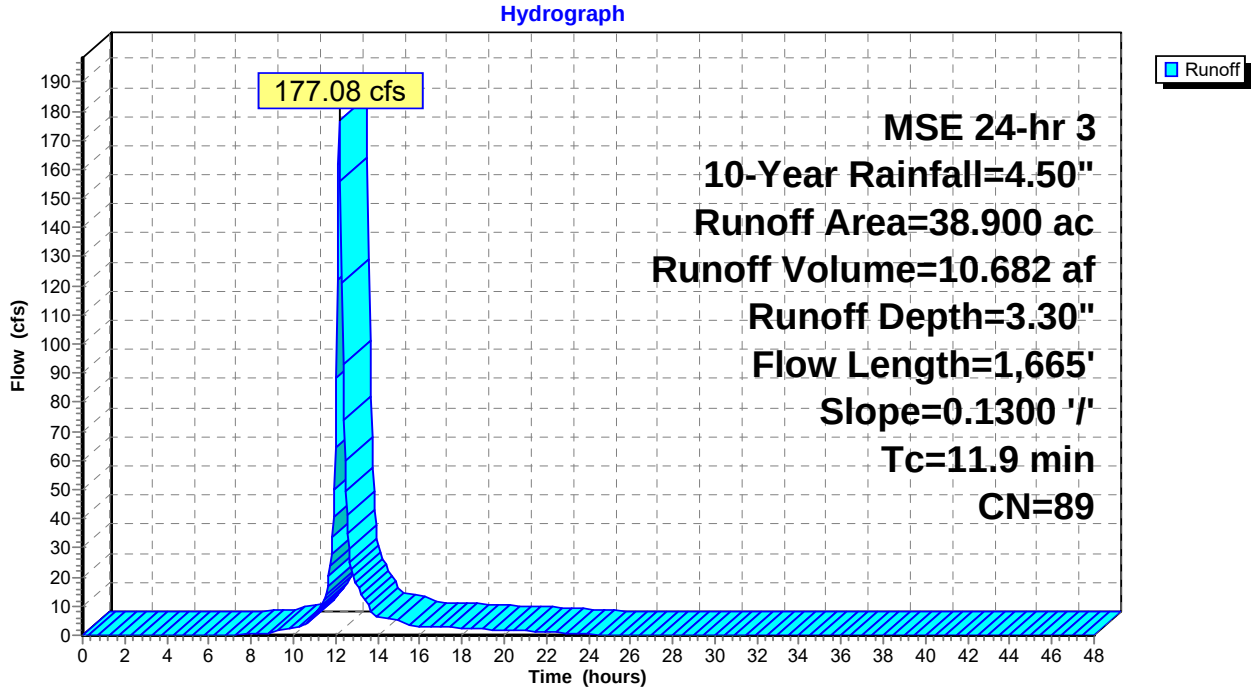
Runoff = 177.08 cfs @ 12.20 hrs, Volume= 10.682 af, Depth= 3.30"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.50"

Area (ac)	CN	Description
16.900	78	Meadow, non-grazed, HSG D
22.000	98	Water Surface, HSG A
38.900	89	Weighted Average
16.900		43.44% Pervious Area
22.000		56.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	300	0.1300	0.67		**Sheet Flow, Hillside Initial Sheet Flow** Grass: Short n= 0.150 P2= 7.11"
1.2	175	0.1300	2.52		**Shallow Concentrated Flow, Hillside Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.2	1,190		6.16		**Lake or Reservoir, Wetland** Mean Depth= 1.18'
11.9	1,665	Total			

Subcatchment 1S: Wetland Direct Watershed



Hydrograph for Subcatchment 1S: Wetland Direct Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.03	0.00	0.00
2.00	0.04	0.00	0.00
2.50	0.06	0.00	0.00
3.00	0.07	0.00	0.00
3.50	0.09	0.00	0.00
4.00	0.12	0.00	0.00
4.50	0.14	0.00	0.00
5.00	0.17	0.00	0.00
5.50	0.20	0.00	0.00
6.00	0.23	0.00	0.00
6.50	0.26	0.00	0.02
7.00	0.30	0.00	0.17
7.50	0.34	0.01	0.33
8.00	0.38	0.01	0.52
8.50	0.42	0.02	0.71
9.00	0.46	0.03	0.91
9.50	0.54	0.06	1.89
10.00	0.62	0.09	2.44
10.50	0.70	0.12	3.00
11.00	0.87	0.21	7.17
11.50	1.12	0.36	12.65
12.00	2.08	1.10	**64.81**
12.50	3.38	2.25	**49.41**
13.00	3.63	2.48	17.32
13.50	3.80	2.63	11.13
14.00	3.88	2.71	6.22
14.50	3.96	2.79	5.82
15.00	4.04	2.86	5.46
15.50	4.08	2.90	3.28
16.00	4.12	2.94	3.11
16.50	4.16	2.98	2.95
17.00	4.20	3.01	2.79
17.50	4.24	3.05	2.63
18.00	4.27	3.08	2.46
18.50	4.30	3.11	2.30
19.00	4.33	3.14	2.14
19.50	4.36	3.16	1.98
20.00	4.38	3.18	1.81
20.50	4.41	3.21	1.65
21.00	4.43	3.22	1.48
21.50	4.44	3.24	1.32
22.00	4.46	3.26	1.15
22.50	4.47	3.27	0.99
23.00	4.48	3.28	0.82
23.50	4.49	3.29	0.66
24.00	**4.50**	**3.30**	0.49
24.50	4.50	3.30	0.00
25.00	4.50	3.30	0.00
25.50	4.50	3.30	0.00
26.00	4.50	3.30	0.00
26.50	4.50	3.30	0.00
27.00	4.50	3.30	0.00
27.50	4.50	3.30	0.00
28.00	4.50	3.30	0.00
28.50	4.50	3.30	0.00
29.00	4.50	3.30	0.00
29.50	4.50	3.30	0.00
30.00	4.50	3.30	0.00
30.50	4.50	3.30	0.00
31.00	4.50	3.30	0.00
31.50	4.50	3.30	0.00
32.00	4.50	3.30	0.00
32.50	4.50	3.30	0.00
33.00	4.50	3.30	0.00
33.50	4.50	3.30	0.00
34.00	4.50	3.30	0.00
34.50	4.50	3.30	0.00
35.00	4.50	3.30	0.00
35.50	4.50	3.30	0.00
36.00	4.50	3.30	0.00
36.50	4.50	3.30	0.00
37.00	4.50	3.30	0.00
37.50	4.50	3.30	0.00
38.00	4.50	3.30	0.00
38.50	4.50	3.30	0.00
39.00	4.50	3.30	0.00
39.50	4.50	3.30	0.00
40.00	4.50	3.30	0.00
40.50	4.50	3.30	0.00
41.00	4.50	3.30	0.00
41.50	4.50	3.30	0.00
42.00	4.50	3.30	0.00
42.50	4.50	3.30	0.00
43.00	4.50	3.30	0.00
43.50	4.50	3.30	0.00
44.00	4.50	3.30	0.00
44.50	4.50	3.30	0.00
45.00	4.50	3.30	0.00
45.50	4.50	3.30	0.00
46.00	4.50	3.30	0.00
46.50	4.50	3.30	0.00
47.00	4.50	3.30	0.00
47.50	4.50	3.30	0.00
48.00	4.50	3.30	0.00

Summary for Subcatchment 3S: Northwest Watershed

This watershed area was computed as 10% of the total watershed area routing through the West Ditch (1,932.8 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the West ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

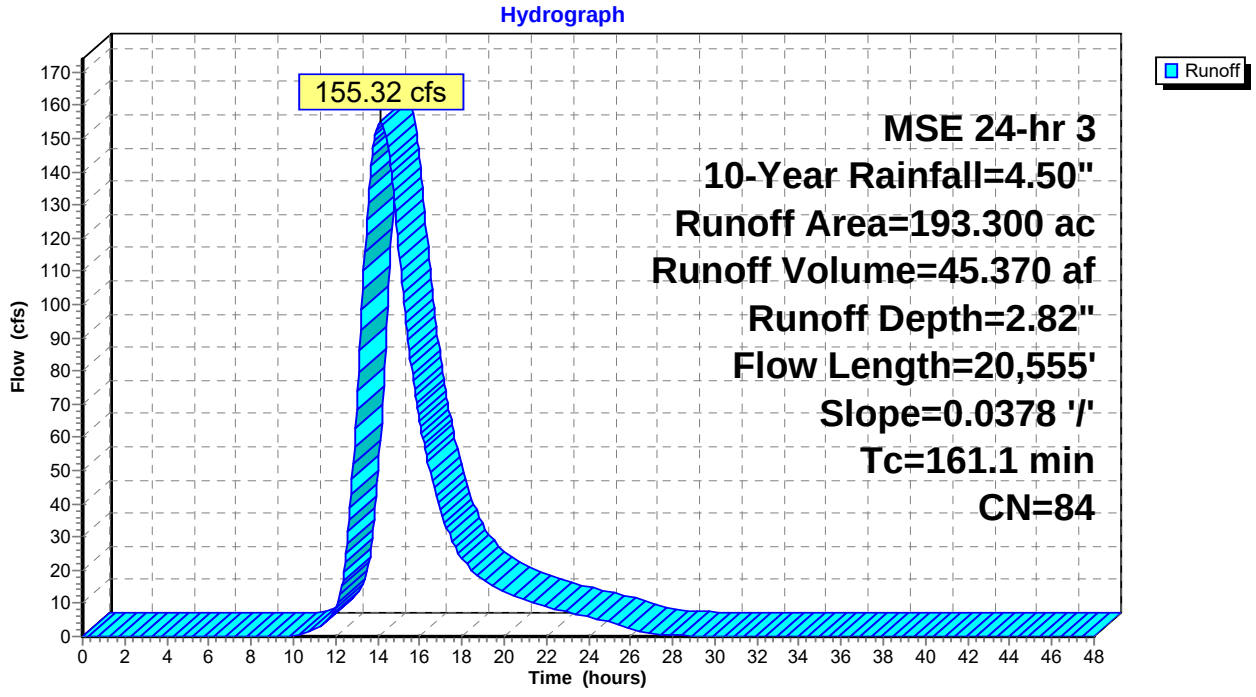
Runoff = 155.32 cfs @ 14.14 hrs, Volume= 45.370 af, Depth= 2.82"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.50"

	Area (ac)	CN	Description
*	193.300	84	Weighted Average of Hydrologic Soil Groups
	193.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
161.1	20,555	0.0378	2.13		**Lag/CN Method,**

Subcatchment 3S: Northwest Watershed



Hydrograph for Subcatchment 3S: Northwest Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.03	0.00	0.00
2.00	0.04	0.00	0.00
2.50	0.06	0.00	0.00
3.00	0.07	0.00	0.00
3.50	0.09	0.00	0.00
4.00	0.12	0.00	0.00
4.50	0.14	0.00	0.00
5.00	0.17	0.00	0.00
5.50	0.20	0.00	0.00
6.00	0.23	0.00	0.00
6.50	0.26	0.00	0.00
7.00	0.30	0.00	0.00
7.50	0.34	0.00	0.00
8.00	0.38	0.00	0.00
8.50	0.42	0.00	0.00
9.00	0.46	0.00	0.01
9.50	0.54	0.01	0.09
10.00	0.62	0.03	0.37
10.50	0.70	0.05	1.00
11.00	0.87	0.10	2.12
11.50	1.12	0.20	4.10
12.00	2.08	0.80	8.38
12.50	3.38	1.84	25.00
13.00	3.63	2.05	68.14
13.50	3.80	2.19	125.73
14.00	3.88	2.27	**153.44**
14.50	3.96	2.34	**146.66**
15.00	4.04	2.40	117.19
15.50	4.08	2.44	86.45
16.00	4.12	2.48	64.94
16.50	4.16	2.52	49.04
17.00	4.20	2.55	37.68
17.50	4.24	2.58	29.39
18.00	4.27	2.61	23.66
18.50	4.30	2.64	19.78
19.00	4.33	2.67	16.99
19.50	4.36	2.69	14.98
20.00	4.38	2.71	13.43
20.50	4.41	2.73	12.10
21.00	4.43	2.75	10.87
21.50	4.44	2.77	9.87
22.00	4.46	2.78	9.04
22.50	4.47	2.79	8.23
23.00	4.48	2.80	7.45
23.50	4.49	2.81	6.67
24.00	**4.50**	**2.82**	5.89
24.50	4.50	2.82	5.12
25.00	4.50	2.82	4.26
25.50	4.50	2.82	3.30
26.00	4.50	2.82	2.34
26.50	4.50	2.82	1.53
27.00	4.50	2.82	0.96
27.50	4.50	2.82	0.60
28.00	4.50	2.82	0.38
28.50	4.50	2.82	0.24
29.00	4.50	2.82	0.15
29.50	4.50	2.82	0.09
30.00	4.50	2.82	0.05
30.50	4.50	2.82	0.03
31.00	4.50	2.82	0.02
31.50	4.50	2.82	0.01
32.00	4.50	2.82	0.00
32.50	4.50	2.82	0.00
33.00	4.50	2.82	0.00
33.50	4.50	2.82	0.00
34.00	4.50	2.82	0.00
34.50	4.50	2.82	0.00
35.00	4.50	2.82	0.00
35.50	4.50	2.82	0.00
36.00	4.50	2.82	0.00
36.50	4.50	2.82	0.00
37.00	4.50	2.82	0.00
37.50	4.50	2.82	0.00
38.00	4.50	2.82	0.00
38.50	4.50	2.82	0.00
39.00	4.50	2.82	0.00
39.50	4.50	2.82	0.00
40.00	4.50	2.82	0.00
40.50	4.50	2.82	0.00
41.00	4.50	2.82	0.00
41.50	4.50	2.82	0.00
42.00	4.50	2.82	0.00
42.50	4.50	2.82	0.00
43.00	4.50	2.82	0.00
43.50	4.50	2.82	0.00
44.00	4.50	2.82	0.00
44.50	4.50	2.82	0.00
45.00	4.50	2.82	0.00
45.50	4.50	2.82	0.00
46.00	4.50	2.82	0.00
46.50	4.50	2.82	0.00
47.00	4.50	2.82	0.00
47.50	4.50	2.82	0.00
48.00	4.50	2.82	0.00

Summary for Subcatchment 4S: Northeast Watershed

This watershed area was computed as 10% of the total watershed area routing through the East Ditch (755.2 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the East ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

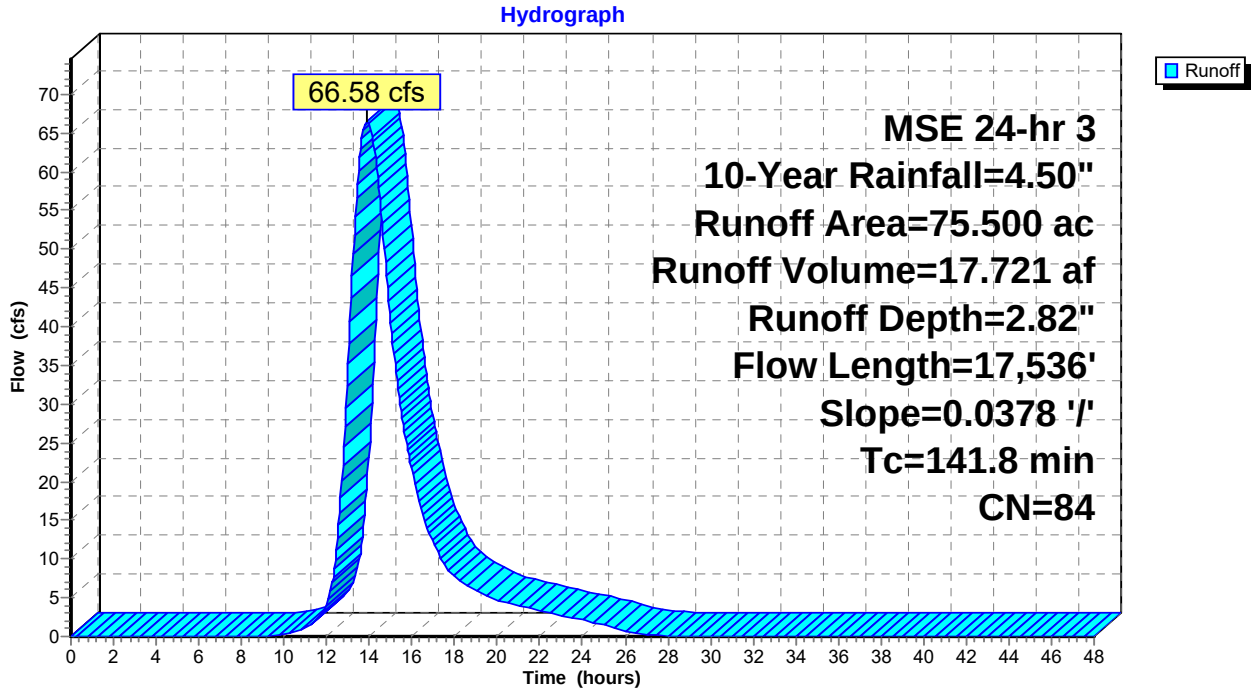
Runoff = 66.58 cfs @ 13.91 hrs, Volume= 17.721 af, Depth= 2.82"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.50"

	Area (ac)	CN	Description
*	75.500	84	Weighted Average of Hydrologic Soil Groups
	75.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
141.8	17,536	0.0378	2.06		**Lag/CN Method,**

Subcatchment 4S: Northeast Watershed



Hydrograph for Subcatchment 4S: Northeast Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.03	0.00	0.00
2.00	0.04	0.00	0.00
2.50	0.06	0.00	0.00
3.00	0.07	0.00	0.00
3.50	0.09	0.00	0.00
4.00	0.12	0.00	0.00
4.50	0.14	0.00	0.00
5.00	0.17	0.00	0.00
5.50	0.20	0.00	0.00
6.00	0.23	0.00	0.00
6.50	0.26	0.00	0.00
7.00	0.30	0.00	0.00
7.50	0.34	0.00	0.00
8.00	0.38	0.00	0.00
8.50	0.42	0.00	0.00
9.00	0.46	0.00	0.01
9.50	0.54	0.01	0.06
10.00	0.62	0.03	0.21
10.50	0.70	0.05	0.53
11.00	0.87	0.10	1.07
11.50	1.12	0.20	2.03
12.00	2.08	0.80	4.23
12.50	3.38	1.84	12.71
13.00	3.63	2.05	35.11
13.50	3.80	2.19	**60.17**
14.00	3.88	2.27	**66.52**
14.50	3.96	2.34	56.47
15.00	4.04	2.40	40.40
15.50	4.08	2.44	29.03
16.00	4.12	2.48	21.26
16.50	4.16	2.52	15.88
17.00	4.20	2.55	12.03
17.50	4.24	2.58	9.46
18.00	4.27	2.61	7.76
18.50	4.30	2.64	6.64
19.00	4.33	2.67	5.85
19.50	4.36	2.69	5.23
20.00	4.38	2.71	4.70
20.50	4.41	2.73	4.28
21.00	4.43	2.75	3.95
21.50	4.44	2.77	3.64
22.00	4.46	2.78	3.33
22.50	4.47	2.79	3.03
23.00	4.48	2.80	2.72
23.50	4.49	2.81	2.42
24.00	**4.50**	**2.82**	2.12
24.50	4.50	2.82	1.81
25.00	4.50	2.82	1.47
25.50	4.50	2.82	1.06
26.00	4.50	2.82	0.69
26.50	4.50	2.82	0.41
27.00	4.50	2.82	0.24
27.50	4.50	2.82	0.14
28.00	4.50	2.82	0.08
28.50	4.50	2.82	0.05
29.00	4.50	2.82	0.03
29.50	4.50	2.82	0.02
30.00	4.50	2.82	0.01
30.50	4.50	2.82	0.00
31.00	4.50	2.82	0.00
31.50	4.50	2.82	0.00
32.00	4.50	2.82	0.00
32.50	4.50	2.82	0.00
33.00	4.50	2.82	0.00
33.50	4.50	2.82	0.00
34.00	4.50	2.82	0.00
34.50	4.50	2.82	0.00
35.00	4.50	2.82	0.00
35.50	4.50	2.82	0.00
36.00	4.50	2.82	0.00
36.50	4.50	2.82	0.00
37.00	4.50	2.82	0.00
37.50	4.50	2.82	0.00
38.00	4.50	2.82	0.00
38.50	4.50	2.82	0.00
39.00	4.50	2.82	0.00
39.50	4.50	2.82	0.00
40.00	4.50	2.82	0.00
40.50	4.50	2.82	0.00
41.00	4.50	2.82	0.00
41.50	4.50	2.82	0.00
42.00	4.50	2.82	0.00
42.50	4.50	2.82	0.00
43.00	4.50	2.82	0.00
43.50	4.50	2.82	0.00
44.00	4.50	2.82	0.00
44.50	4.50	2.82	0.00
45.00	4.50	2.82	0.00
45.50	4.50	2.82	0.00
46.00	4.50	2.82	0.00
46.50	4.50	2.82	0.00
47.00	4.50	2.82	0.00
47.50	4.50	2.82	0.00
48.00	4.50	2.82	0.00

Summary for Pond 2P: Dotson Wetland & Outlets

Inflow Area = 307.700 ac, 7.15% Impervious, Inflow Depth > 3.19" for 10-Year event
Inflow = 228.47 cfs @ 14.07 hrs, Volume= 81.715 af, Incl. 2.00 cfs Base Flow
Outflow = 150.97 cfs @ 15.14 hrs, Volume= 74.972 af, Atten= 34%, Lag= 64.3 min
Primary = 3.23 cfs @ 15.14 hrs, Volume= 7.689 af
Secondary = 147.74 cfs @ 15.14 hrs, Volume= 67.283 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 921.90' Surf.Area= 20.817 ac Storage= 26.525 af
Peak Elev= 923.17' @ 15.14 hrs Surf.Area= 26.472 ac Storage= 57.328 af (30.803 af above start)

Plug-Flow detention time= 496.2 min calculated for 48.442 af (59% of inflow)
Center-of-Mass det. time= 181.1 min (1,144.7 - 963.6)

Volume	Invert	Avail.Storage	Storage Description
#1	919.00'	93.642 af	**Storage to Top of Berm (Prismatic)** Listed below (Recalc)

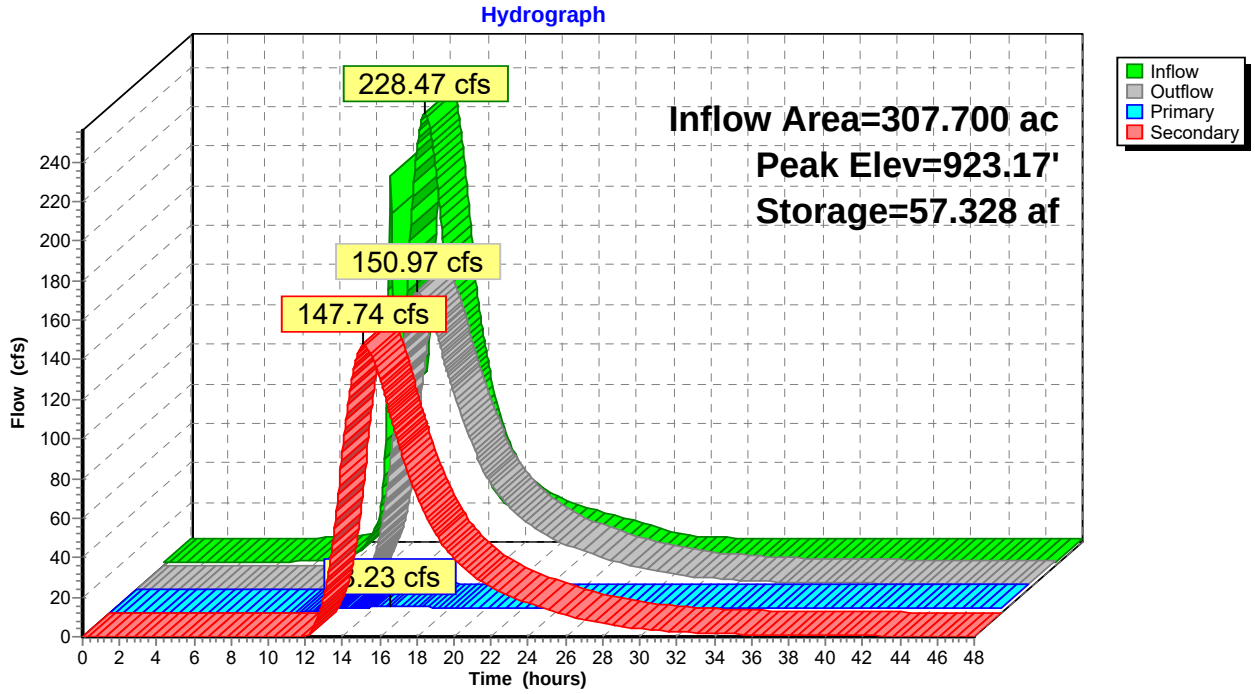
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
919.00	0.034	0.000	0.000
920.00	7.420	3.727	3.727
921.00	10.232	8.826	12.553
922.00	21.993	16.112	28.665
923.00	26.197	24.095	52.760
924.00	27.783	26.990	79.750
924.50	27.783	13.891	93.642

Device	Routing	Invert	Outlet Devices
#1	Device 2	921.90'	**18.0" Horiz. 18" Riser Inlet** C= 0.600 Limited to weir flow at low heads
#2	Primary	920.25'	**12.0" Round CMP_Round 12"** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 920.25' / 920.25' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#3	Secondary	922.20'	**50.0' long + 10.0 '/' SideZ x 12.0' breadth 50' Rock Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

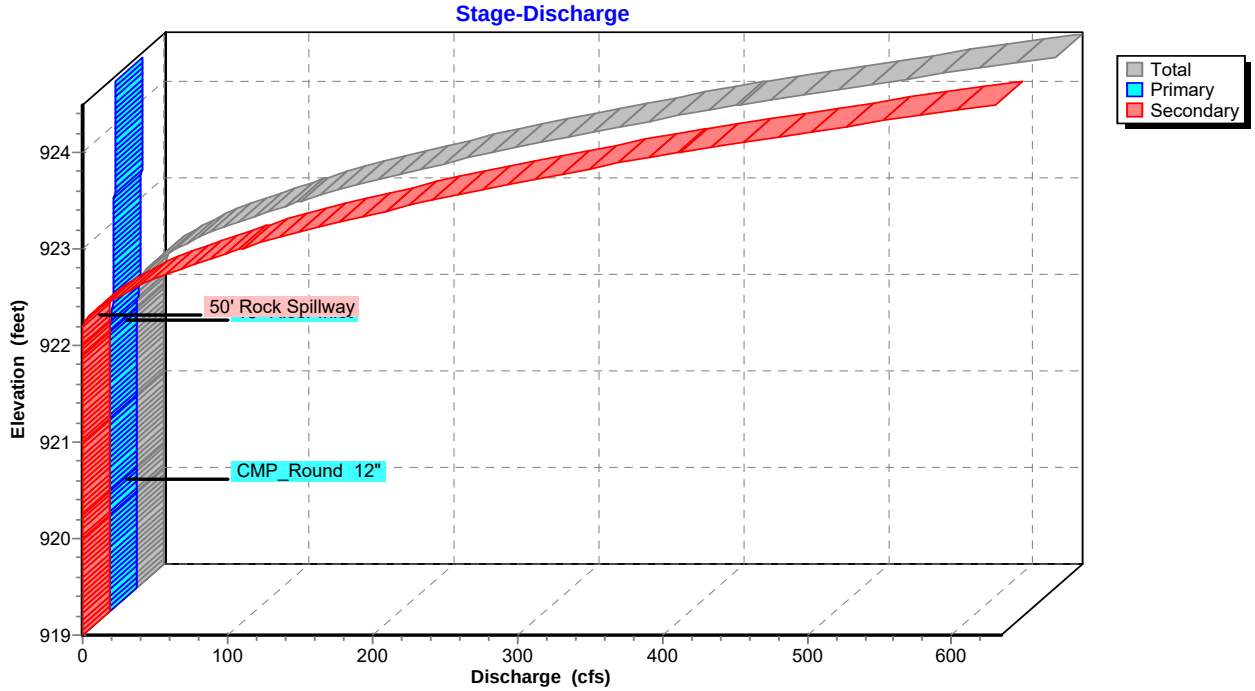
Primary OutFlow Max=3.23 cfs @ 15.14 hrs HW=923.17' (Free Discharge)
└**2=CMP_Round 12"** (Barrel Controls 3.23 cfs @ 4.12 fps)
└**1=18" Riser Inlet** (Passes 3.23 cfs of 9.60 cfs potential flow)

Secondary OutFlow Max=147.69 cfs @ 15.14 hrs HW=923.17' (Free Discharge)
└**3=50' Rock Spillway** (Weir Controls 147.69 cfs @ 2.54 fps)

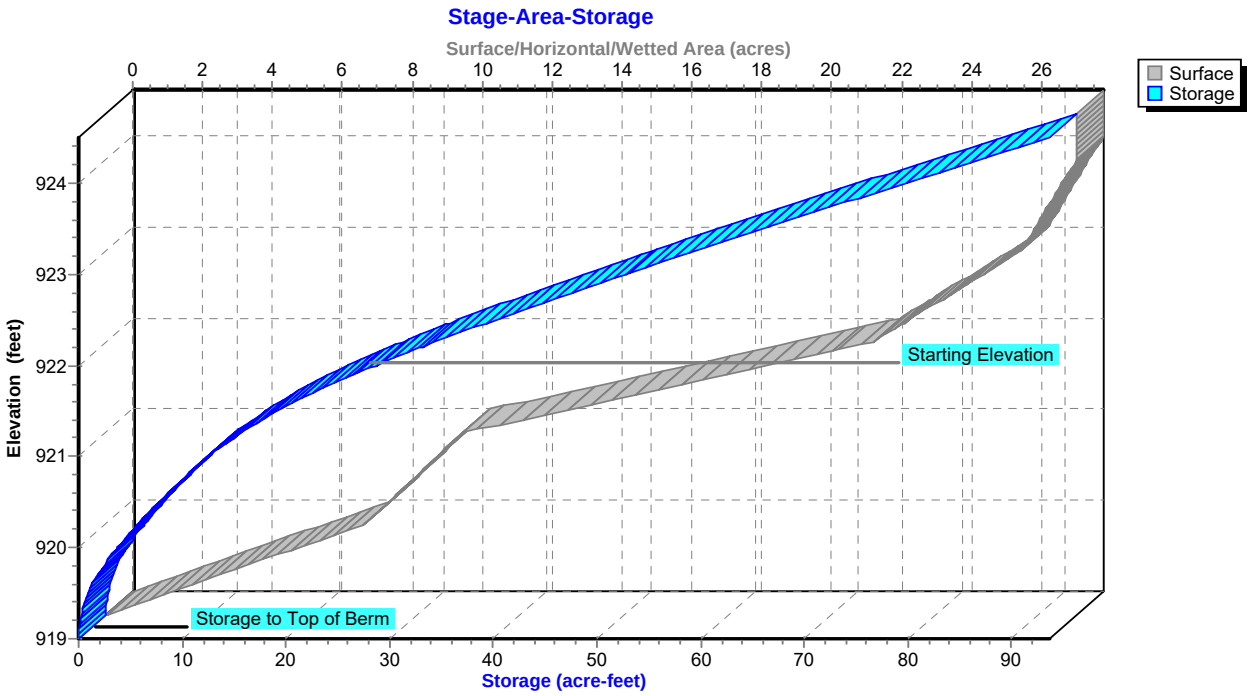
Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Hydrograph for Pond 2P: Dotson Wetland & Outlets

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	2.00	26.529	921.90	0.00	0.00	0.00
1.00	2.00	26.694	921.91	0.02	0.02	0.00
2.00	2.00	26.857	921.92	0.03	0.03	0.00
3.00	2.00	27.018	921.92	0.07	0.07	0.00
4.00	2.00	27.177	921.93	0.10	0.10	0.00
5.00	2.00	27.332	921.94	0.14	0.14	0.00
6.00	2.00	27.485	921.95	0.17	0.17	0.00
7.00	2.17	27.638	921.95	0.20	0.20	0.00
8.00	2.52	27.813	921.96	0.24	0.24	0.00
9.00	2.94	28.016	921.97	0.29	0.29	0.00
10.00	5.01	28.320	921.98	0.38	0.38	0.00
11.00	12.35	28.896	922.01	0.57	0.57	0.00
12.00	79.41	31.105	922.11	1.49	1.49	0.00
13.00	122.57	39.794	922.48	23.13	2.59	20.54
14.00	**228.17**	50.928	922.93	96.35	3.02	93.33
15.00	**165.05**	**57.243**	**923.17**	**150.19**	**3.23**	**146.96**
16.00	91.31	**55.419**	**923.10**	**133.66**	**3.17**	**130.49**
17.00	54.50	51.576	922.95	101.39	3.04	98.35
18.00	35.87	48.002	922.82	74.49	2.92	71.58
19.00	26.98	45.268	922.71	54.87	2.81	52.06
20.00	21.94	43.304	922.63	42.10	2.74	39.36
21.00	18.31	41.851	922.57	33.66	2.68	30.99
22.00	15.52	40.721	922.52	27.63	2.63	25.00
23.00	12.99	39.805	922.48	23.18	2.59	20.59
24.00	10.50	39.018	922.45	19.54	2.56	16.99
25.00	7.73	38.279	922.42	16.35	2.52	13.83
26.00	5.03	37.572	922.39	13.58	2.49	11.09
27.00	3.20	36.887	922.36	11.04	2.46	8.58
28.00	2.46	36.289	922.34	9.10	2.43	6.67
29.00	2.17	35.792	922.31	7.57	2.41	5.16
30.00	2.06	35.394	922.30	6.38	2.39	3.99
31.00	2.02	35.067	922.28	5.62	2.37	3.25
32.00	2.00	34.795	922.27	4.99	2.36	2.63
33.00	2.00	34.571	922.26	4.47	2.35	2.12
34.00	2.00	34.385	922.25	4.04	2.34	1.70
35.00	2.00	34.232	922.25	3.68	2.33	1.35
36.00	2.00	34.103	922.24	3.47	2.32	1.14
37.00	2.00	33.988	922.24	3.32	2.32	1.01
38.00	2.00	33.884	922.23	3.19	2.31	0.88
39.00	2.00	33.791	922.23	3.08	2.31	0.77
40.00	2.00	33.706	922.22	2.97	2.30	0.67
41.00	2.00	33.630	922.22	2.87	2.30	0.58
42.00	2.00	33.561	922.22	2.79	2.29	0.49
43.00	2.00	33.499	922.22	2.71	2.29	0.42
44.00	2.00	33.444	922.21	2.64	2.29	0.35
45.00	2.00	33.393	922.21	2.58	2.29	0.29
46.00	2.00	33.348	922.21	2.52	2.28	0.24
47.00	2.00	33.307	922.21	2.47	2.28	0.19
48.00	2.00	33.270	922.21	2.42	2.28	0.15

Stage-Discharge for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
919.00	0.00	0.00	0.00
919.05	0.00	0.00	0.00
919.10	0.00	0.00	0.00
919.15	0.00	0.00	0.00
919.20	0.00	0.00	0.00
919.25	0.00	0.00	0.00
919.30	0.00	0.00	0.00
919.35	0.00	0.00	0.00
919.40	0.00	0.00	0.00
919.45	0.00	0.00	0.00
919.50	0.00	0.00	0.00
919.55	0.00	0.00	0.00
919.60	0.00	0.00	0.00
919.65	0.00	0.00	0.00
919.70	0.00	0.00	0.00
919.75	0.00	0.00	0.00
919.80	0.00	0.00	0.00
919.85	0.00	0.00	0.00
919.90	0.00	0.00	0.00
919.95	0.00	0.00	0.00
920.00	0.00	0.00	0.00
920.05	0.00	0.00	0.00
920.10	0.00	0.00	0.00
920.15	0.00	0.00	0.00
920.20	0.00	0.00	0.00
920.25	0.00	0.00	0.00
920.30	0.00	0.00	0.00
920.35	0.00	0.00	0.00
920.40	0.00	0.00	0.00
920.45	0.00	0.00	0.00
920.50	0.00	0.00	0.00
920.55	0.00	0.00	0.00
920.60	0.00	0.00	0.00
920.65	0.00	0.00	0.00
920.70	0.00	0.00	0.00
920.75	0.00	0.00	0.00
920.80	0.00	0.00	0.00
920.85	0.00	0.00	0.00
920.90	0.00	0.00	0.00
920.95	0.00	0.00	0.00
921.00	0.00	0.00	0.00
921.05	0.00	0.00	0.00
921.10	0.00	0.00	0.00
921.15	0.00	0.00	0.00
921.20	0.00	0.00	0.00
921.25	0.00	0.00	0.00
921.30	0.00	0.00	0.00
921.35	0.00	0.00	0.00
921.40	0.00	0.00	0.00
921.45	0.00	0.00	0.00
921.50	0.00	0.00	0.00
921.55	0.00	0.00	0.00
921.60	0.00	0.00	0.00
921.65	0.00	0.00	0.00
921.70	0.00	0.00	0.00
921.75	0.00	0.00	0.00
921.80	0.00	0.00	0.00
921.85	0.00	0.00	0.00
921.90	0.00	0.00	0.00
921.95	0.17	0.17	0.00
922.00	0.49	0.49	0.00
922.05	0.90	0.90	0.00
922.10	1.38	1.38	0.00
922.15	1.93	1.93	0.00
922.20	2.27	2.27	0.00
922.25	3.78	2.33	1.45
922.30	6.52	2.39	4.13
922.35	10.09	2.45	7.64
922.40	14.36	2.50	11.86
922.45	19.34	2.55	16.79
922.50	24.95	2.61	22.34
922.55	31.17	2.66	28.51
922.60	37.97	2.71	35.26
922.65	45.47	2.76	42.72
922.70	53.59	2.81	50.78
922.75	62.32	2.86	59.47
922.80	71.67	2.90	68.77
922.85	80.84	2.95	77.89
922.90	90.43	3.00	87.43
922.95	100.43	3.04	97.39
923.00	110.84	3.08	107.75
923.05	121.86	3.13	118.74
923.10	133.33	3.17	130.15
923.15	145.22	3.21	142.00
923.20	157.54	3.26	154.28
923.25	170.59	3.30	167.30
923.30	184.12	3.34	180.79
923.35	198.13	3.38	194.75
923.40	212.60	3.42	209.18
923.45	227.14	3.46	223.68
923.50	242.09	3.50	238.59
923.55	257.45	3.54	253.92
923.60	273.24	3.57	269.67
923.65	289.17	3.61	285.56
923.70	305.49	3.65	301.84
923.75	322.19	3.69	318.50
923.80	339.26	3.72	335.54
923.85	357.39	3.76	353.63
923.90	375.96	3.80	372.16
923.95	394.98	3.83	391.15
924.00	414.45	3.87	410.58
924.05	434.37	3.90	430.46
924.10	454.73	3.94	450.80
924.15	475.56	3.97	471.58
924.20	496.83	4.01	492.83
924.25	518.56	4.04	514.52
924.30	540.74	4.07	536.67
924.35	563.39	4.11	559.28
924.40	586.49	4.14	582.35
924.45	610.05	4.17	605.88
924.50	**634.08**	**4.20**	**629.87**

Stage-Area-Storage for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Surface (acres)	Storage (acre-feet)
919.00	0.034	0.000
919.05	0.403	0.011
919.10	0.773	0.040
919.15	1.142	0.088
919.20	1.511	0.155
919.25	1.880	0.239
919.30	2.250	0.343
919.35	2.619	0.464
919.40	2.988	0.604
919.45	3.358	0.763
919.50	3.727	0.940
919.55	4.096	1.136
919.60	4.466	1.350
919.65	4.835	1.582
919.70	5.204	1.833
919.75	5.573	2.103
919.80	5.943	2.391
919.85	6.312	2.697
919.90	6.681	3.022
919.95	7.051	3.365
920.00	7.420	3.727
920.05	7.561	4.102
920.10	7.701	4.483
920.15	7.842	4.872
920.20	7.982	5.267
920.25	8.123	5.670
920.30	8.264	6.080
920.35	8.404	6.496
920.40	8.545	6.920
920.45	8.685	7.351
920.50	8.826	7.788
920.55	8.967	8.233
920.60	9.107	8.685
920.65	9.248	9.144
920.70	9.388	9.610
920.75	9.529	10.083
920.80	9.670	10.563
920.85	9.810	11.050
920.90	9.951	11.544
920.95	10.091	12.045
921.00	10.232	12.553
921.05	10.820	13.079
921.10	11.408	13.635
921.15	11.996	14.220
921.20	12.584	14.835
921.25	13.172	15.479
921.30	13.760	16.152
921.35	14.348	16.855
921.40	14.936	17.587
921.45	15.524	18.348
921.50	16.112	19.139
921.55	16.701	19.959
921.60	17.289	20.809
921.65	17.877	21.688
921.70	18.465	22.597
921.75	19.053	23.535
921.80	19.641	24.502
921.85	20.229	25.499
921.90	20.817	26.525
921.95	21.405	27.581
922.00	21.993	28.665
922.05	22.203	29.770
922.10	22.413	30.886
922.15	22.624	32.012
922.20	22.834	33.148
922.25	23.044	34.295
922.30	23.254	35.453
922.35	23.464	36.621
922.40	23.675	37.799
922.45	23.885	38.988
922.50	24.095	40.187
922.55	24.305	41.398
922.60	24.515	42.618
922.65	24.726	43.849
922.70	24.936	45.091
922.75	25.146	46.343
922.80	25.356	47.605
922.85	25.566	48.878
922.90	25.777	50.162
922.95	25.987	51.456
923.00	26.197	52.760
923.05	26.276	54.072
923.10	26.356	55.388
923.15	26.435	56.708
923.20	26.514	58.032
923.25	26.594	59.359
923.30	26.673	60.691
923.35	26.752	62.027
923.40	26.831	63.366
923.45	26.911	64.710
923.50	26.990	66.057
923.55	27.069	67.409
923.60	27.149	68.764
923.65	27.228	70.124
923.70	27.307	71.487
923.75	27.386	72.854
923.80	27.466	74.226
923.85	27.545	75.601
923.90	27.624	76.980
923.95	27.704	78.363
924.00	**27.783**	79.750
924.05	27.783	81.140
924.10	27.783	82.529
924.15	27.783	83.918
924.20	27.783	85.307
924.25	27.783	86.696
924.30	27.783	88.085
924.35	27.783	89.475
924.40	27.783	90.864
924.45	27.783	92.253
924.50	27.783	**93.642**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Wetland Direct Runoff Area=38.900 ac 56.56% Impervious Runoff Depth=4.18"
Flow Length=1,665' Slope=0.1300 '/' Tc=11.9 min CN=89 Runoff=221.58 cfs 13.535 af

Subcatchment 3S: Northwest Runoff Area=193.300 ac 0.00% Impervious Runoff Depth=3.66"
Flow Length=20,555' Slope=0.0378 '/' Tc=161.1 min CN=84 Runoff=201.75 cfs 58.905 af

Subcatchment 4S: Northeast Watershed Runoff Area=75.500 ac 0.00% Impervious Runoff Depth=3.66"
Flow Length=17,536' Slope=0.0378 '/' Tc=141.8 min CN=84 Runoff=86.42 cfs 23.007 af

Pond 2P: Dotson Wetland & Outlets Peak Elev=923.39' Storage=63.045 af Inflow=295.70 cfs 103.389 af
Primary=3.41 cfs 7.851 af Secondary=205.74 cfs 88.776 af Outflow=209.15 cfs 96.627 af

Total Runoff Area = 307.700 ac Runoff Volume = 95.447 af Average Runoff Depth = 3.72"
92.85% Pervious = 285.700 ac 7.15% Impervious = 22.000 ac

Summary for Subcatchment 1S: Wetland Direct Watershed

This watershed area is the wetland (water) area itself, and the hillside that drains surface water directly to the wetland.

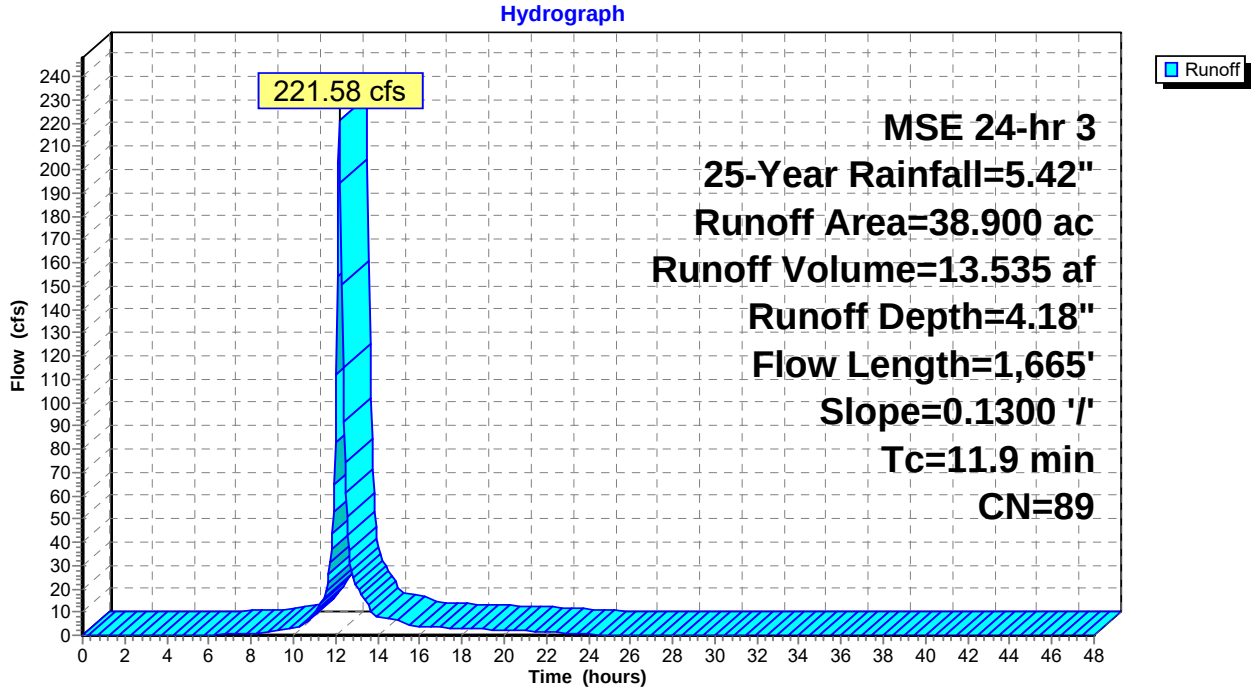
Runoff = 221.58 cfs @ 12.20 hrs, Volume= 13.535 af, Depth= 4.18"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25-Year Rainfall=5.42"

Area (ac)	CN	Description
16.900	78	Meadow, non-grazed, HSG D
22.000	98	Water Surface, HSG A
38.900	89	Weighted Average
16.900		43.44% Pervious Area
22.000		56.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	300	0.1300	0.67		**Sheet Flow, Hillside Initial Sheet Flow** Grass: Short n= 0.150 P2= 7.11"
1.2	175	0.1300	2.52		**Shallow Concentrated Flow, Hillside Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.2	1,190		6.16		**Lake or Reservoir, Wetland** Mean Depth= 1.18'
11.9	1,665	Total			

Subcatchment 1S: Wetland Direct Watershed



Hydrograph for Subcatchment 1S: Wetland Direct Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.03	0.00	0.00
2.00	0.05	0.00	0.00
2.50	0.07	0.00	0.00
3.00	0.09	0.00	0.00
3.50	0.11	0.00	0.00
4.00	0.14	0.00	0.00
4.50	0.17	0.00	0.00
5.00	0.20	0.00	0.00
5.50	0.24	0.00	0.00
6.00	0.28	0.00	0.07
6.50	0.32	0.00	0.26
7.00	0.36	0.01	0.48
7.50	0.41	0.02	0.70
8.00	0.45	0.03	0.95
8.50	0.50	0.04	1.20
9.00	0.56	0.06	1.46
9.50	0.65	0.10	2.89
10.00	0.74	0.14	3.58
10.50	0.85	0.20	4.27
11.00	1.04	0.31	9.90
11.50	1.34	0.52	16.91
12.00	2.51	1.46	**83.06**
12.50	4.08	2.89	**61.04**
13.00	4.38	3.18	21.29
13.50	4.57	3.36	13.66
14.00	4.68	3.46	7.63
14.50	4.77	3.55	7.14
15.00	4.86	3.64	6.69
15.50	4.92	3.69	4.02
16.00	4.97	3.74	3.81
16.50	5.01	3.79	3.61
17.00	5.06	3.83	3.41
17.50	5.10	3.87	3.21
18.00	5.14	3.91	3.01
18.50	5.18	3.95	2.81
19.00	5.22	3.98	2.62
19.50	5.25	4.01	2.41
20.00	5.28	4.04	2.21
20.50	5.31	4.07	2.02
21.00	5.33	4.09	1.81
21.50	5.35	4.11	1.61
22.00	5.37	4.13	1.40
22.50	5.39	4.14	1.20
23.00	5.40	4.16	1.00
23.50	5.41	4.17	0.81
24.00	**5.42**	**4.18**	0.60
24.50	5.42	4.18	0.00
25.00	5.42	4.18	0.00
25.50	5.42	4.18	0.00
26.00	5.42	4.18	0.00
26.50	5.42	4.18	0.00
27.00	5.42	4.18	0.00
27.50	5.42	4.18	0.00
28.00	5.42	4.18	0.00
28.50	5.42	4.18	0.00
29.00	5.42	4.18	0.00
29.50	5.42	4.18	0.00
30.00	5.42	4.18	0.00
30.50	5.42	4.18	0.00
31.00	5.42	4.18	0.00
31.50	5.42	4.18	0.00
32.00	5.42	4.18	0.00
32.50	5.42	4.18	0.00
33.00	5.42	4.18	0.00
33.50	5.42	4.18	0.00
34.00	5.42	4.18	0.00
34.50	5.42	4.18	0.00
35.00	5.42	4.18	0.00
35.50	5.42	4.18	0.00
36.00	5.42	4.18	0.00
36.50	5.42	4.18	0.00
37.00	5.42	4.18	0.00
37.50	5.42	4.18	0.00
38.00	5.42	4.18	0.00
38.50	5.42	4.18	0.00
39.00	5.42	4.18	0.00
39.50	5.42	4.18	0.00
40.00	5.42	4.18	0.00
40.50	5.42	4.18	0.00
41.00	5.42	4.18	0.00
41.50	5.42	4.18	0.00
42.00	5.42	4.18	0.00
42.50	5.42	4.18	0.00
43.00	5.42	4.18	0.00
43.50	5.42	4.18	0.00
44.00	5.42	4.18	0.00
44.50	5.42	4.18	0.00
45.00	5.42	4.18	0.00
45.50	5.42	4.18	0.00
46.00	5.42	4.18	0.00
46.50	5.42	4.18	0.00
47.00	5.42	4.18	0.00
47.50	5.42	4.18	0.00
48.00	5.42	4.18	0.00

Summary for Subcatchment 3S: Northwest Watershed

This watershed area was computed as 10% of the total watershed area routing through the West Ditch (1,932.8 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the West ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

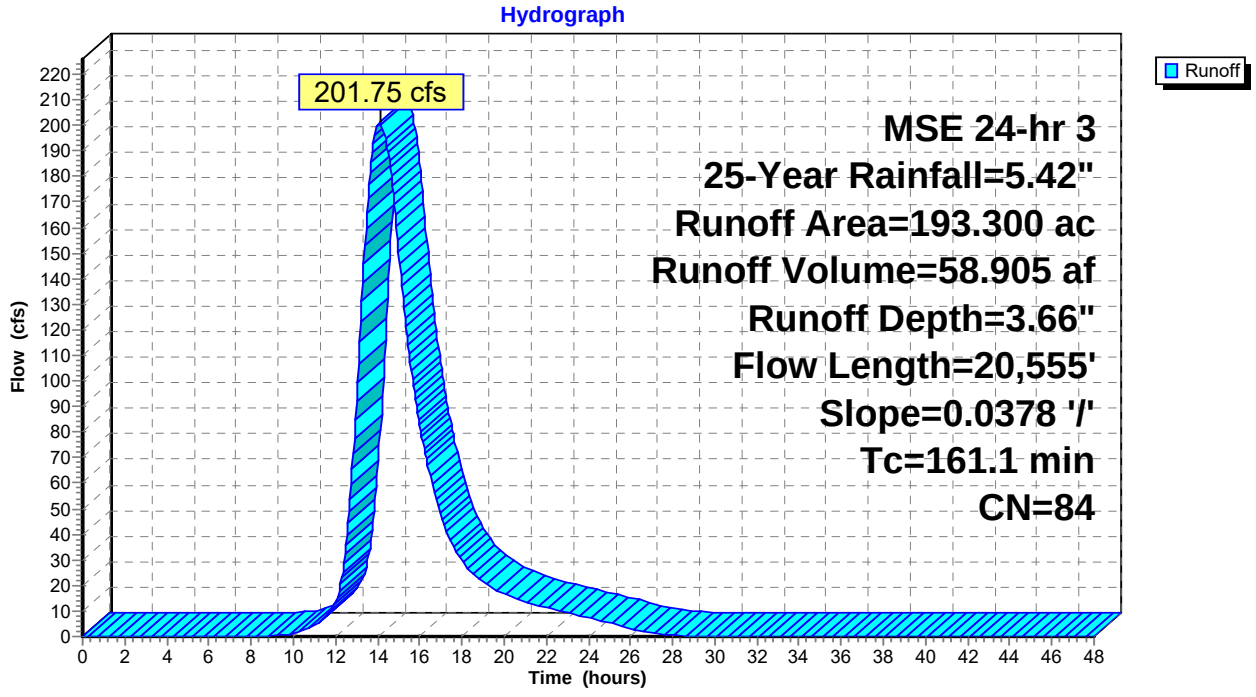
Runoff = 201.75 cfs @ 14.13 hrs, Volume= 58.905 af, Depth= 3.66"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25-Year Rainfall=5.42"

	Area (ac)	CN	Description
*	193.300	84	Weighted Average of Hydrologic Soil Groups
	193.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
161.1	20,555	0.0378	2.13		**Lag/CN Method,**

Subcatchment 3S: Northwest Watershed



Hydrograph for Subcatchment 3S: Northwest Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.03	0.00	0.00
2.00	0.05	0.00	0.00
2.50	0.07	0.00	0.00
3.00	0.09	0.00	0.00
3.50	0.11	0.00	0.00
4.00	0.14	0.00	0.00
4.50	0.17	0.00	0.00
5.00	0.20	0.00	0.00
5.50	0.24	0.00	0.00
6.00	0.28	0.00	0.00
6.50	0.32	0.00	0.00
7.00	0.36	0.00	0.00
7.50	0.41	0.00	0.00
8.00	0.45	0.00	0.01
8.50	0.50	0.01	0.06
9.00	0.56	0.02	0.24
9.50	0.65	0.03	0.62
10.00	0.74	0.06	1.33
10.50	0.85	0.09	2.56
11.00	1.04	0.17	4.43
11.50	1.34	0.32	7.44
12.00	2.51	1.12	13.56
12.50	4.08	2.44	35.84
13.00	4.38	2.70	91.98
13.50	4.57	2.88	165.60
14.00	4.68	2.97	**199.77**
14.50	4.77	3.06	**189.50**
15.00	4.86	3.14	150.51
15.50	4.92	3.19	110.52
16.00	4.97	3.24	82.69
16.50	5.01	3.28	62.21
17.00	5.06	3.33	47.63
17.50	5.10	3.37	37.03
18.00	5.14	3.40	29.71
18.50	5.18	3.44	24.78
19.00	5.22	3.47	21.23
19.50	5.25	3.50	18.67
20.00	5.28	3.53	16.72
20.50	5.31	3.55	15.04
21.00	5.33	3.57	13.49
21.50	5.35	3.59	12.24
22.00	5.37	3.61	11.21
22.50	5.39	3.63	10.20
23.00	5.40	3.64	9.23
23.50	5.41	3.65	8.26
24.00	**5.42**	**3.66**	7.29
24.50	5.42	3.66	6.33
25.00	5.42	3.66	5.28
25.50	5.42	3.66	4.08
26.00	5.42	3.66	2.89
26.50	5.42	3.66	1.90
27.00	5.42	3.66	1.19
27.50	5.42	3.66	0.75
28.00	5.42	3.66	0.47
28.50	5.42	3.66	0.29
29.00	5.42	3.66	0.18
29.50	5.42	3.66	0.11
30.00	5.42	3.66	0.07
30.50	5.42	3.66	0.04
31.00	5.42	3.66	0.02
31.50	5.42	3.66	0.01
32.00	5.42	3.66	0.00
32.50	5.42	3.66	0.00
33.00	5.42	3.66	0.00
33.50	5.42	3.66	0.00
34.00	5.42	3.66	0.00
34.50	5.42	3.66	0.00
35.00	5.42	3.66	0.00
35.50	5.42	3.66	0.00
36.00	5.42	3.66	0.00
36.50	5.42	3.66	0.00
37.00	5.42	3.66	0.00
37.50	5.42	3.66	0.00
38.00	5.42	3.66	0.00
38.50	5.42	3.66	0.00
39.00	5.42	3.66	0.00
39.50	5.42	3.66	0.00
40.00	5.42	3.66	0.00
40.50	5.42	3.66	0.00
41.00	5.42	3.66	0.00
41.50	5.42	3.66	0.00
42.00	5.42	3.66	0.00
42.50	5.42	3.66	0.00
43.00	5.42	3.66	0.00
43.50	5.42	3.66	0.00
44.00	5.42	3.66	0.00
44.50	5.42	3.66	0.00
45.00	5.42	3.66	0.00
45.50	5.42	3.66	0.00
46.00	5.42	3.66	0.00
46.50	5.42	3.66	0.00
47.00	5.42	3.66	0.00
47.50	5.42	3.66	0.00
48.00	5.42	3.66	0.00

Summary for Subcatchment 4S: Northeast Watershed

This watershed area was computed as 10% of the total watershed area routing through the East Ditch (755.2 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the East ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

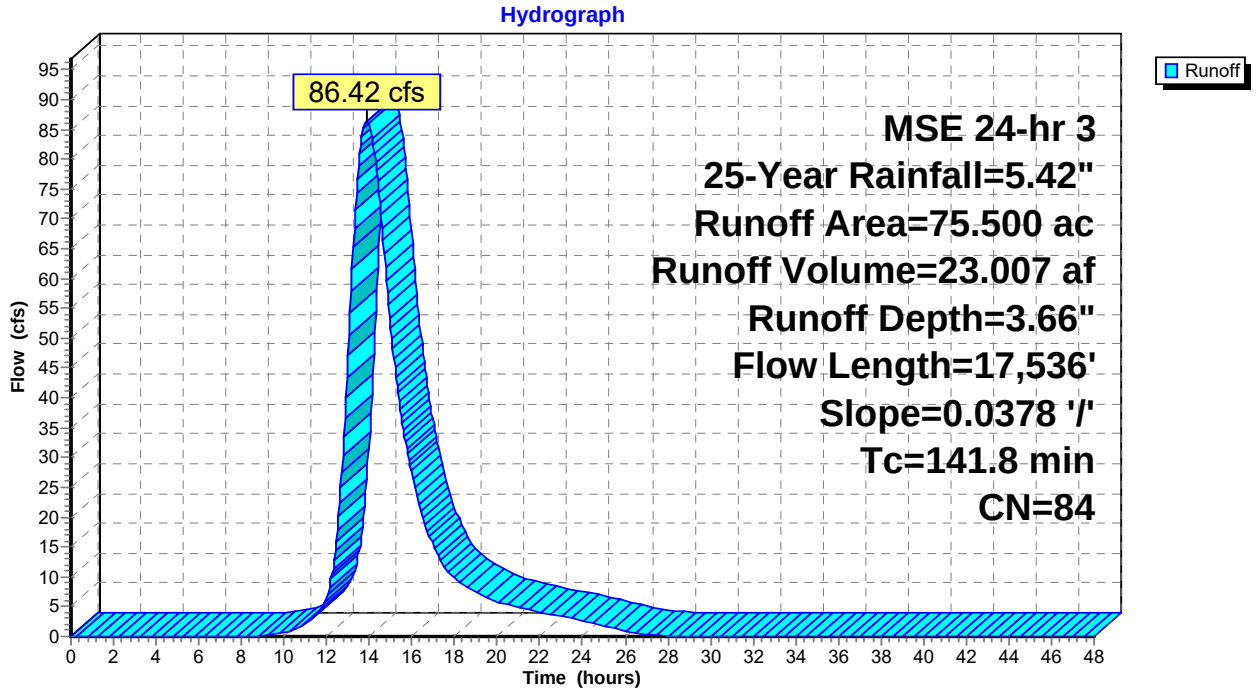
Runoff = 86.42 cfs @ 13.88 hrs, Volume= 23.007 af, Depth= 3.66"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25-Year Rainfall=5.42"

	Area (ac)	CN	Description
*	75.500	84	Weighted Average of Hydrologic Soil Groups
	75.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
141.8	17,536	0.0378	2.06		**Lag/CN Method,**

Subcatchment 4S: Northeast Watershed



Hydrograph for Subcatchment 4S: Northeast Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.03	0.00	0.00
2.00	0.05	0.00	0.00
2.50	0.07	0.00	0.00
3.00	0.09	0.00	0.00
3.50	0.11	0.00	0.00
4.00	0.14	0.00	0.00
4.50	0.17	0.00	0.00
5.00	0.20	0.00	0.00
5.50	0.24	0.00	0.00
6.00	0.28	0.00	0.00
6.50	0.32	0.00	0.00
7.00	0.36	0.00	0.00
7.50	0.41	0.00	0.00
8.00	0.45	0.00	0.00
8.50	0.50	0.01	0.04
9.00	0.56	0.02	0.13
9.50	0.65	0.03	0.33
10.00	0.74	0.06	0.68
10.50	0.85	0.09	1.27
11.00	1.04	0.17	2.13
11.50	1.34	0.32	3.56
12.00	2.51	1.12	6.67
12.50	4.08	2.44	18.02
13.00	4.38	2.70	47.06
13.50	4.57	2.88	**78.81**
14.00	4.68	2.97	**86.17**
14.50	4.77	3.06	72.61
15.00	4.86	3.14	51.66
15.50	4.92	3.19	36.96
16.00	4.97	3.24	26.95
16.50	5.01	3.28	20.06
17.00	5.06	3.33	15.15
17.50	5.10	3.37	11.87
18.00	5.14	3.40	9.70
18.50	5.18	3.44	8.28
19.00	5.22	3.47	7.28
19.50	5.25	3.50	6.50
20.00	5.28	3.53	5.83
20.50	5.31	3.55	5.31
21.00	5.33	3.57	4.90
21.50	5.35	3.59	4.51
22.00	5.37	3.61	4.13
22.50	5.39	3.63	3.75
23.00	5.40	3.64	3.37
23.50	5.41	3.65	3.00
24.00	**5.42**	**3.66**	2.63
24.50	5.42	3.66	2.25
25.00	5.42	3.66	1.81
25.50	5.42	3.66	1.32
26.00	5.42	3.66	0.86
26.50	5.42	3.66	0.51
27.00	5.42	3.66	0.30
27.50	5.42	3.66	0.18
28.00	5.42	3.66	0.10
28.50	5.42	3.66	0.06
29.00	5.42	3.66	0.03
29.50	5.42	3.66	0.02
30.00	5.42	3.66	0.01
30.50	5.42	3.66	0.00
31.00	5.42	3.66	0.00
31.50	5.42	3.66	0.00
32.00	5.42	3.66	0.00
32.50	5.42	3.66	0.00
33.00	5.42	3.66	0.00
33.50	5.42	3.66	0.00
34.00	5.42	3.66	0.00
34.50	5.42	3.66	0.00
35.00	5.42	3.66	0.00
35.50	5.42	3.66	0.00
36.00	5.42	3.66	0.00
36.50	5.42	3.66	0.00
37.00	5.42	3.66	0.00
37.50	5.42	3.66	0.00
38.00	5.42	3.66	0.00
38.50	5.42	3.66	0.00
39.00	5.42	3.66	0.00
39.50	5.42	3.66	0.00
40.00	5.42	3.66	0.00
40.50	5.42	3.66	0.00
41.00	5.42	3.66	0.00
41.50	5.42	3.66	0.00
42.00	5.42	3.66	0.00
42.50	5.42	3.66	0.00
43.00	5.42	3.66	0.00
43.50	5.42	3.66	0.00
44.00	5.42	3.66	0.00
44.50	5.42	3.66	0.00
45.00	5.42	3.66	0.00
45.50	5.42	3.66	0.00
46.00	5.42	3.66	0.00
46.50	5.42	3.66	0.00
47.00	5.42	3.66	0.00
47.50	5.42	3.66	0.00
48.00	5.42	3.66	0.00

Summary for Pond 2P: Dotson Wetland & Outlets

Inflow Area = 307.700 ac, 7.15% Impervious, Inflow Depth > 4.03" for 25-Year event
Inflow = 295.70 cfs @ 14.04 hrs, Volume= 103.389 af, Incl. 2.00 cfs Base Flow
Outflow = 209.15 cfs @ 15.01 hrs, Volume= 96.627 af, Atten= 29%, Lag= 58.4 min
Primary = 3.41 cfs @ 15.01 hrs, Volume= 7.851 af
Secondary = 205.74 cfs @ 15.01 hrs, Volume= 88.776 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 921.90' Surf.Area= 20.817 ac Storage= 26.525 af
Peak Elev= 923.39' @ 15.01 hrs Surf.Area= 26.812 ac Storage= 63.045 af (36.520 af above start)

Plug-Flow detention time= 399.7 min calculated for 70.097 af (68% of inflow)
Center-of-Mass det. time= 162.2 min (1,110.7 - 948.5)

Volume	Invert	Avail.Storage	Storage Description
#1	919.00'	93.642 af	**Storage to Top of Berm (Prismatic)** Listed below (Recalc)

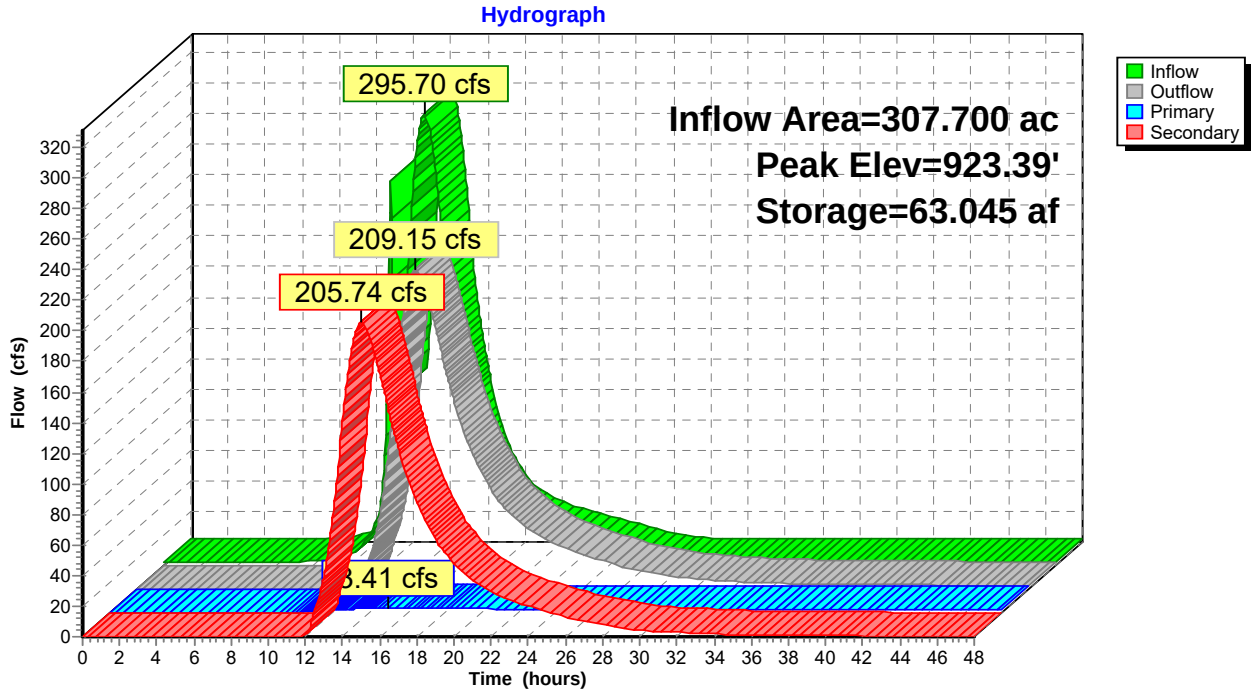
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
919.00	0.034	0.000	0.000
920.00	7.420	3.727	3.727
921.00	10.232	8.826	12.553
922.00	21.993	16.112	28.665
923.00	26.197	24.095	52.760
924.00	27.783	26.990	79.750
924.50	27.783	13.891	93.642

Device	Routing	Invert	Outlet Devices
#1	Device 2	921.90'	**18.0" Horiz. 18" Riser Inlet** C= 0.600 Limited to weir flow at low heads
#2	Primary	920.25'	**12.0" Round CMP_Round 12"** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 920.25' / 920.25' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#3	Secondary	922.20'	**50.0' long + 10.0 '/' SideZ x 12.0' breadth 50' Rock Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

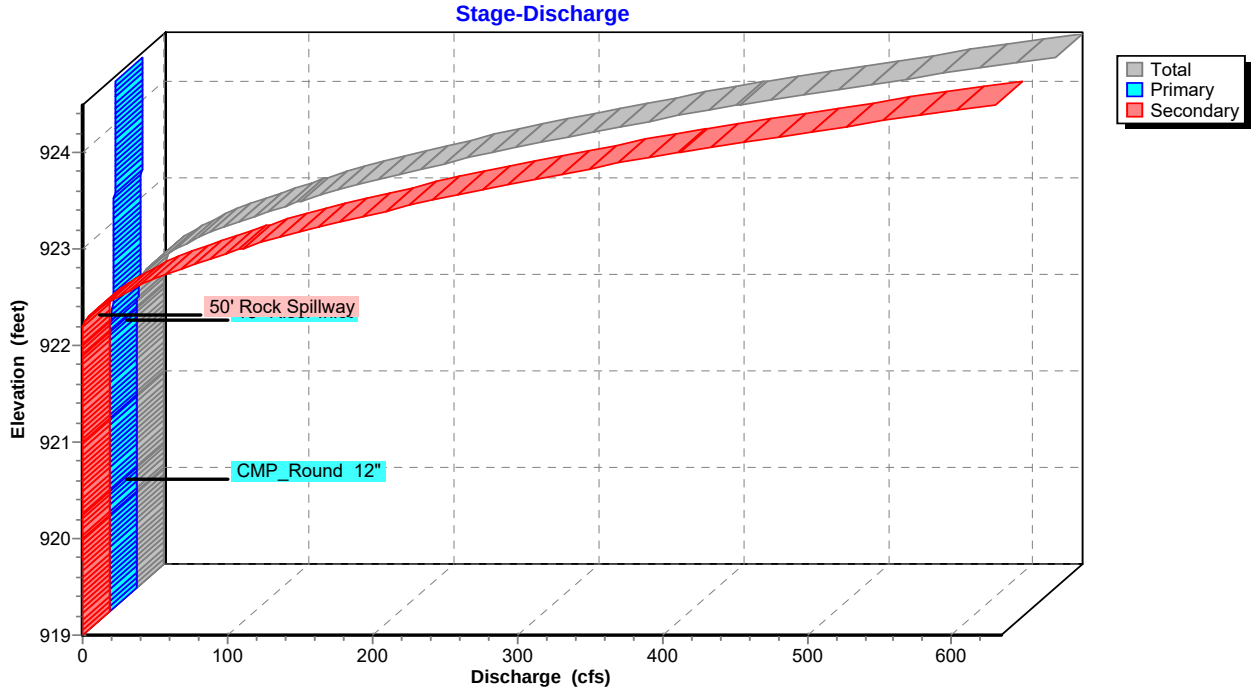
Primary OutFlow Max=3.41 cfs @ 15.01 hrs HW=923.39' (Free Discharge)
└**2=CMP_Round 12"** (Barrel Controls 3.41 cfs @ 4.34 fps)
└**1=18" Riser Inlet** (Passes 3.41 cfs of 10.38 cfs potential flow)

Secondary OutFlow Max=205.66 cfs @ 15.01 hrs HW=923.39' (Free Discharge)
└**3=50' Rock Spillway** (Weir Controls 205.66 cfs @ 2.80 fps)

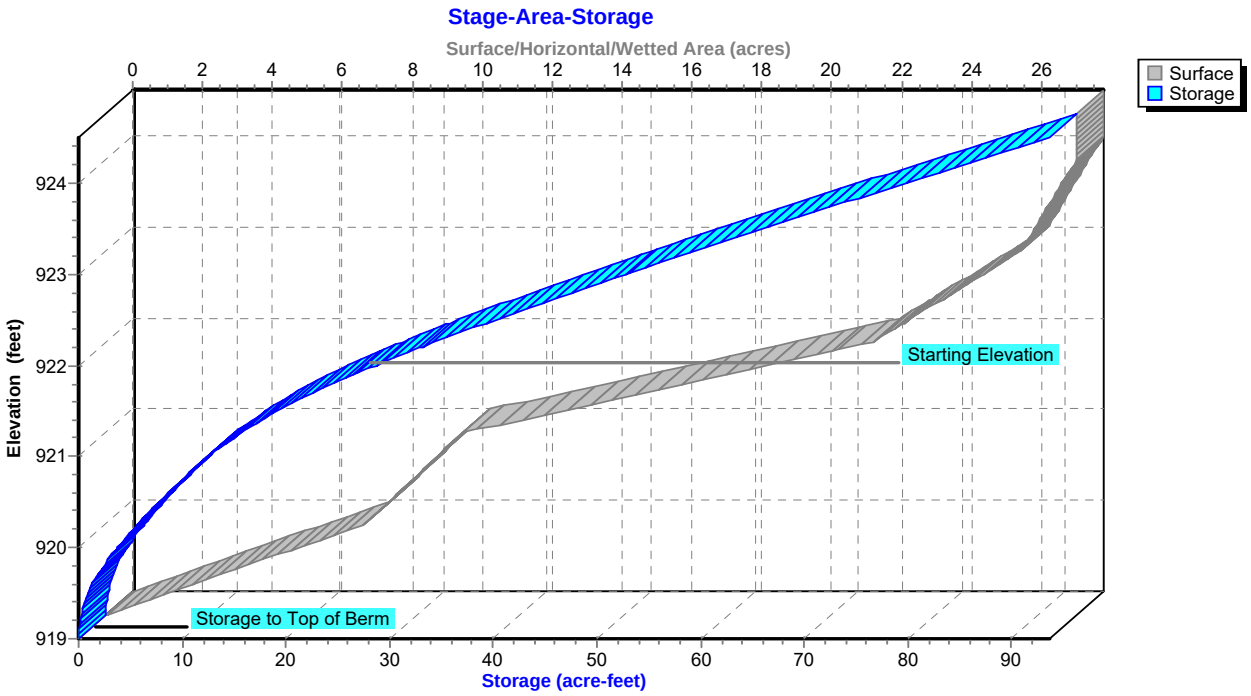
Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Hydrograph for Pond 2P: Dotson Wetland & Outlets

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	2.00	26.529	921.90	0.00	0.00	0.00
1.00	2.00	26.694	921.91	0.02	0.02	0.00
2.00	2.00	26.857	921.92	0.03	0.03	0.00
3.00	2.00	27.018	921.92	0.07	0.07	0.00
4.00	2.00	27.177	921.93	0.10	0.10	0.00
5.00	2.00	27.332	921.94	0.14	0.14	0.00
6.00	2.07	27.485	921.95	0.17	0.17	0.00
7.00	2.48	27.657	921.95	0.21	0.21	0.00
8.00	2.96	27.862	921.96	0.25	0.25	0.00
9.00	3.84	28.114	921.97	0.32	0.32	0.00
10.00	7.60	28.560	922.00	0.45	0.45	0.00
11.00	18.46	29.450	922.04	0.78	0.78	0.00
12.00	105.29	32.542	922.17	2.11	2.11	0.00
13.00	162.33	43.292	922.63	42.03	2.74	39.29
14.00	**295.57**	56.540	923.14	143.74	3.21	140.53
15.00	**210.86**	**63.045**	**923.39**	**209.13**	**3.41**	**205.72**
16.00	115.45	59.791	923.27	175.00	3.31	171.69
17.00	68.19	54.721	923.07	127.48	3.15	124.33
18.00	44.43	50.298	922.91	91.46	3.00	88.46
19.00	33.13	46.967	922.77	66.95	2.88	64.07
20.00	26.76	44.622	922.68	50.49	2.79	47.70
21.00	22.20	42.932	922.61	39.92	2.72	37.19
22.00	18.74	41.641	922.56	32.55	2.67	29.88
23.00	15.60	40.605	922.52	27.05	2.63	24.43
24.00	12.52	39.714	922.48	22.74	2.59	20.15
25.00	9.09	38.878	922.45	18.94	2.55	16.39
26.00	5.75	38.070	922.41	15.45	2.51	12.94
27.00	3.49	37.286	922.38	12.52	2.48	10.05
28.00	2.57	36.603	922.35	10.07	2.44	7.63
29.00	2.21	36.041	922.33	8.33	2.42	5.92
30.00	2.08	35.588	922.31	6.94	2.40	4.54
31.00	2.02	35.227	922.29	5.99	2.38	3.62
32.00	2.00	34.928	922.28	5.30	2.36	2.94
33.00	2.00	34.680	922.27	4.72	2.35	2.37
34.00	2.00	34.475	922.26	4.25	2.34	1.91
35.00	2.00	34.306	922.25	3.85	2.33	1.52
36.00	2.00	34.167	922.24	3.54	2.33	1.22
37.00	2.00	34.045	922.24	3.39	2.32	1.07
38.00	2.00	33.936	922.23	3.26	2.31	0.94
39.00	2.00	33.837	922.23	3.13	2.31	0.83
40.00	2.00	33.748	922.23	3.02	2.30	0.72
41.00	2.00	33.668	922.22	2.92	2.30	0.62
42.00	2.00	33.596	922.22	2.83	2.30	0.54
43.00	2.00	33.530	922.22	2.75	2.29	0.46
44.00	2.00	33.471	922.21	2.68	2.29	0.39
45.00	2.00	33.418	922.21	2.61	2.29	0.32
46.00	2.00	33.370	922.21	2.55	2.28	0.27
47.00	2.00	33.327	922.21	2.50	2.28	0.21
48.00	2.00	33.288	922.21	2.45	2.28	0.17

Stage-Discharge for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
919.00	0.00	0.00	0.00
919.05	0.00	0.00	0.00
919.10	0.00	0.00	0.00
919.15	0.00	0.00	0.00
919.20	0.00	0.00	0.00
919.25	0.00	0.00	0.00
919.30	0.00	0.00	0.00
919.35	0.00	0.00	0.00
919.40	0.00	0.00	0.00
919.45	0.00	0.00	0.00
919.50	0.00	0.00	0.00
919.55	0.00	0.00	0.00
919.60	0.00	0.00	0.00
919.65	0.00	0.00	0.00
919.70	0.00	0.00	0.00
919.75	0.00	0.00	0.00
919.80	0.00	0.00	0.00
919.85	0.00	0.00	0.00
919.90	0.00	0.00	0.00
919.95	0.00	0.00	0.00
920.00	0.00	0.00	0.00
920.05	0.00	0.00	0.00
920.10	0.00	0.00	0.00
920.15	0.00	0.00	0.00
920.20	0.00	0.00	0.00
920.25	0.00	0.00	0.00
920.30	0.00	0.00	0.00
920.35	0.00	0.00	0.00
920.40	0.00	0.00	0.00
920.45	0.00	0.00	0.00
920.50	0.00	0.00	0.00
920.55	0.00	0.00	0.00
920.60	0.00	0.00	0.00
920.65	0.00	0.00	0.00
920.70	0.00	0.00	0.00
920.75	0.00	0.00	0.00
920.80	0.00	0.00	0.00
920.85	0.00	0.00	0.00
920.90	0.00	0.00	0.00
920.95	0.00	0.00	0.00
921.00	0.00	0.00	0.00
921.05	0.00	0.00	0.00
921.10	0.00	0.00	0.00
921.15	0.00	0.00	0.00
921.20	0.00	0.00	0.00
921.25	0.00	0.00	0.00
921.30	0.00	0.00	0.00
921.35	0.00	0.00	0.00
921.40	0.00	0.00	0.00
921.45	0.00	0.00	0.00
921.50	0.00	0.00	0.00
921.55	0.00	0.00	0.00
921.60	0.00	0.00	0.00
921.65	0.00	0.00	0.00
921.70	0.00	0.00	0.00
921.75	0.00	0.00	0.00
921.80	0.00	0.00	0.00
921.85	0.00	0.00	0.00
921.90	0.00	0.00	0.00
921.95	0.17	0.17	0.00
922.00	0.49	0.49	0.00
922.05	0.90	0.90	0.00
922.10	1.38	1.38	0.00
922.15	1.93	1.93	0.00
922.20	2.27	2.27	0.00
922.25	3.78	2.33	1.45
922.30	6.52	2.39	4.13
922.35	10.09	2.45	7.64
922.40	14.36	2.50	11.86
922.45	19.34	2.55	16.79
922.50	24.95	2.61	22.34
922.55	31.17	2.66	28.51
922.60	37.97	2.71	35.26
922.65	45.47	2.76	42.72
922.70	53.59	2.81	50.78
922.75	62.32	2.86	59.47
922.80	71.67	2.90	68.77
922.85	80.84	2.95	77.89
922.90	90.43	3.00	87.43
922.95	100.43	3.04	97.39
923.00	110.84	3.08	107.75
923.05	121.86	3.13	118.74
923.10	133.33	3.17	130.15
923.15	145.22	3.21	142.00
923.20	157.54	3.26	154.28
923.25	170.59	3.30	167.30
923.30	184.12	3.34	180.79
923.35	198.13	3.38	194.75
923.40	212.60	3.42	209.18
923.45	227.14	3.46	223.68
923.50	242.09	3.50	238.59
923.55	257.45	3.54	253.92
923.60	273.24	3.57	269.67
923.65	289.17	3.61	285.56
923.70	305.49	3.65	301.84
923.75	322.19	3.69	318.50
923.80	339.26	3.72	335.54
923.85	357.39	3.76	353.63
923.90	375.96	3.80	372.16
923.95	394.98	3.83	391.15
924.00	414.45	3.87	410.58
924.05	434.37	3.90	430.46
924.10	454.73	3.94	450.80
924.15	475.56	3.97	471.58
924.20	496.83	4.01	492.83
924.25	518.56	4.04	514.52
924.30	540.74	4.07	536.67
924.35	563.39	4.11	559.28
924.40	586.49	4.14	582.35
924.45	610.05	4.17	605.88
924.50	**634.08**	**4.20**	**629.87**

Stage-Area-Storage for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Surface (acres)	Storage (acre-feet)
919.00	0.034	0.000
919.05	0.403	0.011
919.10	0.773	0.040
919.15	1.142	0.088
919.20	1.511	0.155
919.25	1.880	0.239
919.30	2.250	0.343
919.35	2.619	0.464
919.40	2.988	0.604
919.45	3.358	0.763
919.50	3.727	0.940
919.55	4.096	1.136
919.60	4.466	1.350
919.65	4.835	1.582
919.70	5.204	1.833
919.75	5.573	2.103
919.80	5.943	2.391
919.85	6.312	2.697
919.90	6.681	3.022
919.95	7.051	3.365
920.00	7.420	3.727
920.05	7.561	4.102
920.10	7.701	4.483
920.15	7.842	4.872
920.20	7.982	5.267
920.25	8.123	5.670
920.30	8.264	6.080
920.35	8.404	6.496
920.40	8.545	6.920
920.45	8.685	7.351
920.50	8.826	7.788
920.55	8.967	8.233
920.60	9.107	8.685
920.65	9.248	9.144
920.70	9.388	9.610
920.75	9.529	10.083
920.80	9.670	10.563
920.85	9.810	11.050
920.90	9.951	11.544
920.95	10.091	12.045
921.00	10.232	12.553
921.05	10.820	13.079
921.10	11.408	13.635
921.15	11.996	14.220
921.20	12.584	14.835
921.25	13.172	15.479
921.30	13.760	16.152
921.35	14.348	16.855
921.40	14.936	17.587
921.45	15.524	18.348
921.50	16.112	19.139
921.55	16.701	19.959
921.60	17.289	20.809
921.65	17.877	21.688
921.70	18.465	22.597
921.75	19.053	23.535
921.80	19.641	24.502
921.85	20.229	25.499
921.90	20.817	26.525
921.95	21.405	27.581
922.00	21.993	28.665
922.05	22.203	29.770
922.10	22.413	30.886
922.15	22.624	32.012
922.20	22.834	33.148
922.25	23.044	34.295
922.30	23.254	35.453
922.35	23.464	36.621
922.40	23.675	37.799
922.45	23.885	38.988
922.50	24.095	40.187
922.55	24.305	41.398
922.60	24.515	42.618
922.65	24.726	43.849
922.70	24.936	45.091
922.75	25.146	46.343
922.80	25.356	47.605
922.85	25.566	48.878
922.90	25.777	50.162
922.95	25.987	51.456
923.00	26.197	52.760
923.05	26.276	54.072
923.10	26.356	55.388
923.15	26.435	56.708
923.20	26.514	58.032
923.25	26.594	59.359
923.30	26.673	60.691
923.35	26.752	62.027
923.40	26.831	63.366
923.45	26.911	64.710
923.50	26.990	66.057
923.55	27.069	67.409
923.60	27.149	68.764
923.65	27.228	70.124
923.70	27.307	71.487
923.75	27.386	72.854
923.80	27.466	74.226
923.85	27.545	75.601
923.90	27.624	76.980
923.95	27.704	78.363
924.00	**27.783**	79.750
924.05	27.783	81.140
924.10	27.783	82.529
924.15	27.783	83.918
924.20	27.783	85.307
924.25	27.783	86.696
924.30	27.783	88.085
924.35	27.783	89.475
924.40	27.783	90.864
924.45	27.783	92.253
924.50	27.783	**93.642**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Wetland Direct Runoff Area=38.900 ac 56.56% Impervious Runoff Depth=5.69"
Flow Length=1,665' Slope=0.1300 '/' Tc=11.9 min CN=89 Runoff=296.58 cfs 18.440 af

Subcatchment 3S: Northwest Runoff Area=193.300 ac 0.00% Impervious Runoff Depth=5.12"
Flow Length=20,555' Slope=0.0378 '/' Tc=161.1 min CN=84 Runoff=281.62 cfs 82.490 af

Subcatchment 4S: Northeast Watershed Runoff Area=75.500 ac 0.00% Impervious Runoff Depth=5.12"
Flow Length=17,536' Slope=0.0378 '/' Tc=141.8 min CN=84 Runoff=120.59 cfs 32.219 af

Pond 2P: Dotson Wetland & Outlets Peak Elev=923.72' Storage=71.975 af Inflow=411.52 cfs 141.091 af
Primary=3.66 cfs 8.116 af Secondary=307.78 cfs 126.189 af Outflow=311.45 cfs 134.305 af

Total Runoff Area = 307.700 ac Runoff Volume = 133.149 af Average Runoff Depth = 5.19"
92.85% Pervious = 285.700 ac 7.15% Impervious = 22.000 ac

Summary for Subcatchment 1S: Wetland Direct Watershed

This watershed area is the wetland (water) area itself, and the hillside that drains surface water directly to the wetland.

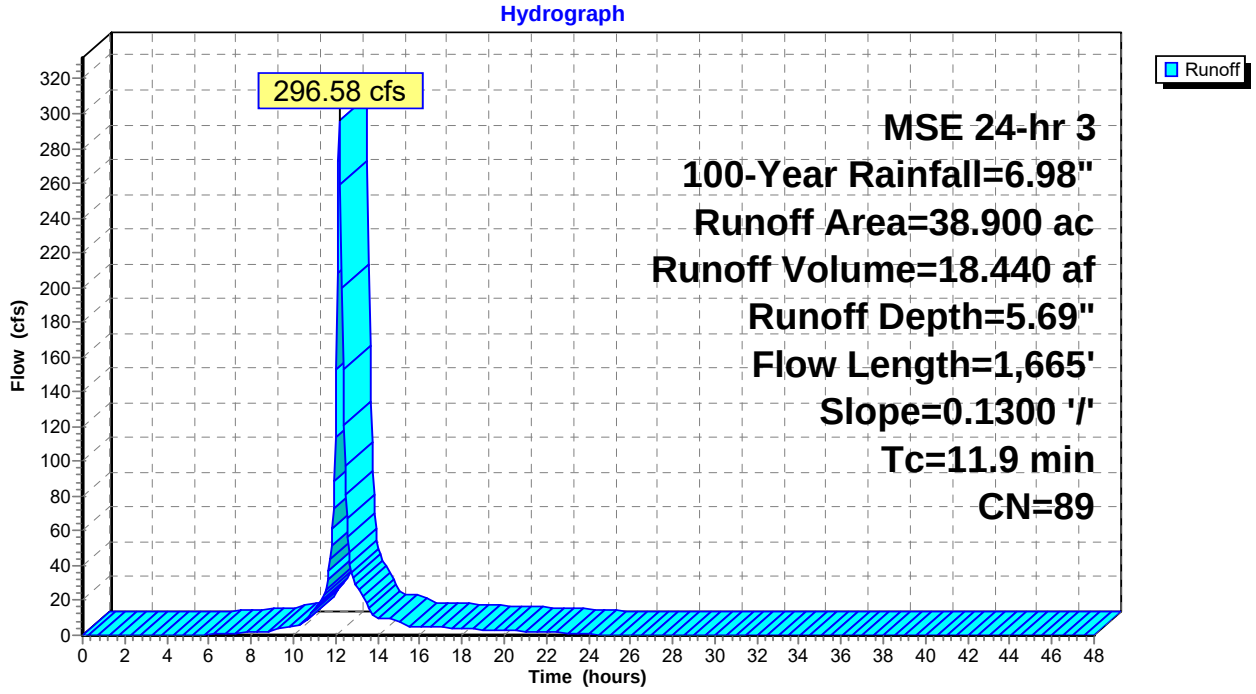
Runoff = 296.58 cfs @ 12.19 hrs, Volume= 18.440 af, Depth= 5.69"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=6.98"

Area (ac)	CN	Description
16.900	78	Meadow, non-grazed, HSG D
22.000	98	Water Surface, HSG A
38.900	89	Weighted Average
16.900		43.44% Pervious Area
22.000		56.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	300	0.1300	0.67		**Sheet Flow, Hillside Initial Sheet Flow** Grass: Short n= 0.150 P2= 7.11"
1.2	175	0.1300	2.52		**Shallow Concentrated Flow, Hillside Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.2	1,190		6.16		**Lake or Reservoir, Wetland** Mean Depth= 1.18'
11.9	1,665	Total			

Subcatchment 1S: Wetland Direct Watershed



Hydrograph for Subcatchment 1S: Wetland Direct Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.04	0.00	0.00
2.00	0.06	0.00	0.00
2.50	0.09	0.00	0.00
3.00	0.12	0.00	0.00
3.50	0.15	0.00	0.00
4.00	0.18	0.00	0.00
4.50	0.22	0.00	0.00
5.00	0.26	0.00	0.01
5.50	0.31	0.00	0.24
6.00	0.36	0.01	0.51
6.50	0.41	0.02	0.80
7.00	0.46	0.03	1.12
7.50	0.52	0.05	1.45
8.00	0.58	0.07	1.79
8.50	0.65	0.10	2.15
9.00	0.72	0.13	2.51
9.50	0.84	0.19	4.75
10.00	0.96	0.26	5.67
10.50	1.09	0.34	6.57
11.00	1.35	0.52	14.73
11.50	1.73	0.81	24.30
12.00	3.23	2.11	**114.04**
12.50	5.25	4.01	**80.61**
13.00	5.63	4.38	27.97
13.50	5.89	4.63	17.92
14.00	6.02	4.76	10.00
14.50	6.14	4.88	9.35
15.00	6.26	4.99	8.76
15.50	6.33	5.06	5.26
16.00	6.40	5.12	4.98
16.50	6.46	5.18	4.72
17.00	6.52	5.24	4.46
17.50	6.57	5.29	4.20
18.00	6.62	5.34	3.94
18.50	6.67	5.39	3.67
19.00	6.72	5.43	3.42
19.50	6.76	5.47	3.15
20.00	6.80	5.51	2.88
20.50	6.83	5.54	2.63
21.00	6.86	5.58	2.37
21.50	6.89	5.60	2.10
22.00	6.92	5.63	1.83
22.50	6.94	5.65	1.57
23.00	6.96	5.66	1.31
23.50	6.97	5.68	1.05
24.00	**6.98**	**5.69**	0.79
24.50	6.98	5.69	0.01
25.00	6.98	5.69	0.00
25.50	6.98	5.69	0.00
26.00	6.98	5.69	0.00
26.50	6.98	5.69	0.00
27.00	6.98	5.69	0.00
27.50	6.98	5.69	0.00
28.00	6.98	5.69	0.00
28.50	6.98	5.69	0.00
29.00	6.98	5.69	0.00
29.50	6.98	5.69	0.00
30.00	6.98	5.69	0.00
30.50	6.98	5.69	0.00
31.00	6.98	5.69	0.00
31.50	6.98	5.69	0.00
32.00	6.98	5.69	0.00
32.50	6.98	5.69	0.00
33.00	6.98	5.69	0.00
33.50	6.98	5.69	0.00
34.00	6.98	5.69	0.00
34.50	6.98	5.69	0.00
35.00	6.98	5.69	0.00
35.50	6.98	5.69	0.00
36.00	6.98	5.69	0.00
36.50	6.98	5.69	0.00
37.00	6.98	5.69	0.00
37.50	6.98	5.69	0.00
38.00	6.98	5.69	0.00
38.50	6.98	5.69	0.00
39.00	6.98	5.69	0.00
39.50	6.98	5.69	0.00
40.00	6.98	5.69	0.00
40.50	6.98	5.69	0.00
41.00	6.98	5.69	0.00
41.50	6.98	5.69	0.00
42.00	6.98	5.69	0.00
42.50	6.98	5.69	0.00
43.00	6.98	5.69	0.00
43.50	6.98	5.69	0.00
44.00	6.98	5.69	0.00
44.50	6.98	5.69	0.00
45.00	6.98	5.69	0.00
45.50	6.98	5.69	0.00
46.00	6.98	5.69	0.00
46.50	6.98	5.69	0.00
47.00	6.98	5.69	0.00
47.50	6.98	5.69	0.00
48.00	6.98	5.69	0.00

Summary for Subcatchment 3S: Northwest Watershed

This watershed area was computed as 10% of the total watershed area routing through the West Ditch (1,932.8 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the West ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

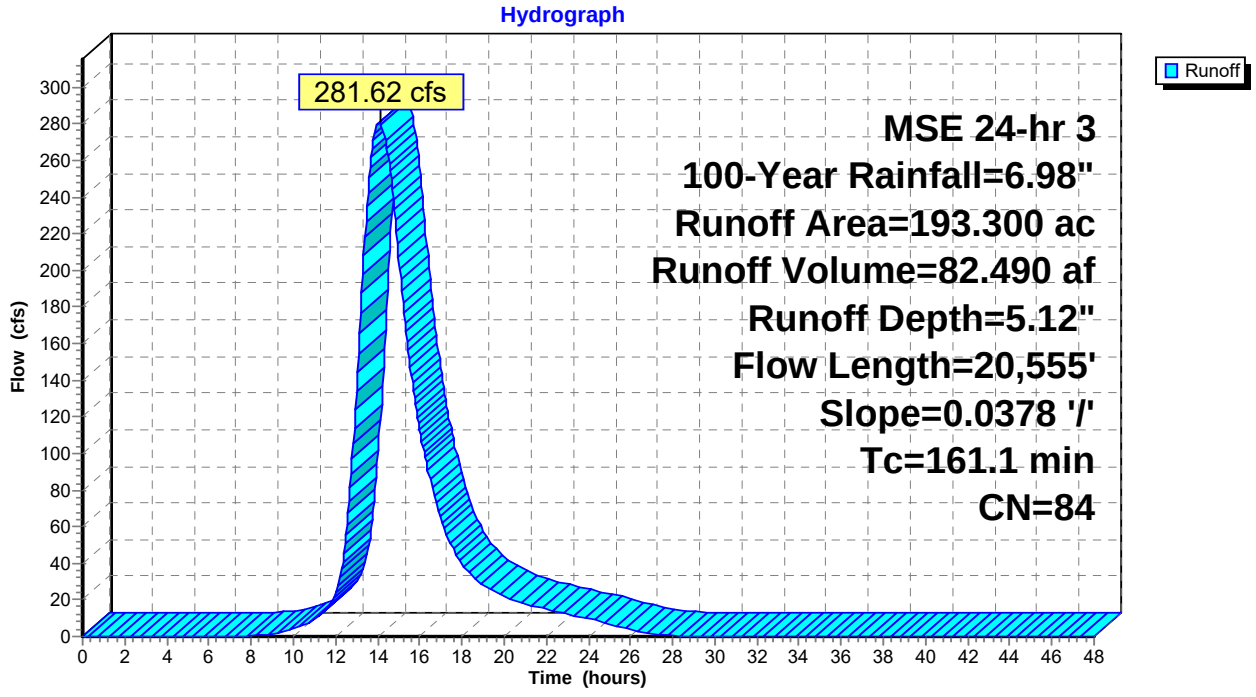
Runoff = 281.62 cfs @ 14.13 hrs, Volume= 82.490 af, Depth= 5.12"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=6.98"

	Area (ac)	CN	Description
*	193.300	84	Weighted Average of Hydrologic Soil Groups
	193.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
161.1	20,555	0.0378	2.13		**Lag/CN Method,**

Subcatchment 3S: Northwest Watershed



Hydrograph for Subcatchment 3S: Northwest Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.04	0.00	0.00
2.00	0.06	0.00	0.00
2.50	0.09	0.00	0.00
3.00	0.12	0.00	0.00
3.50	0.15	0.00	0.00
4.00	0.18	0.00	0.00
4.50	0.22	0.00	0.00
5.00	0.26	0.00	0.00
5.50	0.31	0.00	0.00
6.00	0.36	0.00	0.00
6.50	0.41	0.00	0.00
7.00	0.46	0.00	0.01
7.50	0.52	0.01	0.07
8.00	0.58	0.02	0.31
8.50	0.65	0.03	0.79
9.00	0.72	0.05	1.54
9.50	0.84	0.09	2.56
10.00	0.96	0.13	4.00
10.50	1.09	0.19	6.22
11.00	1.35	0.32	9.36
11.50	1.73	0.56	14.17
12.00	3.23	1.71	23.59
12.50	5.25	3.50	55.68
13.00	5.63	3.86	134.06
13.50	5.89	4.09	234.80
14.00	6.02	4.22	**279.57**
14.50	6.14	4.33	**262.93**
15.00	6.26	4.44	207.45
15.50	6.33	4.51	151.56
16.00	6.40	4.57	112.91
16.50	6.46	4.63	84.59
17.00	6.52	4.68	64.51
17.50	6.57	4.73	49.96
18.00	6.62	4.78	39.96
18.50	6.67	4.83	33.21
19.00	6.72	4.87	28.37
19.50	6.76	4.91	24.90
20.00	6.80	4.95	22.25
20.50	6.83	4.98	19.97
21.00	6.86	5.01	17.89
21.50	6.89	5.04	16.22
22.00	6.92	5.06	14.85
22.50	6.94	5.08	13.51
23.00	6.96	5.10	12.22
23.50	6.97	5.11	10.94
24.00	**6.98**	**5.12**	9.65
24.50	6.98	5.12	8.38
25.00	6.98	5.12	6.98
25.50	6.98	5.12	5.40
26.00	6.98	5.12	3.83
26.50	6.98	5.12	2.51
27.00	6.98	5.12	1.57
27.50	6.98	5.12	0.99
28.00	6.98	5.12	0.62
28.50	6.98	5.12	0.39
29.00	6.98	5.12	0.24
29.50	6.98	5.12	0.15
30.00	6.98	5.12	0.09
30.50	6.98	5.12	0.05
31.00	6.98	5.12	0.03
31.50	6.98	5.12	0.01
32.00	6.98	5.12	0.01
32.50	6.98	5.12	0.00
33.00	6.98	5.12	0.00
33.50	6.98	5.12	0.00
34.00	6.98	5.12	0.00
34.50	6.98	5.12	0.00
35.00	6.98	5.12	0.00
35.50	6.98	5.12	0.00
36.00	6.98	5.12	0.00
36.50	6.98	5.12	0.00
37.00	6.98	5.12	0.00
37.50	6.98	5.12	0.00
38.00	6.98	5.12	0.00
38.50	6.98	5.12	0.00
39.00	6.98	5.12	0.00
39.50	6.98	5.12	0.00
40.00	6.98	5.12	0.00
40.50	6.98	5.12	0.00
41.00	6.98	5.12	0.00
41.50	6.98	5.12	0.00
42.00	6.98	5.12	0.00
42.50	6.98	5.12	0.00
43.00	6.98	5.12	0.00
43.50	6.98	5.12	0.00
44.00	6.98	5.12	0.00
44.50	6.98	5.12	0.00
45.00	6.98	5.12	0.00
45.50	6.98	5.12	0.00
46.00	6.98	5.12	0.00
46.50	6.98	5.12	0.00
47.00	6.98	5.12	0.00
47.50	6.98	5.12	0.00
48.00	6.98	5.12	0.00

Summary for Subcatchment 4S: Northeast Watershed

This watershed area was computed as 10% of the total watershed area routing through the East Ditch (755.2 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the East ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

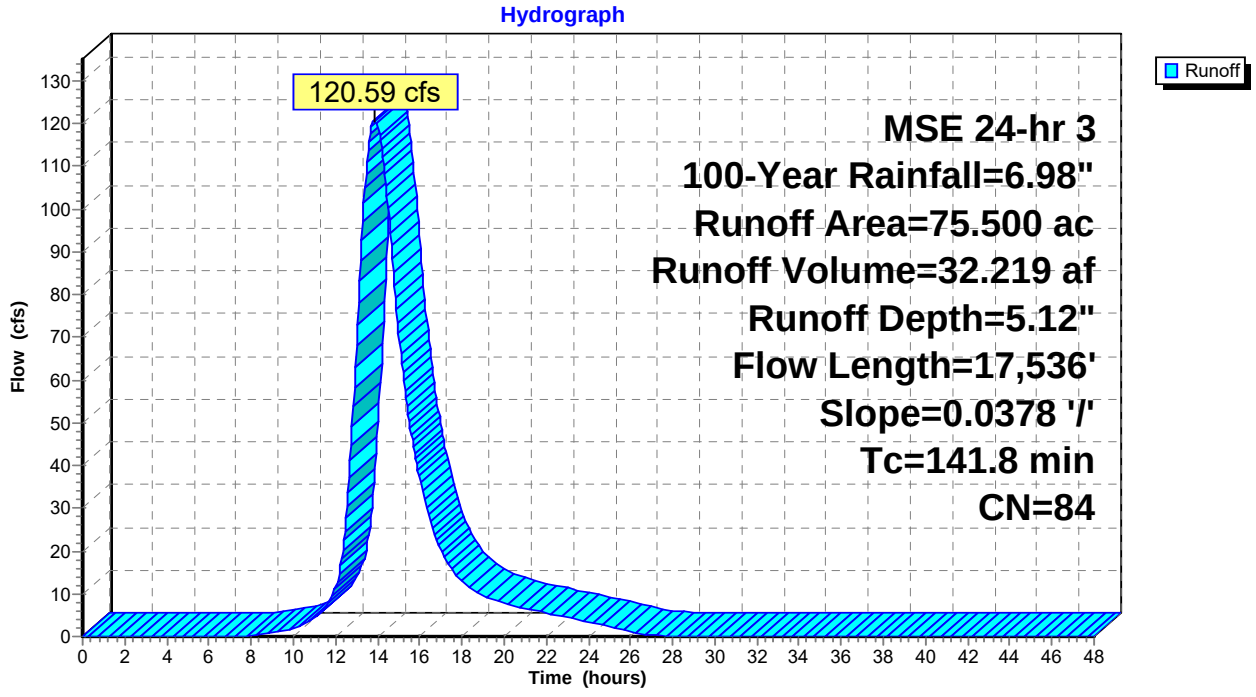
Runoff = 120.59 cfs @ 13.86 hrs, Volume= 32.219 af, Depth= 5.12"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=6.98"

	Area (ac)	CN	Description
*	75.500	84	Weighted Average of Hydrologic Soil Groups
	75.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
141.8	17,536	0.0378	2.06		**Lag/CN Method,**

Subcatchment 4S: Northeast Watershed



Hydrograph for Subcatchment 4S: Northeast Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.50	0.01	0.00	0.00
1.00	0.02	0.00	0.00
1.50	0.04	0.00	0.00
2.00	0.06	0.00	0.00
2.50	0.09	0.00	0.00
3.00	0.12	0.00	0.00
3.50	0.15	0.00	0.00
4.00	0.18	0.00	0.00
4.50	0.22	0.00	0.00
5.00	0.26	0.00	0.00
5.50	0.31	0.00	0.00
6.00	0.36	0.00	0.00
6.50	0.41	0.00	0.00
7.00	0.46	0.00	0.01
7.50	0.52	0.01	0.04
8.00	0.58	0.02	0.17
8.50	0.65	0.03	0.41
9.00	0.72	0.05	0.77
9.50	0.84	0.09	1.22
10.00	0.96	0.13	1.89
10.50	1.09	0.19	2.92
11.00	1.35	0.32	4.34
11.50	1.73	0.56	6.59
12.00	3.23	1.71	11.32
12.50	5.25	3.50	27.64
13.00	5.63	3.86	68.01
13.50	5.89	4.09	**111.02**
14.00	6.02	4.22	**119.90**
14.50	6.14	4.33	100.18
15.00	6.26	4.44	70.86
15.50	6.33	4.51	50.46
16.00	6.40	4.57	36.63
16.50	6.46	4.63	27.14
17.00	6.52	4.68	20.41
17.50	6.57	4.73	15.94
18.00	6.62	4.78	12.99
18.50	6.67	4.83	11.06
19.00	6.72	4.87	9.70
19.50	6.76	4.91	8.63
20.00	6.80	4.95	7.73
20.50	6.83	4.98	7.04
21.00	6.86	5.01	6.50
21.50	6.89	5.04	5.97
22.00	6.92	5.06	5.47
22.50	6.94	5.08	4.97
23.00	6.96	5.10	4.46
23.50	6.97	5.11	3.98
24.00	**6.98**	**5.12**	3.48
24.50	6.98	5.12	2.97
25.00	6.98	5.12	2.40
25.50	6.98	5.12	1.74
26.00	6.98	5.12	1.13
26.50	6.98	5.12	0.68
27.00	6.98	5.12	0.40
27.50	6.98	5.12	0.24
28.00	6.98	5.12	0.14
28.50	6.98	5.12	0.08
29.00	6.98	5.12	0.05
29.50	6.98	5.12	0.03
30.00	6.98	5.12	0.01
30.50	6.98	5.12	0.01
31.00	6.98	5.12	0.00
31.50	6.98	5.12	0.00
32.00	6.98	5.12	0.00
32.50	6.98	5.12	0.00
33.00	6.98	5.12	0.00
33.50	6.98	5.12	0.00
34.00	6.98	5.12	0.00
34.50	6.98	5.12	0.00
35.00	6.98	5.12	0.00
35.50	6.98	5.12	0.00
36.00	6.98	5.12	0.00
36.50	6.98	5.12	0.00
37.00	6.98	5.12	0.00
37.50	6.98	5.12	0.00
38.00	6.98	5.12	0.00
38.50	6.98	5.12	0.00
39.00	6.98	5.12	0.00
39.50	6.98	5.12	0.00
40.00	6.98	5.12	0.00
40.50	6.98	5.12	0.00
41.00	6.98	5.12	0.00
41.50	6.98	5.12	0.00
42.00	6.98	5.12	0.00
42.50	6.98	5.12	0.00
43.00	6.98	5.12	0.00
43.50	6.98	5.12	0.00
44.00	6.98	5.12	0.00
44.50	6.98	5.12	0.00
45.00	6.98	5.12	0.00
45.50	6.98	5.12	0.00
46.00	6.98	5.12	0.00
46.50	6.98	5.12	0.00
47.00	6.98	5.12	0.00
47.50	6.98	5.12	0.00
48.00	6.98	5.12	0.00

Summary for Pond 2P: Dotson Wetland & Outlets

Inflow Area = 307.700 ac, 7.15% Impervious, Inflow Depth > 5.50" for 100-Year event
Inflow = 411.52 cfs @ 14.02 hrs, Volume= 141.091 af, Incl. 2.00 cfs Base Flow
Outflow = 311.45 cfs @ 14.88 hrs, Volume= 134.305 af, Atten= 24%, Lag= 52.0 min
Primary = 3.66 cfs @ 14.88 hrs, Volume= 8.116 af
Secondary = 307.78 cfs @ 14.88 hrs, Volume= 126.189 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 921.90' Surf.Area= 20.817 ac Storage= 26.525 af
Peak Elev= 923.72' @ 14.88 hrs Surf.Area= 27.336 ac Storage= 71.975 af (45.450 af above start)

Plug-Flow detention time= 310.8 min calculated for 107.664 af (76% of inflow)
Center-of-Mass det. time= 141.4 min (1,073.1 - 931.8)

Volume	Invert	Avail.Storage	Storage Description
#1	919.00'	93.642 af	**Storage to Top of Berm (Prismatic)**Listed below (Recalc)

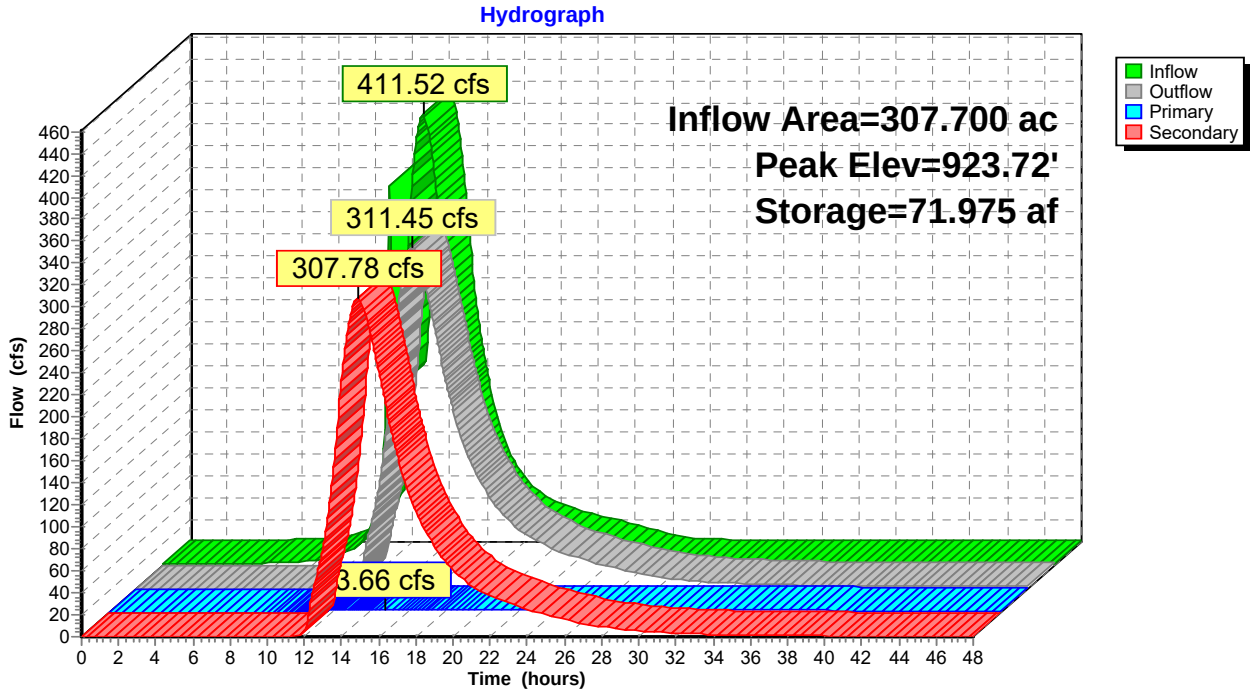
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
919.00	0.034	0.000	0.000
920.00	7.420	3.727	3.727
921.00	10.232	8.826	12.553
922.00	21.993	16.112	28.665
923.00	26.197	24.095	52.760
924.00	27.783	26.990	79.750
924.50	27.783	13.891	93.642

Device	Routing	Invert	Outlet Devices
#1	Device 2	921.90'	**18.0" Horiz. 18" Riser Inlet** C= 0.600 Limited to weir flow at low heads
#2	Primary	920.25'	**12.0" Round CMP_Round 12"** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 920.25' / 920.25' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#3	Secondary	922.20'	**50.0' long + 10.0 '/' SideZ x 12.0' breadth 50' Rock Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

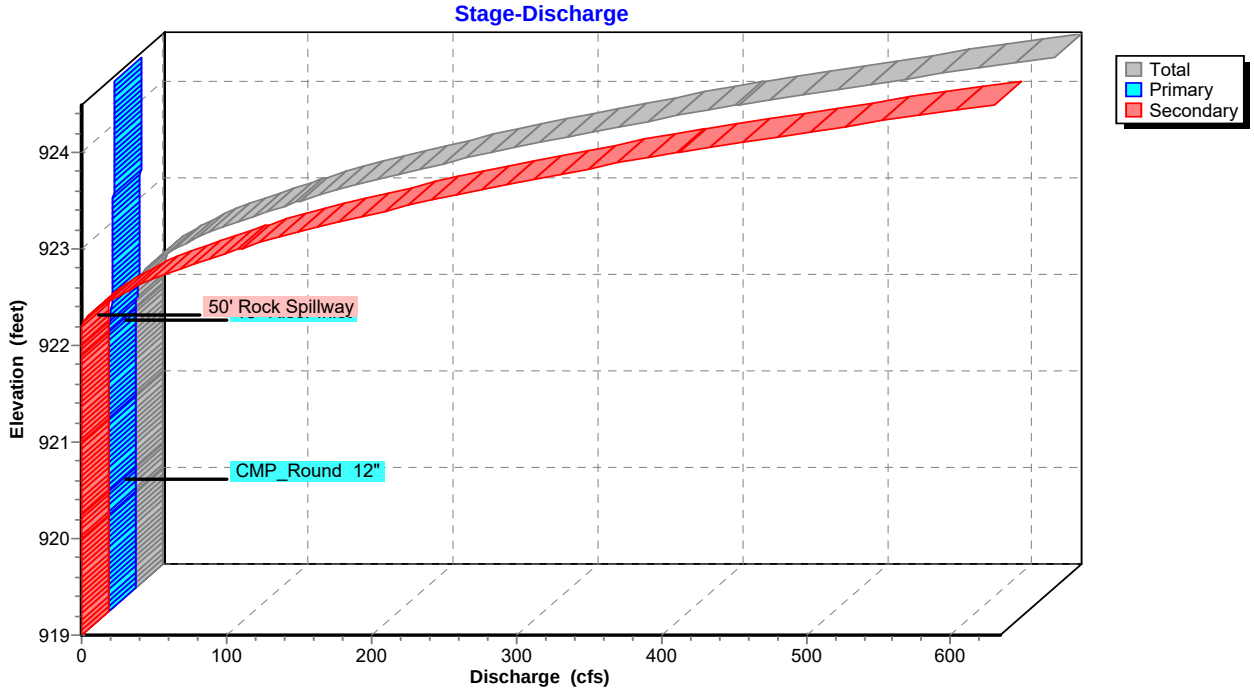
Primary OutFlow Max=3.66 cfs @ 14.88 hrs HW=923.72' (Free Discharge)
└**2=CMP_Round 12"** (Barrel Controls 3.66 cfs @ 4.66 fps)
└**1=18" Riser Inlet** (Passes 3.66 cfs of 11.47 cfs potential flow)

Secondary OutFlow Max=307.69 cfs @ 14.88 hrs HW=923.72' (Free Discharge)
└**3=50' Rock Spillway** (Weir Controls 307.69 cfs @ 3.11 fps)

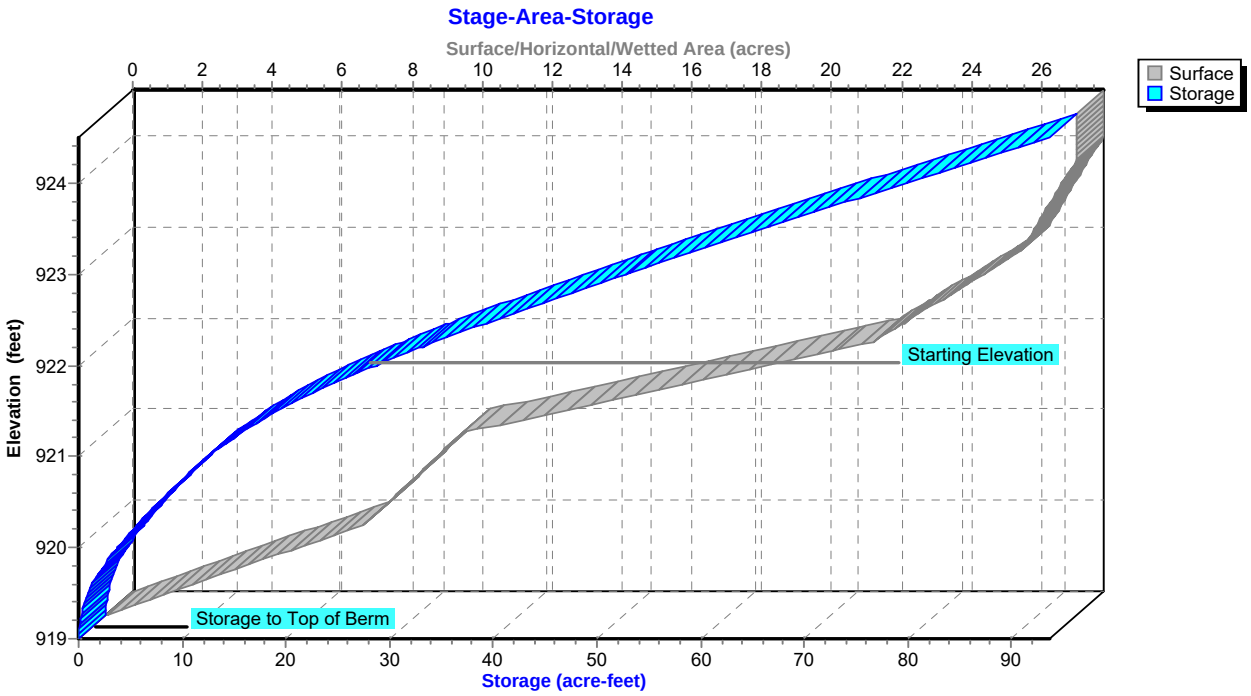
Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Hydrograph for Pond 2P: Dotson Wetland & Outlets

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	2.00	26.529	921.90	0.00	0.00	0.00
1.00	2.00	26.694	921.91	0.02	0.02	0.00
2.00	2.00	26.857	921.92	0.03	0.03	0.00
3.00	2.00	27.018	921.92	0.07	0.07	0.00
4.00	2.00	27.177	921.93	0.10	0.10	0.00
5.00	2.01	27.332	921.94	0.14	0.14	0.00
6.00	2.51	27.505	921.95	0.17	0.17	0.00
7.00	3.13	27.720	921.96	0.22	0.22	0.00
8.00	4.27	27.998	921.97	0.28	0.28	0.00
9.00	6.82	28.417	921.99	0.41	0.41	0.00
10.00	13.56	29.232	922.03	0.69	0.69	0.00
11.00	30.43	30.768	922.09	1.33	1.33	0.00
12.00	150.94	35.458	922.30	6.54	2.39	4.15
13.00	232.03	49.169	922.86	83.02	2.96	80.06
14.00	**411.46**	**65.469**	**923.48**	**235.57**	**3.48**	**232.09**
15.00	289.07	**71.870**	**923.71**	**310.18**	**3.66**	**306.52**
16.00	156.52	66.243	923.51	244.19	3.50	240.69
17.00	91.39	59.224	923.24	169.28	3.29	165.99
18.00	58.88	53.569	923.03	117.64	3.11	114.53
19.00	43.49	49.455	922.87	85.15	2.97	82.18
20.00	34.87	46.559	922.76	63.96	2.86	61.10
21.00	28.75	44.519	922.68	49.83	2.79	47.04
22.00	24.15	42.996	922.62	40.29	2.72	37.57
23.00	19.99	41.790	922.57	33.34	2.68	30.66
24.00	15.91	40.752	922.52	27.80	2.63	25.17
25.00	11.38	39.767	922.48	22.99	2.59	20.41
26.00	6.96	38.808	922.44	18.64	2.55	16.09
27.00	3.97	37.873	922.40	14.70	2.50	12.20
28.00	2.76	37.058	922.37	11.67	2.47	9.21
29.00	2.28	36.398	922.34	9.44	2.43	7.00
30.00	2.10	35.868	922.32	7.80	2.41	5.39
31.00	2.03	35.449	922.30	6.51	2.39	4.12
32.00	2.01	35.112	922.29	5.73	2.37	3.35
33.00	2.00	34.832	922.27	5.08	2.36	2.72
34.00	2.00	34.600	922.26	4.54	2.35	2.19
35.00	2.00	34.409	922.25	4.09	2.34	1.76
36.00	2.00	34.252	922.25	3.73	2.33	1.40
37.00	2.00	34.121	922.24	3.49	2.32	1.16
38.00	2.00	34.004	922.24	3.34	2.32	1.02
39.00	2.00	33.899	922.23	3.21	2.31	0.90
40.00	2.00	33.804	922.23	3.09	2.31	0.78
41.00	2.00	33.718	922.22	2.98	2.30	0.68
42.00	2.00	33.641	922.22	2.89	2.30	0.59
43.00	2.00	33.571	922.22	2.80	2.29	0.51
44.00	2.00	33.508	922.22	2.72	2.29	0.43
45.00	2.00	33.451	922.21	2.65	2.29	0.36
46.00	2.00	33.400	922.21	2.59	2.29	0.30
47.00	2.00	33.354	922.21	2.53	2.28	0.25
48.00	2.00	33.312	922.21	2.48	2.28	0.20

Stage-Discharge for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
919.00	0.00	0.00	0.00
919.05	0.00	0.00	0.00
919.10	0.00	0.00	0.00
919.15	0.00	0.00	0.00
919.20	0.00	0.00	0.00
919.25	0.00	0.00	0.00
919.30	0.00	0.00	0.00
919.35	0.00	0.00	0.00
919.40	0.00	0.00	0.00
919.45	0.00	0.00	0.00
919.50	0.00	0.00	0.00
919.55	0.00	0.00	0.00
919.60	0.00	0.00	0.00
919.65	0.00	0.00	0.00
919.70	0.00	0.00	0.00
919.75	0.00	0.00	0.00
919.80	0.00	0.00	0.00
919.85	0.00	0.00	0.00
919.90	0.00	0.00	0.00
919.95	0.00	0.00	0.00
920.00	0.00	0.00	0.00
920.05	0.00	0.00	0.00
920.10	0.00	0.00	0.00
920.15	0.00	0.00	0.00
920.20	0.00	0.00	0.00
920.25	0.00	0.00	0.00
920.30	0.00	0.00	0.00
920.35	0.00	0.00	0.00
920.40	0.00	0.00	0.00
920.45	0.00	0.00	0.00
920.50	0.00	0.00	0.00
920.55	0.00	0.00	0.00
920.60	0.00	0.00	0.00
920.65	0.00	0.00	0.00
920.70	0.00	0.00	0.00
920.75	0.00	0.00	0.00
920.80	0.00	0.00	0.00
920.85	0.00	0.00	0.00
920.90	0.00	0.00	0.00
920.95	0.00	0.00	0.00
921.00	0.00	0.00	0.00
921.05	0.00	0.00	0.00
921.10	0.00	0.00	0.00
921.15	0.00	0.00	0.00
921.20	0.00	0.00	0.00
921.25	0.00	0.00	0.00
921.30	0.00	0.00	0.00
921.35	0.00	0.00	0.00
921.40	0.00	0.00	0.00
921.45	0.00	0.00	0.00
921.50	0.00	0.00	0.00
921.55	0.00	0.00	0.00
921.60	0.00	0.00	0.00
921.65	0.00	0.00	0.00
921.70	0.00	0.00	0.00
921.75	0.00	0.00	0.00
921.80	0.00	0.00	0.00
921.85	0.00	0.00	0.00
921.90	0.00	0.00	0.00
921.95	0.17	0.17	0.00
922.00	0.49	0.49	0.00
922.05	0.90	0.90	0.00
922.10	1.38	1.38	0.00
922.15	1.93	1.93	0.00
922.20	2.27	2.27	0.00
922.25	3.78	2.33	1.45
922.30	6.52	2.39	4.13
922.35	10.09	2.45	7.64
922.40	14.36	2.50	11.86
922.45	19.34	2.55	16.79
922.50	24.95	2.61	22.34
922.55	31.17	2.66	28.51
922.60	37.97	2.71	35.26
922.65	45.47	2.76	42.72
922.70	53.59	2.81	50.78
922.75	62.32	2.86	59.47
922.80	71.67	2.90	68.77
922.85	80.84	2.95	77.89
922.90	90.43	3.00	87.43
922.95	100.43	3.04	97.39
923.00	110.84	3.08	107.75
923.05	121.86	3.13	118.74
923.10	133.33	3.17	130.15
923.15	145.22	3.21	142.00
923.20	157.54	3.26	154.28
923.25	170.59	3.30	167.30
923.30	184.12	3.34	180.79
923.35	198.13	3.38	194.75
923.40	212.60	3.42	209.18
923.45	227.14	3.46	223.68
923.50	242.09	3.50	238.59
923.55	257.45	3.54	253.92
923.60	273.24	3.57	269.67
923.65	289.17	3.61	285.56
923.70	305.49	3.65	301.84
923.75	322.19	3.69	318.50
923.80	339.26	3.72	335.54
923.85	357.39	3.76	353.63
923.90	375.96	3.80	372.16
923.95	394.98	3.83	391.15
924.00	414.45	3.87	410.58
924.05	434.37	3.90	430.46
924.10	454.73	3.94	450.80
924.15	475.56	3.97	471.58
924.20	496.83	4.01	492.83
924.25	518.56	4.04	514.52
924.30	540.74	4.07	536.67
924.35	563.39	4.11	559.28
924.40	586.49	4.14	582.35
924.45	610.05	4.17	605.88
924.50	**634.08**	**4.20**	**629.87**

Stage-Area-Storage for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Surface (acres)	Storage (acre-feet)
919.00	0.034	0.000
919.05	0.403	0.011
919.10	0.773	0.040
919.15	1.142	0.088
919.20	1.511	0.155
919.25	1.880	0.239
919.30	2.250	0.343
919.35	2.619	0.464
919.40	2.988	0.604
919.45	3.358	0.763
919.50	3.727	0.940
919.55	4.096	1.136
919.60	4.466	1.350
919.65	4.835	1.582
919.70	5.204	1.833
919.75	5.573	2.103
919.80	5.943	2.391
919.85	6.312	2.697
919.90	6.681	3.022
919.95	7.051	3.365
920.00	7.420	3.727
920.05	7.561	4.102
920.10	7.701	4.483
920.15	7.842	4.872
920.20	7.982	5.267
920.25	8.123	5.670
920.30	8.264	6.080
920.35	8.404	6.496
920.40	8.545	6.920
920.45	8.685	7.351
920.50	8.826	7.788
920.55	8.967	8.233
920.60	9.107	8.685
920.65	9.248	9.144
920.70	9.388	9.610
920.75	9.529	10.083
920.80	9.670	10.563
920.85	9.810	11.050
920.90	9.951	11.544
920.95	10.091	12.045
921.00	10.232	12.553
921.05	10.820	13.079
921.10	11.408	13.635
921.15	11.996	14.220
921.20	12.584	14.835
921.25	13.172	15.479
921.30	13.760	16.152
921.35	14.348	16.855
921.40	14.936	17.587
921.45	15.524	18.348
921.50	16.112	19.139
921.55	16.701	19.959
921.60	17.289	20.809
921.65	17.877	21.688
921.70	18.465	22.597
921.75	19.053	23.535
921.80	19.641	24.502
921.85	20.229	25.499
921.90	20.817	26.525
921.95	21.405	27.581
922.00	21.993	28.665
922.05	22.203	29.770
922.10	22.413	30.886
922.15	22.624	32.012
922.20	22.834	33.148
922.25	23.044	34.295
922.30	23.254	35.453
922.35	23.464	36.621
922.40	23.675	37.799
922.45	23.885	38.988
922.50	24.095	40.187
922.55	24.305	41.398
922.60	24.515	42.618
922.65	24.726	43.849
922.70	24.936	45.091
922.75	25.146	46.343
922.80	25.356	47.605
922.85	25.566	48.878
922.90	25.777	50.162
922.95	25.987	51.456
923.00	26.197	52.760
923.05	26.276	54.072
923.10	26.356	55.388
923.15	26.435	56.708
923.20	26.514	58.032
923.25	26.594	59.359
923.30	26.673	60.691
923.35	26.752	62.027
923.40	26.831	63.366
923.45	26.911	64.710
923.50	26.990	66.057
923.55	27.069	67.409
923.60	27.149	68.764
923.65	27.228	70.124
923.70	27.307	71.487
923.75	27.386	72.854
923.80	27.466	74.226
923.85	27.545	75.601
923.90	27.624	76.980
923.95	27.704	78.363
924.00	**27.783**	79.750
924.05	27.783	81.140
924.10	27.783	82.529
924.15	27.783	83.918
924.20	27.783	85.307
924.25	27.783	86.696
924.30	27.783	88.085
924.35	27.783	89.475
924.40	27.783	90.864
924.45	27.783	92.253
924.50	27.783	**93.642**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Wetland Direct Runoff Area=38.900 ac 56.56% Impervious Runoff Depth=0.00"
Flow Length=1,665' Slope=0.1300 '/' Tc=11.9 min CN=89 Runoff=0.00 cfs 0.000 af

Subcatchment 3S: Northwest Runoff Area=193.300 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=20,555' Slope=0.0378 '/' Tc=161.1 min CN=84 Runoff=0.00 cfs 0.000 af

Subcatchment 4S: Northeast Watershed Runoff Area=75.500 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=17,536' Slope=0.0378 '/' Tc=141.8 min CN=84 Runoff=0.00 cfs 0.000 af

Pond 2P: Dotson Wetland & Outlets Peak Elev=922.11' Storage=31.200 af Inflow=2.00 cfs 7.942 af
Primary=1.53 cfs 3.265 af Secondary=0.00 cfs 0.000 af Outflow=1.53 cfs 3.265 af

Total Runoff Area = 307.700 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
92.85% Pervious = 285.700 ac 7.15% Impervious = 22.000 ac

Summary for Subcatchment 1S: Wetland Direct Watershed

This watershed area is the wetland (water) area itself, and the hillside that drains surface water directly to the wetland.

[45] Hint: Runoff=Zero

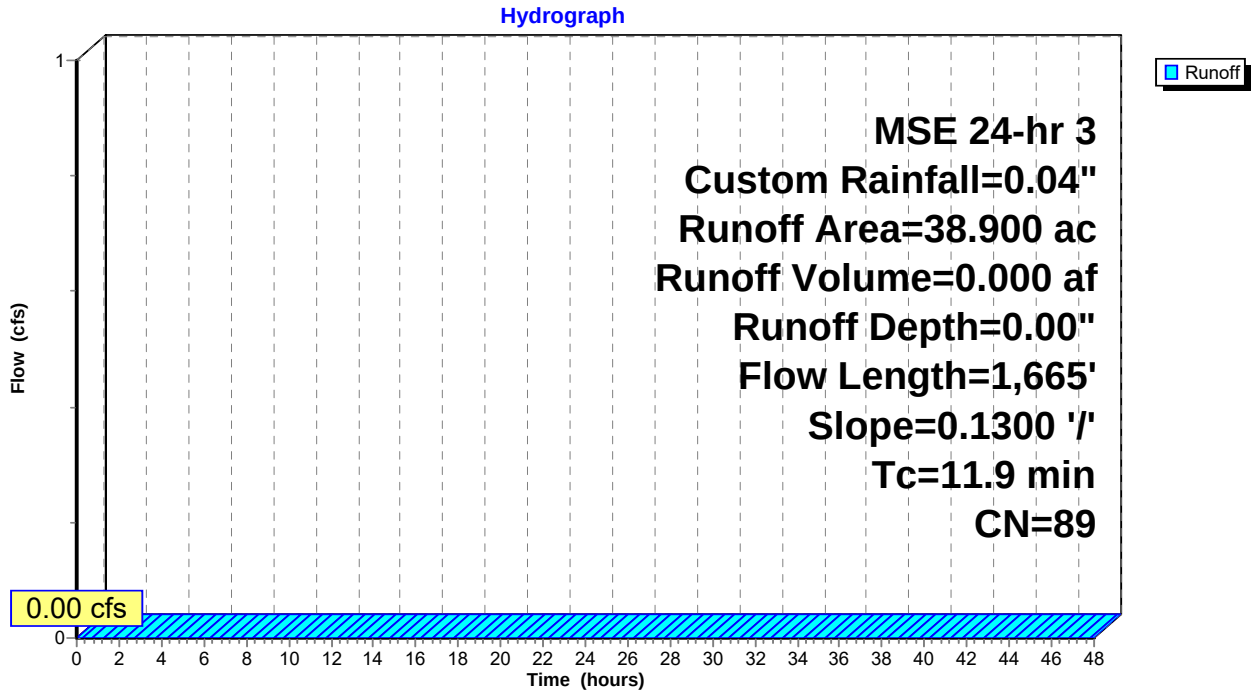
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Custom Rainfall=0.04"

Area (ac)	CN	Description
16.900	78	Meadow, non-grazed, HSG D
22.000	98	Water Surface, HSG A
38.900	89	Weighted Average
16.900		43.44% Pervious Area
22.000		56.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	300	0.1300	0.67		**Sheet Flow, Hillside Initial Sheet Flow** Grass: Short n= 0.150 P2= 7.11"
1.2	175	0.1300	2.52		**Shallow Concentrated Flow, Hillside Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
3.2	1,190		6.16		**Lake or Reservoir, Wetland** Mean Depth= 1.18'
11.9	1,665	Total			

Subcatchment 1S: Wetland Direct Watershed



Hydrograph for Subcatchment 1S: Wetland Direct Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	**0.00**	**0.00**
0.50	0.00	0.00	0.00
1.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00
2.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00
4.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00
5.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00
6.00	0.00	0.00	0.00
6.50	0.00	0.00	0.00
7.00	0.00	0.00	0.00
7.50	0.00	0.00	0.00
8.00	0.00	0.00	0.00
8.50	0.00	0.00	0.00
9.00	0.00	0.00	0.00
9.50	0.00	0.00	0.00
10.00	0.01	0.00	0.00
10.50	0.01	0.00	0.00
11.00	0.01	0.00	0.00
11.50	0.01	0.00	0.00
12.00	0.02	0.00	0.00
12.50	0.03	0.00	0.00
13.00	0.03	0.00	0.00
13.50	0.03	0.00	0.00
14.00	0.03	0.00	0.00
14.50	0.04	0.00	0.00
15.00	0.04	0.00	0.00
15.50	0.04	0.00	0.00
16.00	0.04	0.00	0.00
16.50	0.04	0.00	0.00
17.00	0.04	0.00	0.00
17.50	0.04	0.00	0.00
18.00	0.04	0.00	0.00
18.50	0.04	0.00	0.00
19.00	0.04	0.00	0.00
19.50	0.04	0.00	0.00
20.00	0.04	0.00	0.00
20.50	0.04	0.00	0.00
21.00	0.04	0.00	0.00
21.50	0.04	0.00	0.00
22.00	0.04	0.00	0.00
22.50	0.04	0.00	0.00
23.00	0.04	0.00	0.00
23.50	0.04	0.00	0.00
24.00	**0.04**	0.00	0.00
24.50	0.04	0.00	0.00
25.00	0.04	0.00	0.00
25.50	0.04	0.00	0.00
26.00	0.04	0.00	0.00
26.50	0.04	0.00	0.00
27.00	0.04	0.00	0.00
27.50	0.04	0.00	0.00
28.00	0.04	0.00	0.00
28.50	0.04	0.00	0.00
29.00	0.04	0.00	0.00
29.50	0.04	0.00	0.00
30.00	0.04	0.00	0.00
30.50	0.04	0.00	0.00
31.00	0.04	0.00	0.00
31.50	0.04	0.00	0.00
32.00	0.04	0.00	0.00
32.50	0.04	0.00	0.00
33.00	0.04	0.00	0.00
33.50	0.04	0.00	0.00
34.00	0.04	0.00	0.00
34.50	0.04	0.00	0.00
35.00	0.04	0.00	0.00
35.50	0.04	0.00	0.00
36.00	0.04	0.00	0.00
36.50	0.04	0.00	0.00
37.00	0.04	0.00	0.00
37.50	0.04	0.00	0.00
38.00	0.04	0.00	0.00
38.50	0.04	0.00	0.00
39.00	0.04	0.00	0.00
39.50	0.04	0.00	0.00
40.00	0.04	0.00	0.00
40.50	0.04	0.00	0.00
41.00	0.04	0.00	0.00
41.50	0.04	0.00	0.00
42.00	0.04	0.00	0.00
42.50	0.04	0.00	0.00
43.00	0.04	0.00	0.00
43.50	0.04	0.00	0.00
44.00	0.04	0.00	0.00
44.50	0.04	0.00	0.00
45.00	0.04	0.00	0.00
45.50	0.04	0.00	0.00
46.00	0.04	0.00	0.00
46.50	0.04	0.00	0.00
47.00	0.04	0.00	0.00
47.50	0.04	0.00	0.00
48.00	0.04	0.00	0.00

Summary for Subcatchment 3S: Northwest Watershed

This watershed area was computed as 10% of the total watershed area routing through the West Ditch (1,932.8 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the West ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

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[45] Hint: Runoff=Zero

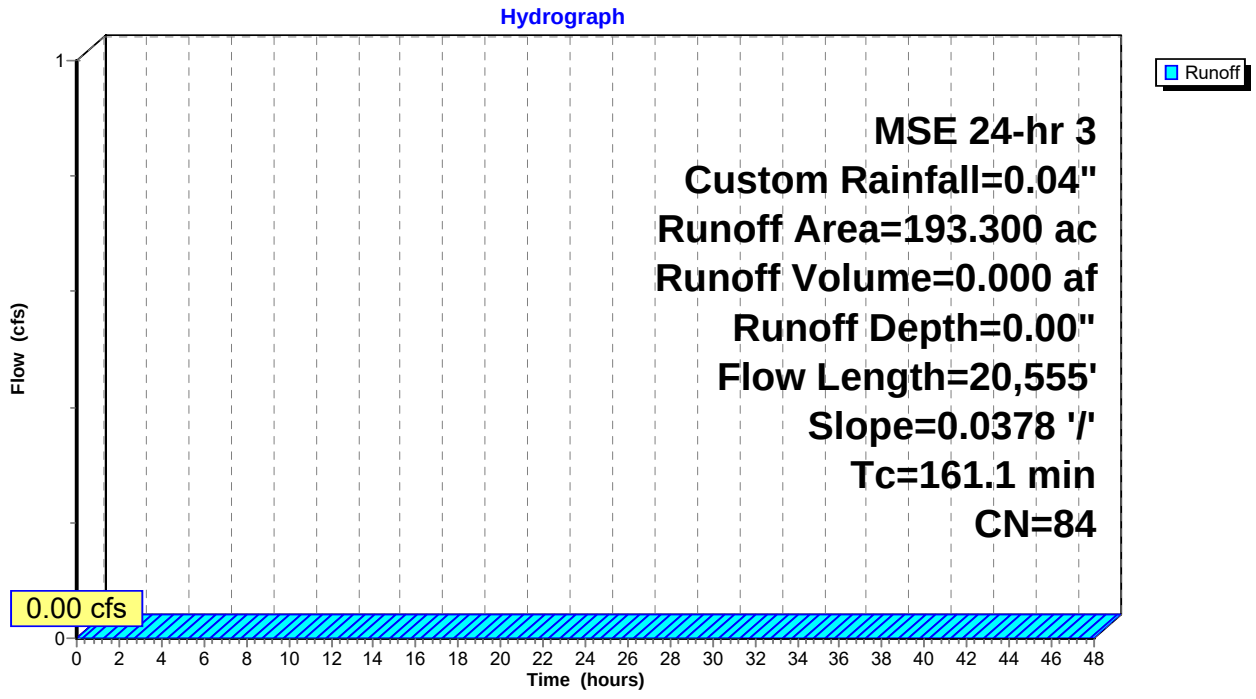
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Custom Rainfall=0.04"

	Area (ac)	CN	Description
*	193.300	84	Weighted Average of Hydrologic Soil Groups
	193.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
161.1	20,555	0.0378	2.13		**Lag/CN Method,**

Subcatchment 3S: Northwest Watershed



Hydrograph for Subcatchment 3S: Northwest Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	**0.00**	**0.00**	29.00	0.04	0.00	0.00
0.50	0.00	0.00	0.00	29.50	0.04	0.00	0.00
1.00	0.00	0.00	0.00	30.00	0.04	0.00	0.00
1.50	0.00	0.00	0.00	30.50	0.04	0.00	0.00
2.00	0.00	0.00	0.00	31.00	0.04	0.00	0.00
2.50	0.00	0.00	0.00	31.50	0.04	0.00	0.00
3.00	0.00	0.00	0.00	32.00	0.04	0.00	0.00
3.50	0.00	0.00	0.00	32.50	0.04	0.00	0.00
4.00	0.00	0.00	0.00	33.00	0.04	0.00	0.00
4.50	0.00	0.00	0.00	33.50	0.04	0.00	0.00
5.00	0.00	0.00	0.00	34.00	0.04	0.00	0.00
5.50	0.00	0.00	0.00	34.50	0.04	0.00	0.00
6.00	0.00	0.00	0.00	35.00	0.04	0.00	0.00
6.50	0.00	0.00	0.00	35.50	0.04	0.00	0.00
7.00	0.00	0.00	0.00	36.00	0.04	0.00	0.00
7.50	0.00	0.00	0.00	36.50	0.04	0.00	0.00
8.00	0.00	0.00	0.00	37.00	0.04	0.00	0.00
8.50	0.00	0.00	0.00	37.50	0.04	0.00	0.00
9.00	0.00	0.00	0.00	38.00	0.04	0.00	0.00
9.50	0.00	0.00	0.00	38.50	0.04	0.00	0.00
10.00	0.01	0.00	0.00	39.00	0.04	0.00	0.00
10.50	0.01	0.00	0.00	39.50	0.04	0.00	0.00
11.00	0.01	0.00	0.00	40.00	0.04	0.00	0.00
11.50	0.01	0.00	0.00	40.50	0.04	0.00	0.00
12.00	0.02	0.00	0.00	41.00	0.04	0.00	0.00
12.50	0.03	0.00	0.00	41.50	0.04	0.00	0.00
13.00	0.03	0.00	0.00	42.00	0.04	0.00	0.00
13.50	0.03	0.00	0.00	42.50	0.04	0.00	0.00
14.00	0.03	0.00	0.00	43.00	0.04	0.00	0.00
14.50	0.04	0.00	0.00	43.50	0.04	0.00	0.00
15.00	0.04	0.00	0.00	44.00	0.04	0.00	0.00
15.50	0.04	0.00	0.00	44.50	0.04	0.00	0.00
16.00	0.04	0.00	0.00	45.00	0.04	0.00	0.00
16.50	0.04	0.00	0.00	45.50	0.04	0.00	0.00
17.00	0.04	0.00	0.00	46.00	0.04	0.00	0.00
17.50	0.04	0.00	0.00	46.50	0.04	0.00	0.00
18.00	0.04	0.00	0.00	47.00	0.04	0.00	0.00
18.50	0.04	0.00	0.00	47.50	0.04	0.00	0.00
19.00	0.04	0.00	0.00	48.00	0.04	0.00	0.00
19.50	0.04	0.00	0.00				
20.00	0.04	0.00	0.00				
20.50	0.04	0.00	0.00				
21.00	0.04	0.00	0.00				
21.50	0.04	0.00	0.00				
22.00	0.04	0.00	0.00				
22.50	0.04	0.00	0.00				
23.00	0.04	0.00	0.00				
23.50	0.04	0.00	0.00				
24.00	**0.04**	0.00	0.00				
24.50	0.04	0.00	0.00				
25.00	0.04	0.00	0.00				
25.50	0.04	0.00	0.00				
26.00	0.04	0.00	0.00				
26.50	0.04	0.00	0.00				
27.00	0.04	0.00	0.00				
27.50	0.04	0.00	0.00				
28.00	0.04	0.00	0.00				
28.50	0.04	0.00	0.00				

Summary for Subcatchment 4S: Northeast Watershed

This watershed area was computed as 10% of the total watershed area routing through the East Ditch (755.2 acres), which does not directly route to the wetland area. Further analysis indicates that flow from the East ditch would still not route to the wetland during a 25-year event. This 10% addition of watershed area was added as a factor of safety in the design. The average landslope was computed by a computer generated surface of the Lidar elevation data for the watershed area.

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[45] Hint: Runoff=Zero

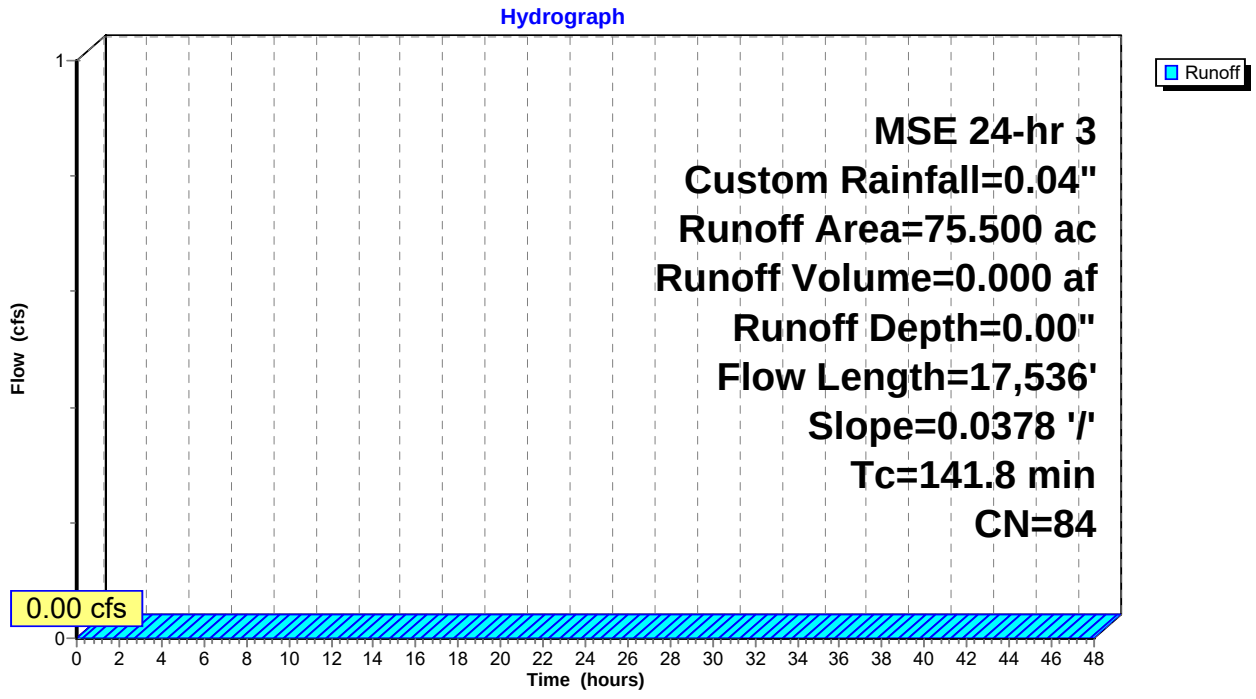
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Pond 2P : Dotson Wetland & Outlets

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Custom Rainfall=0.04"

	Area (ac)	CN	Description
*	75.500	84	Weighted Average of Hydrologic Soil Groups
	75.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
141.8	17,536	0.0378	2.06		**Lag/CN Method,**

Subcatchment 4S: Northeast Watershed



Hydrograph for Subcatchment 4S: Northeast Watershed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	**0.00**	**0.00**	29.00	0.04	0.00	0.00
0.50	0.00	0.00	0.00	29.50	0.04	0.00	0.00
1.00	0.00	0.00	0.00	30.00	0.04	0.00	0.00
1.50	0.00	0.00	0.00	30.50	0.04	0.00	0.00
2.00	0.00	0.00	0.00	31.00	0.04	0.00	0.00
2.50	0.00	0.00	0.00	31.50	0.04	0.00	0.00
3.00	0.00	0.00	0.00	32.00	0.04	0.00	0.00
3.50	0.00	0.00	0.00	32.50	0.04	0.00	0.00
4.00	0.00	0.00	0.00	33.00	0.04	0.00	0.00
4.50	0.00	0.00	0.00	33.50	0.04	0.00	0.00
5.00	0.00	0.00	0.00	34.00	0.04	0.00	0.00
5.50	0.00	0.00	0.00	34.50	0.04	0.00	0.00
6.00	0.00	0.00	0.00	35.00	0.04	0.00	0.00
6.50	0.00	0.00	0.00	35.50	0.04	0.00	0.00
7.00	0.00	0.00	0.00	36.00	0.04	0.00	0.00
7.50	0.00	0.00	0.00	36.50	0.04	0.00	0.00
8.00	0.00	0.00	0.00	37.00	0.04	0.00	0.00
8.50	0.00	0.00	0.00	37.50	0.04	0.00	0.00
9.00	0.00	0.00	0.00	38.00	0.04	0.00	0.00
9.50	0.00	0.00	0.00	38.50	0.04	0.00	0.00
10.00	0.01	0.00	0.00	39.00	0.04	0.00	0.00
10.50	0.01	0.00	0.00	39.50	0.04	0.00	0.00
11.00	0.01	0.00	0.00	40.00	0.04	0.00	0.00
11.50	0.01	0.00	0.00	40.50	0.04	0.00	0.00
12.00	0.02	0.00	0.00	41.00	0.04	0.00	0.00
12.50	0.03	0.00	0.00	41.50	0.04	0.00	0.00
13.00	0.03	0.00	0.00	42.00	0.04	0.00	0.00
13.50	0.03	0.00	0.00	42.50	0.04	0.00	0.00
14.00	0.03	0.00	0.00	43.00	0.04	0.00	0.00
14.50	0.04	0.00	0.00	43.50	0.04	0.00	0.00
15.00	0.04	0.00	0.00	44.00	0.04	0.00	0.00
15.50	0.04	0.00	0.00	44.50	0.04	0.00	0.00
16.00	0.04	0.00	0.00	45.00	0.04	0.00	0.00
16.50	0.04	0.00	0.00	45.50	0.04	0.00	0.00
17.00	0.04	0.00	0.00	46.00	0.04	0.00	0.00
17.50	0.04	0.00	0.00	46.50	0.04	0.00	0.00
18.00	0.04	0.00	0.00	47.00	0.04	0.00	0.00
18.50	0.04	0.00	0.00	47.50	0.04	0.00	0.00
19.00	0.04	0.00	0.00	48.00	0.04	0.00	0.00
19.50	0.04	0.00	0.00				
20.00	0.04	0.00	0.00				
20.50	0.04	0.00	0.00				
21.00	0.04	0.00	0.00				
21.50	0.04	0.00	0.00				
22.00	0.04	0.00	0.00				
22.50	0.04	0.00	0.00				
23.00	0.04	0.00	0.00				
23.50	0.04	0.00	0.00				
24.00	**0.04**	0.00	0.00				
24.50	0.04	0.00	0.00				
25.00	0.04	0.00	0.00				
25.50	0.04	0.00	0.00				
26.00	0.04	0.00	0.00				
26.50	0.04	0.00	0.00				
27.00	0.04	0.00	0.00				
27.50	0.04	0.00	0.00				
28.00	0.04	0.00	0.00				
28.50	0.04	0.00	0.00				

Summary for Pond 2P: Dotson Wetland & Outlets

Inflow Area = 307.700 ac, 7.15% Impervious, Inflow Depth > 0.31" for Custom event
Inflow = 2.00 cfs @ 0.00 hrs, Volume= 7.942 af, Incl. 2.00 cfs Base Flow
Outflow = 1.53 cfs @ 48.00 hrs, Volume= 3.265 af, Atten= 23%, Lag= 2,880.0 min
Primary = 1.53 cfs @ 48.00 hrs, Volume= 3.265 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 921.90' Surf.Area= 20.817 ac Storage= 26.525 af
Peak Elev= 922.11' @ 48.00 hrs Surf.Area= 22.472 ac Storage= 31.200 af (4.675 af above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 483.1 min (1,923.1 - 1,440.0)

Volume	Invert	Avail.Storage	Storage Description
#1	919.00'	93.642 af	**Storage to Top of Berm (Prismatic)**Listed below (Recalc)

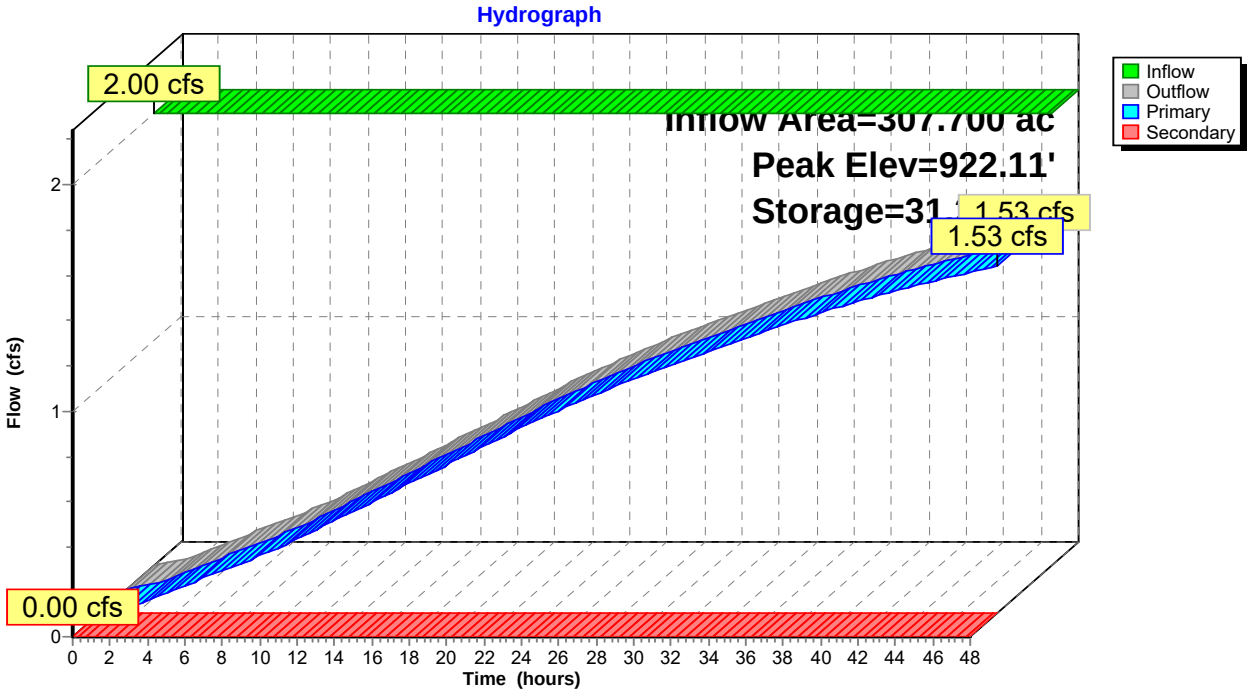
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
919.00	0.034	0.000	0.000
920.00	7.420	3.727	3.727
921.00	10.232	8.826	12.553
922.00	21.993	16.112	28.665
923.00	26.197	24.095	52.760
924.00	27.783	26.990	79.750
924.50	27.783	13.891	93.642

Device	Routing	Invert	Outlet Devices
#1	Device 2	921.90'	**18.0" Horiz. 18" Riser Inlet** C= 0.600 Limited to weir flow at low heads
#2	Primary	920.25'	**12.0" Round CMP_Round 12"** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 920.25' / 920.25' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#3	Secondary	922.20'	**50.0' long + 10.0 '/' SideZ x 12.0' breadth 50' Rock Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

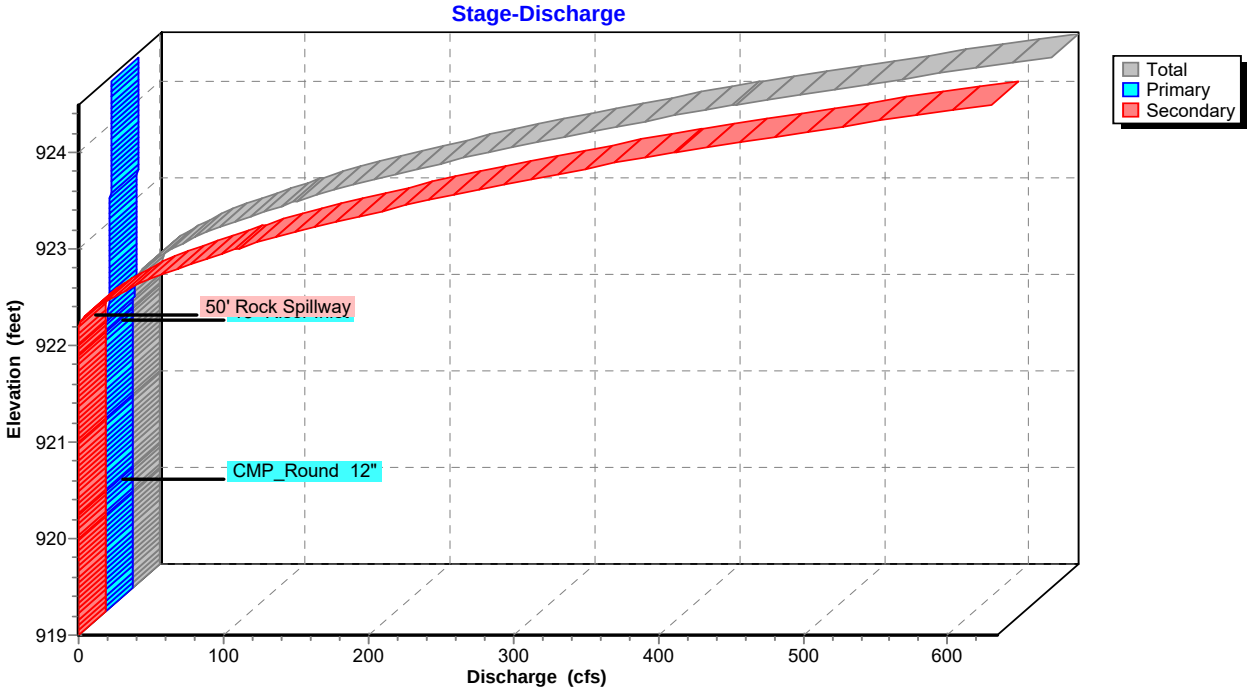
Primary OutFlow Max=1.53 cfs @ 48.00 hrs HW=922.11' (Free Discharge)
└**2=CMP_Round 12"** (Passes 1.53 cfs of 2.17 cfs potential flow)
└**1=18" Riser Inlet** (Weir Controls 1.53 cfs @ 1.51 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=921.90' (Free Discharge)
└**3=50' Rock Spillway** (Controls 0.00 cfs)

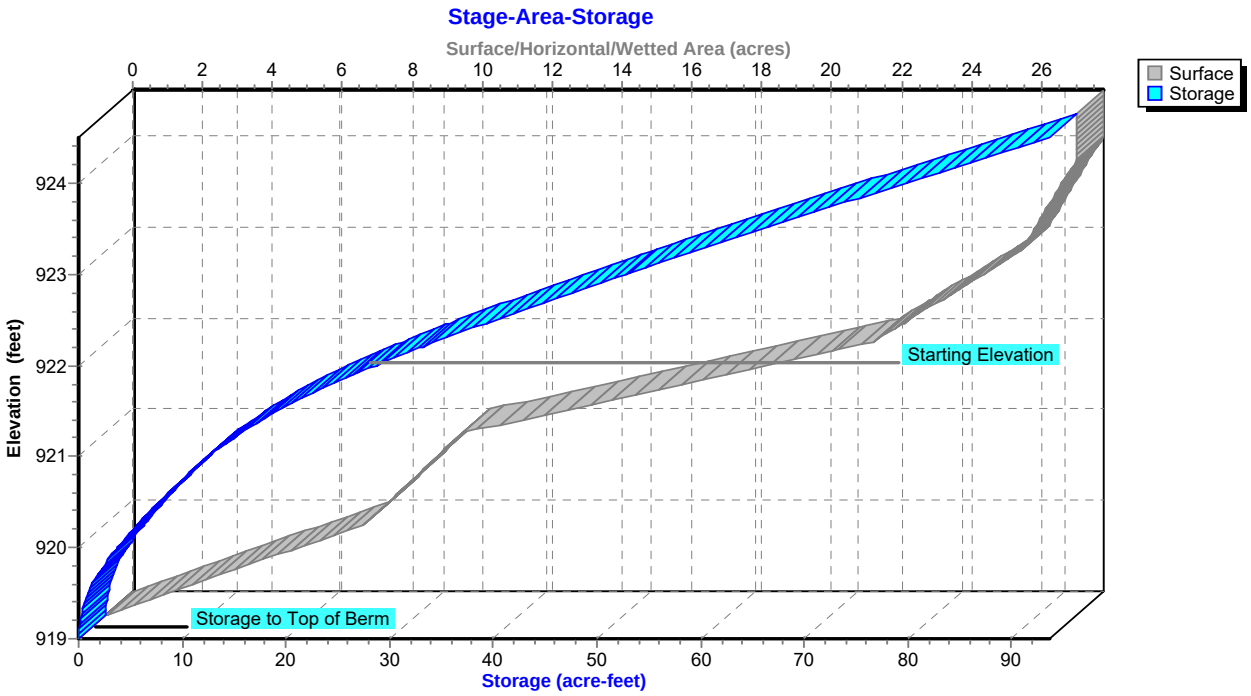
Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Pond 2P: Dotson Wetland & Outlets



Hydrograph for Pond 2P: Dotson Wetland & Outlets

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)
0.00	**2.00**	26.529	921.90	0.00	0.00	**0.00**
1.00	2.00	26.694	921.91	0.02	0.02	0.00
2.00	2.00	26.857	921.92	0.03	0.03	0.00
3.00	2.00	27.018	921.92	0.07	0.07	0.00
4.00	2.00	27.177	921.93	0.10	0.10	0.00
5.00	2.00	27.332	921.94	0.14	0.14	0.00
6.00	2.00	27.485	921.95	0.17	0.17	0.00
7.00	2.00	27.635	921.95	0.20	0.20	0.00
8.00	2.00	27.782	921.96	0.24	0.24	0.00
9.00	2.00	27.926	921.97	0.27	0.27	0.00
10.00	2.00	28.068	921.97	0.30	0.30	0.00
11.00	2.00	28.207	921.98	0.35	0.35	0.00
12.00	2.00	28.342	921.99	0.39	0.39	0.00
13.00	2.00	28.473	921.99	0.43	0.43	0.00
14.00	2.00	28.601	922.00	0.47	0.47	0.00
15.00	2.00	28.726	922.00	0.51	0.51	0.00
16.00	2.00	28.848	922.01	0.55	0.55	0.00
17.00	2.00	28.966	922.01	0.59	0.59	0.00
18.00	2.00	29.081	922.02	0.63	0.63	0.00
19.00	2.00	29.192	922.02	0.67	0.67	0.00
20.00	2.00	29.300	922.03	0.71	0.71	0.00
21.00	2.00	29.404	922.03	0.76	0.76	0.00
22.00	2.00	29.505	922.04	0.80	0.80	0.00
23.00	2.00	29.603	922.04	0.84	0.84	0.00
24.00	2.00	29.697	922.05	0.88	0.88	0.00
25.00	2.00	29.789	922.05	0.91	0.91	0.00
26.00	2.00	29.877	922.05	0.95	0.95	0.00
27.00	2.00	29.963	922.06	0.98	0.98	0.00
28.00	2.00	30.045	922.06	1.02	1.02	0.00
29.00	2.00	30.125	922.07	1.05	1.05	0.00
30.00	2.00	30.202	922.07	1.08	1.08	0.00
31.00	2.00	30.277	922.07	1.11	1.11	0.00
32.00	2.00	30.349	922.08	1.14	1.14	0.00
33.00	2.00	30.419	922.08	1.17	1.17	0.00
34.00	2.00	30.486	922.08	1.20	1.20	0.00
35.00	2.00	30.551	922.09	1.23	1.23	0.00
36.00	2.00	30.614	922.09	1.26	1.26	0.00
37.00	2.00	30.674	922.09	1.29	1.29	0.00
38.00	2.00	30.732	922.09	1.31	1.31	0.00
39.00	2.00	30.787	922.10	1.34	1.34	0.00
40.00	2.00	30.841	922.10	1.37	1.37	0.00
41.00	2.00	30.892	922.10	1.39	1.39	0.00
42.00	2.00	30.942	922.10	1.41	1.41	0.00
43.00	2.00	30.989	922.10	1.44	1.44	0.00
44.00	2.00	31.035	922.11	1.46	1.46	0.00
45.00	2.00	31.079	922.11	1.48	1.48	0.00
46.00	2.00	31.122	922.11	1.50	1.50	0.00
47.00	2.00	31.162	922.11	1.52	1.52	0.00
48.00	2.00	**31.202**	**922.11**	**1.53**	**1.53**	0.00

Stage-Discharge for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
919.00	0.00	0.00	0.00
919.05	0.00	0.00	0.00
919.10	0.00	0.00	0.00
919.15	0.00	0.00	0.00
919.20	0.00	0.00	0.00
919.25	0.00	0.00	0.00
919.30	0.00	0.00	0.00
919.35	0.00	0.00	0.00
919.40	0.00	0.00	0.00
919.45	0.00	0.00	0.00
919.50	0.00	0.00	0.00
919.55	0.00	0.00	0.00
919.60	0.00	0.00	0.00
919.65	0.00	0.00	0.00
919.70	0.00	0.00	0.00
919.75	0.00	0.00	0.00
919.80	0.00	0.00	0.00
919.85	0.00	0.00	0.00
919.90	0.00	0.00	0.00
919.95	0.00	0.00	0.00
920.00	0.00	0.00	0.00
920.05	0.00	0.00	0.00
920.10	0.00	0.00	0.00
920.15	0.00	0.00	0.00
920.20	0.00	0.00	0.00
920.25	0.00	0.00	0.00
920.30	0.00	0.00	0.00
920.35	0.00	0.00	0.00
920.40	0.00	0.00	0.00
920.45	0.00	0.00	0.00
920.50	0.00	0.00	0.00
920.55	0.00	0.00	0.00
920.60	0.00	0.00	0.00
920.65	0.00	0.00	0.00
920.70	0.00	0.00	0.00
920.75	0.00	0.00	0.00
920.80	0.00	0.00	0.00
920.85	0.00	0.00	0.00
920.90	0.00	0.00	0.00
920.95	0.00	0.00	0.00
921.00	0.00	0.00	0.00
921.05	0.00	0.00	0.00
921.10	0.00	0.00	0.00
921.15	0.00	0.00	0.00
921.20	0.00	0.00	0.00
921.25	0.00	0.00	0.00
921.30	0.00	0.00	0.00
921.35	0.00	0.00	0.00
921.40	0.00	0.00	0.00
921.45	0.00	0.00	0.00
921.50	0.00	0.00	0.00
921.55	0.00	0.00	0.00
921.60	0.00	0.00	0.00
921.65	0.00	0.00	0.00
921.70	0.00	0.00	0.00
921.75	0.00	0.00	0.00
921.80	0.00	0.00	0.00
921.85	0.00	0.00	0.00
921.90	0.00	0.00	0.00
921.95	0.17	0.17	0.00
922.00	0.49	0.49	0.00
922.05	0.90	0.90	0.00
922.10	1.38	1.38	0.00
922.15	1.93	1.93	0.00
922.20	2.27	2.27	0.00
922.25	3.78	2.33	1.45
922.30	6.52	2.39	4.13
922.35	10.09	2.45	7.64
922.40	14.36	2.50	11.86
922.45	19.34	2.55	16.79
922.50	24.95	2.61	22.34
922.55	31.17	2.66	28.51
922.60	37.97	2.71	35.26
922.65	45.47	2.76	42.72
922.70	53.59	2.81	50.78
922.75	62.32	2.86	59.47
922.80	71.67	2.90	68.77
922.85	80.84	2.95	77.89
922.90	90.43	3.00	87.43
922.95	100.43	3.04	97.39
923.00	110.84	3.08	107.75
923.05	121.86	3.13	118.74
923.10	133.33	3.17	130.15
923.15	145.22	3.21	142.00
923.20	157.54	3.26	154.28
923.25	170.59	3.30	167.30
923.30	184.12	3.34	180.79
923.35	198.13	3.38	194.75
923.40	212.60	3.42	209.18
923.45	227.14	3.46	223.68
923.50	242.09	3.50	238.59
923.55	257.45	3.54	253.92
923.60	273.24	3.57	269.67
923.65	289.17	3.61	285.56
923.70	305.49	3.65	301.84
923.75	322.19	3.69	318.50
923.80	339.26	3.72	335.54
923.85	357.39	3.76	353.63
923.90	375.96	3.80	372.16
923.95	394.98	3.83	391.15
924.00	414.45	3.87	410.58
924.05	434.37	3.90	430.46
924.10	454.73	3.94	450.80
924.15	475.56	3.97	471.58
924.20	496.83	4.01	492.83
924.25	518.56	4.04	514.52
924.30	540.74	4.07	536.67
924.35	563.39	4.11	559.28
924.40	586.49	4.14	582.35
924.45	610.05	4.17	605.88
924.50	**634.08**	**4.20**	**629.87**

Stage-Area-Storage for Pond 2P: Dotson Wetland & Outlets

Elevation (feet)	Surface (acres)	Storage (acre-feet)
919.00	0.034	0.000
919.05	0.403	0.011
919.10	0.773	0.040
919.15	1.142	0.088
919.20	1.511	0.155
919.25	1.880	0.239
919.30	2.250	0.343
919.35	2.619	0.464
919.40	2.988	0.604
919.45	3.358	0.763
919.50	3.727	0.940
919.55	4.096	1.136
919.60	4.466	1.350
919.65	4.835	1.582
919.70	5.204	1.833
919.75	5.573	2.103
919.80	5.943	2.391
919.85	6.312	2.697
919.90	6.681	3.022
919.95	7.051	3.365
920.00	7.420	3.727
920.05	7.561	4.102
920.10	7.701	4.483
920.15	7.842	4.872
920.20	7.982	5.267
920.25	8.123	5.670
920.30	8.264	6.080
920.35	8.404	6.496
920.40	8.545	6.920
920.45	8.685	7.351
920.50	8.826	7.788
920.55	8.967	8.233
920.60	9.107	8.685
920.65	9.248	9.144
920.70	9.388	9.610
920.75	9.529	10.083
920.80	9.670	10.563
920.85	9.810	11.050
920.90	9.951	11.544
920.95	10.091	12.045
921.00	10.232	12.553
921.05	10.820	13.079
921.10	11.408	13.635
921.15	11.996	14.220
921.20	12.584	14.835
921.25	13.172	15.479
921.30	13.760	16.152
921.35	14.348	16.855
921.40	14.936	17.587
921.45	15.524	18.348
921.50	16.112	19.139
921.55	16.701	19.959
921.60	17.289	20.809
921.65	17.877	21.688
921.70	18.465	22.597
921.75	19.053	23.535
921.80	19.641	24.502
921.85	20.229	25.499
921.90	20.817	26.525
921.95	21.405	27.581
922.00	21.993	28.665
922.05	22.203	29.770
922.10	22.413	30.886
922.15	22.624	32.012
922.20	22.834	33.148
922.25	23.044	34.295
922.30	23.254	35.453
922.35	23.464	36.621
922.40	23.675	37.799
922.45	23.885	38.988
922.50	24.095	40.187
922.55	24.305	41.398
922.60	24.515	42.618
922.65	24.726	43.849
922.70	24.936	45.091
922.75	25.146	46.343
922.80	25.356	47.605
922.85	25.566	48.878
922.90	25.777	50.162
922.95	25.987	51.456
923.00	26.197	52.760
923.05	26.276	54.072
923.10	26.356	55.388
923.15	26.435	56.708
923.20	26.514	58.032
923.25	26.594	59.359
923.30	26.673	60.691
923.35	26.752	62.027
923.40	26.831	63.366
923.45	26.911	64.710
923.50	26.990	66.057
923.55	27.069	67.409
923.60	27.149	68.764
923.65	27.228	70.124
923.70	27.307	71.487
923.75	27.386	72.854
923.80	27.466	74.226
923.85	27.545	75.601
923.90	27.624	76.980
923.95	27.704	78.363
924.00	**27.783**	79.750
924.05	27.783	81.140
924.10	27.783	82.529
924.15	27.783	83.918
924.20	27.783	85.307
924.25	27.783	86.696
924.30	27.783	88.085
924.35	27.783	89.475
924.40	27.783	90.864
924.45	27.783	92.253
924.50	27.783	**93.642**

Events for Subcatchment 1S: Wetland Direct Watershed

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5-Year	3.86	146.04	8.726	2.69
10-Year	4.50	177.08	10.682	3.30
25-Year	5.42	221.58	13.535	4.18
100-Year	**6.98**	**296.58**	**18.440**	**5.69**
Custom	0.04	0.00	0.000	0.00

Events for Subcatchment 3S: Northwest Watershed

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5-Year	3.86	123.63	36.214	2.25
10-Year	4.50	155.32	45.370	2.82
25-Year	5.42	201.75	58.905	3.66
100-Year	**6.98**	**281.62**	**82.490**	**5.12**
Custom	0.04	0.00	0.000	0.00

Events for Subcatchment 4S: Northeast Watershed

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5-Year	3.86	53.10	14.145	2.25
10-Year	4.50	66.58	17.721	2.82
25-Year	5.42	86.42	23.007	3.66
100-Year	**6.98**	**120.59**	**32.219**	**5.12**
Custom	0.04	0.00	0.000	0.00

Events for Pond 2P: Dotson Wetland & Outlets

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (acre-feet)
5-Year	182.63	113.46	3.10	110.36	923.01	53.076
10-Year	228.47	150.97	3.23	147.74	923.17	57.328
25-Year	295.70	209.15	3.41	205.74	923.39	63.045
100-Year	**411.52**	**311.45**	**3.66**	**307.78**	**923.72**	**71.975**
Custom	2.00	1.53	1.53	0.00	922.11	31.200

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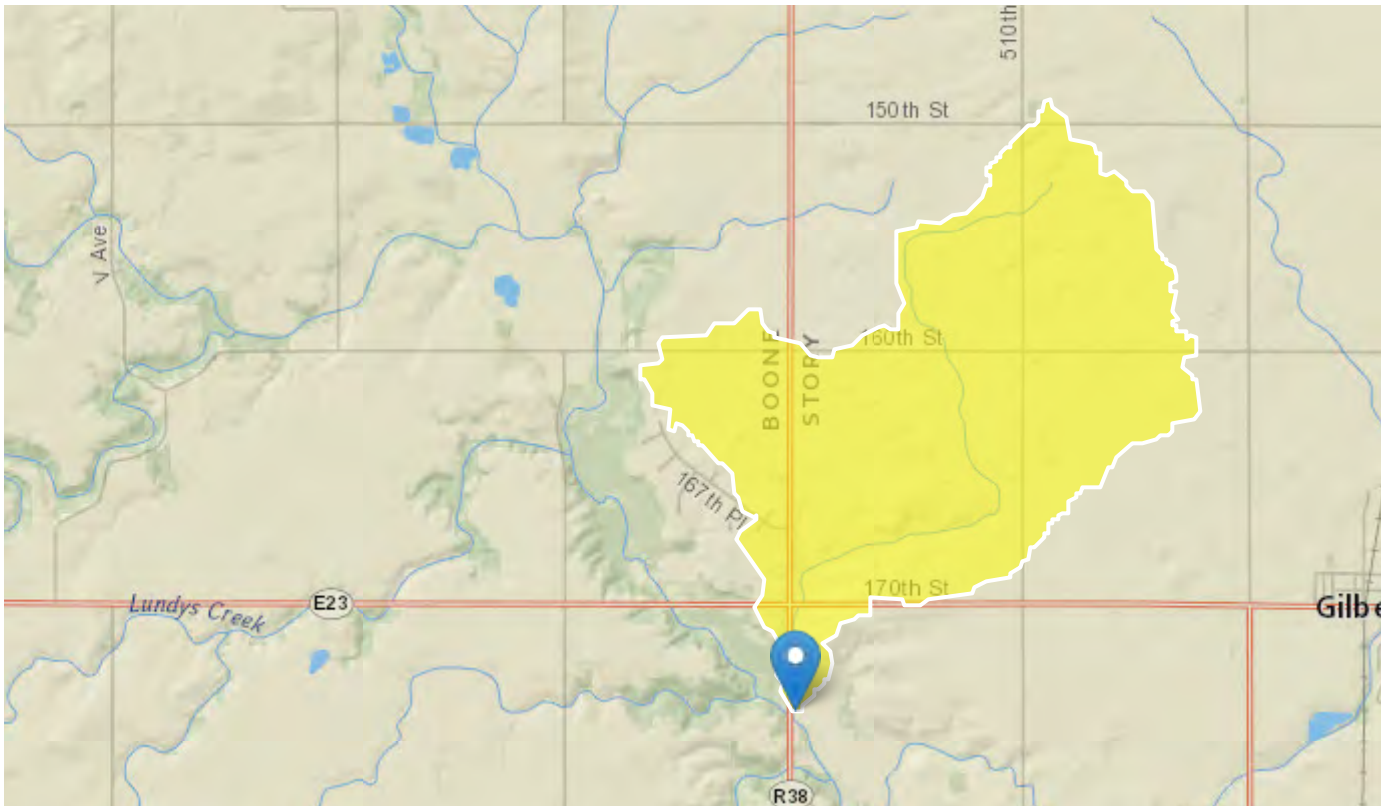
GREAT LAKES/ATLANTIC REGION
7322 Newman Blvd., Bldg. 2
Dexter, MI 48130
(734) 623-2000
www.ducks.org

Appendix A-2

StreamStats Reports

StreamStats Report - Story County - Dotson - SW Corner Watershed

Region ID: IA
Workspace ID: IA20210108171344571000
Clicked Point (Latitude, Longitude): 42.10021, -93.69835
Time: 2021-01-08 11:14:01 -0600



Watershed taken at a point along drainage ditch at the SW Corner of the Proposed Wetland.

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	3.02	square miles
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	4.47	inches
CCM	Constant of channel maintenance computed as drainage area divided by total stream length	0.54	square mile per mile

Parameter Code	Parameter Description	Value	Unit
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	5.566	miles
BFI	Proportion of mean annual flow that is from ground water (base flow)	0.5348	dimensionless
SSURGOA	Percentage of area of Hydrologic Soil Type A from SSURGO	1.63	percent
SSURGOC	Percentage of area of Hydrologic Soil Type C from SSURGO	0	percent
PRECIP	Mean Annual Precipitation	34.33	inches
RSD	Relative stream density first defined in SIR 2012_5171	0.29	dimensionless
HYSEP	Median percentage of baseflow to annual streamflow	53.92	percent
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.635	dimensionless
SSURGOB	Percentage of area of Hydrologic Soil Type B from SSURGO	98.4	percent
SSURGOD	Percentage of area of Hydrologic Soil Type D from SSURGO	0	percent
TAU_ANN_G	Tau, Average annual base-flow recession time constant as defined in SIR 2008-5065	22.48	days
BASLENAH	Basin length from outlet to basin divide determined using the method in the ArcHydro Toolset	2.98	miles
BSHAPE	Basin Shape Factor for Area	2.94	dimensionless
BSLDEM10M	Mean basin slope computed from 10 m DEM	2.14	percent
CSL100	Longest flow path slope in feet per miles, using DEM	32.3	feet per mi
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	25.4	feet per mi
DESMOIN	Area underlain by Des Moines Lobe	100	percent
DRNFREQ	Number of first order streams per square mile of drainage area	0.99	1st-order streams per square mile

Parameter Code	Parameter Description	Value	Unit
FOSTREAM	Number of First Order Streams	3	dimensionless
HIGHREG	HIGHREG	1	dimensionless
LC11CRPHAY	Percentage of cultivated crops and hay, classes 81 and 82, from NLCD 2011	91.7	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	6.35	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.56	percent
PRJULDEC10	Basin average mean precipitation for July to December from PRISM 1981-2010	3.05	inches
SSURGOKSAT	Saturated hydraulic conductivity in micrometers per second from NRCS SSURGO database	12.18	micrometers per second

Peak-Flow Statistics Parameters[Peak Region 1 2013 5086]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.02	square miles	0.06	5464
I24H10Y	24 Hour 10 Year Precipitation	4.47	inches	3.58	4.5
CCM	Constant of Channel Maintenance	0.54	square mile per mile	0.11	3.87
STRMTOT	Stream Length Total	5.566	miles		

Peak-Flow Statistics Flow Report[Peak Region 1 2013 5086]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	SEp
50_percent_AEP_flood	170	ft^3/s	85.5	338	41.6
20_percent_AEP_flood	413	ft^3/s	238	717	32.6
10_percent_AEP_flood	638	ft^3/s	371	1100	31.8
4_percent_AEP_flood	975	ft^3/s	552	1720	33.2
2_percent_AEP_flood	1250	ft^3/s	680	2300	35.6
1_percent_AEP_flood	1560	ft^3/s	818	2980	38

Statistic	Value	Unit	PII	PIu	SEp
0_5_percent_AEP_flood	1910	ft^3/s	955	3820	41
0_2_percent_AEP_flood	2330	ft^3/s	1090	4970	45.2

Peak-Flow Statistics Citations

Eash, D.A., Barnes, K.K., and Veilleux, A.G.,2013, Methods for estimating annual exceedance-probability discharges for streams in Iowa, based on data through water year 2010: U.S. Geological Survey Scientific Investigations Report 2013-5086, 63 p. with a (http://pubs.usgs.gov/sir/2013/5086/)

Low-Flow Statistics Parameters[Low Flow Northwest annual 2012 5171]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.02	square miles	23.4	5464
BFI	Base Flow Index	0.5348	dimensionless	0.358	0.623
SSURGOA	SSURGO Percent Hydrologic Soil Type A	1.63	percent	0	7.87

Low-Flow Statistics Disclaimers[Low Flow Northwest annual 2012 5171]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report[Low Flow Northwest annual 2012 5171]

Statistic	Value	Unit
1 Day 10 Year Low Flow	0.000649	ft^3/s
7 Day 10 Year Low Flow	0.00099	ft^3/s
30 Day 10 Year Low Flow	0.00645	ft^3/s
30 Day 5 Year Low Flow	0.0242	ft^3/s

Low-Flow Statistics Citations

Eash, D.A., and Barnes, K.K.,2012, Methods for estimating selected low-flow frequency statistics and harmonic mean flows for streams in Iowa: U.S. Geological Survey Scientific Investigations Report 2012-5171, 99 p. (http://pubs.usgs.gov/sir/2012/5171/)

Flow-Duration Statistics Parameters[Statewide Flow Duration 2012 5232]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.02	square miles	15.5	7782
SSURGOC	SSURGO Percent Hydrologic Soil Type C	0	percent	0.09	83.5
PRECIP	Mean Annual Precipitation	34.33	inches	27.7	38
RSD	Relative Stream Density	0.29	dimensionless	0.22	0.49
HYSEP	Hydrograph separation percent	53.92	percent	20.3	78
STREAM_VARG	Streamflow Variability Index from Grid	0.635	dimensionless	0.21	0.76
SSURGOB	SSURGO Percent Hydrologic Soil Type B	98.4	percent	5.7	99.4
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	57

Flow-Duration Statistics Disclaimers[Statewide Flow Duration 2012 5232]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Flow-Duration Statistics Flow Report[Statewide Flow Duration 2012 5232]

Statistic	Value	Unit
1 Percent Duration	19.7	ft^3/s
5 Percent Duration	3.77	ft^3/s
10 Percent Duration	1.85	ft^3/s
15 Percent Duration	2.02	ft^3/s
20 Percent Duration	1.64	ft^3/s
30 Percent Duration	1.25	ft^3/s
40 Percent Duration	0.917	ft^3/s
50 Percent Duration	0.72	ft^3/s
60 Percent Duration	0.522	ft^3/s
70 Percent Duration	0.319	ft^3/s
80 Percent Duration	0.0937	ft^3/s

Statistic	Value	Unit
85 Percent Duration	0.0603	ft^3/s
90 Percent Duration	0.0389	ft^3/s
95 Percent Duration	0.0152	ft^3/s
99 Percent Duration	0.00358	ft^3/s

Flow-Duration Statistics Citations

Linhart, S.M., Nania, J.F., Sanders, C.L., Jr., and Archfield, S.A.,2012, Computing daily mean streamflow at ungaged locations in Iowa by using the Flow Anywhere and Flow Duration Curve Transfer statistical methods: U.S. Geological Survey Scientific Investigations Report 2012–5232, 50 p. (http://pubs.usgs.gov/sir/2012/5232/)

Seasonal Flow Statistics Parameters[Low Flow Northwest Apr Jun 2016 5111]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.02	square miles	7.42	5460
SSURGOA	SSURGO Percent Hydrologic Soil Type A	1.63	percent	0.014	7.89
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	11.4

Seasonal Flow Statistics Parameters[Low Flow Northwest Oct Dec 2016 5111]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.02	square miles	7.42	5460
SSURGOA	SSURGO Percent Hydrologic Soil Type A	1.63	percent	0.014	7.89
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	11.4

Seasonal Flow Statistics Disclaimers[Low Flow Northwest Apr Jun 2016 5111]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Seasonal Flow Statistics Flow Report[Low Flow Northwest Apr Jun 2016 5111]

Statistic	Value	Unit
Apr to Jun 1 Day 10 Year Low Flow	0.00658	ft^3/s
Apr to Jun 7 Day 10 Year Low Flow	0.00911	ft^3/s
Apr to Jun 30 Day 10 Year Low Flow	0.0244	ft^3/s

Seasonal Flow Statistics Disclaimers[Low Flow Northwest Oct Dec 2016 5111]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Seasonal Flow Statistics Flow Report[Low Flow Northwest Oct Dec 2016 5111]

Statistic	Value	Unit
1 Day 10 Year lowflow Oct to Dec	0.000212	ft^3/s
7 Day 10 Year lowflow Oct to Dec	0.00033	ft^3/s
Oct_to_Dec_30_Day_10_Year_Low_Flow	0.00111	ft^3/s

Seasonal Flow Statistics Flow Report[Area-Averaged]

Statistic	Value	Unit
Apr to Jun 1 Day 10 Year Low Flow	0.00658	ft^3/s
Apr to Jun 7 Day 10 Year Low Flow	0.00911	ft^3/s
Apr to Jun 30 Day 10 Year Low Flow	0.0244	ft^3/s
1 Day 10 Year lowflow Oct to Dec	0.000212	ft^3/s
7 Day 10 Year lowflow Oct to Dec	0.00033	ft^3/s
Oct_to_Dec_30_Day_10_Year_Low_Flow	0.00111	ft^3/s

Seasonal Flow Statistics Citations

Eash, D.A., Barnes, K.K., and O'Shea, P.S.,2016, Methods for estimating selected spring and fall low-flow frequency statistics for ungaged stream sites in Iowa, based on data through June 2014: U.S. Geological Survey Scientific Investigations Report 2016–5111, 32 p. (http://dx.doi.org/10.3133/sir20165111)

General Flow Statistics Parameters[Low Flow Northwest annual 2012 5171]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.02	square miles	23.4	5464
TAU_ANN_G	Tau Annual from Grid	22.48	days	21.2	35.8
RSD	Relative Stream Density	0.29	dimensionless	0.189	0.511

General Flow Statistics Disclaimers[Low Flow Northwest annual 2012 5171]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

General Flow Statistics Flow Report[Low Flow Northwest annual 2012 5171]

Statistic	Value	Unit
Harmonic Mean Streamflow	0.00463	ft^3/s

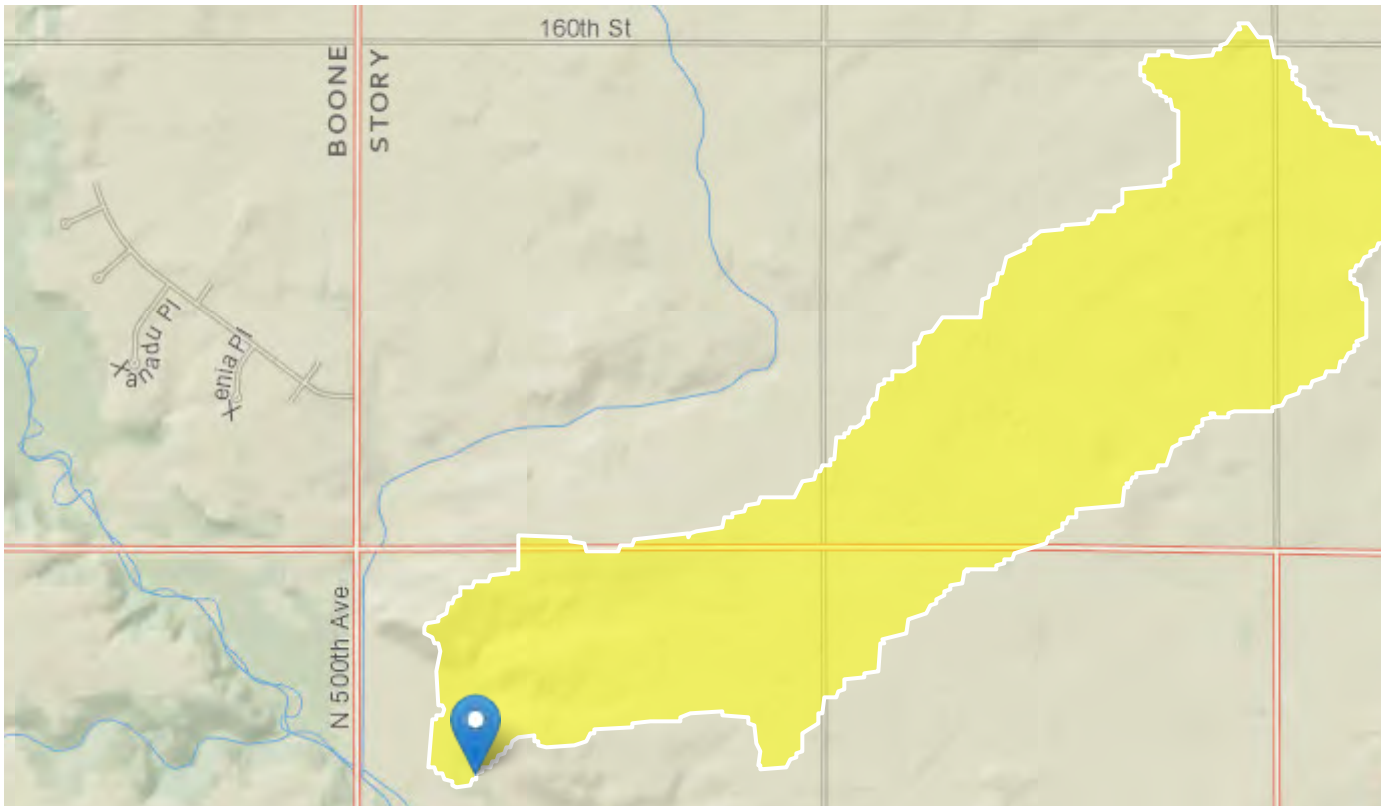
General Flow Statistics Citations

Eash, D.A., and Barnes, K.K.,2012, Methods for estimating selected low-flow frequency statistics and harmonic mean flows for streams in Iowa: U.S. Geological Survey Scientific Investigations Report 2012-5171, 99 p. (http://pubs.usgs.gov/sir/2012/5171/)

Application Version: 4.4.0

StreamStats Report - Story County - Dotson - SE Corner Watershed

Region ID: IA
Workspace ID: IA20210108172233959000
Clicked Point (Latitude, Longitude): 42.09980, -93.69362
Time: 2021-01-08 11:22:51 -0600



Watershed taken at a point along East ditch at the SE Corner of the proposed watershed.

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.18	square miles
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	4.47	inches
CCM	Constant of channel maintenance computed as drainage area divided by total stream length	1.79	square mile per mile

Parameter Code	Parameter Description	Value	Unit
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	0.658	miles
BFI	Proportion of mean annual flow that is from ground water (base flow)	0.5348	dimensionless
SSURGOA	Percentage of area of Hydrologic Soil Type A from SSURGO	0.56	percent
SSURGOC	Percentage of area of Hydrologic Soil Type C from SSURGO	0	percent
PRECIP	Mean Annual Precipitation	34.34	inches
RSD	Relative stream density first defined in SIR 2012_5171	2.73	dimensionless
HYSEP	Median percentage of baseflow to annual streamflow	53.91	percent
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.64	dimensionless
SSURGOB	Percentage of area of Hydrologic Soil Type B from SSURGO	99.4	percent
SSURGOD	Percentage of area of Hydrologic Soil Type D from SSURGO	0	percent
TAU_ANN_G	Tau, Average annual base-flow recession time constant as defined in SIR 2008-5065	22.45	days
BASLENAH	Basin length from outlet to basin divide determined using the method in the ArcHydro Toolset	2.79	miles
BSHAPE	Basin Shape Factor for Area	6.6	dimensionless
BSLDEM10M	Mean basin slope computed from 10 m DEM	1.76	percent
CSL100	Longest flow path slope in feet per miles, using DEM	30.9	feet per mi
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	26.8	feet per mi
DESMOIN	Area underlain by Des Moines Lobe	100	percent
DRNFREQ	Number of first order streams per square mile of drainage area	0.85	1st-order streams per square mile

Parameter Code	Parameter Description	Value	Unit
FOSTREAM	Number of First Order Streams	1	dimensionless
HIGHREG	HIGHREG	1	dimensionless
LC11CRPHAY	Percentage of cultivated crops and hay, classes 81 and 82, from NLCD 2011	92.2	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	7.35	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.81	percent
PRJULDEC10	Basin average mean precipitation for July to December from PRISM 1981-2010	3.06	inches
SSURGOKSAT	Saturated hydraulic conductivity in micrometers per second from NRCS SSURGO database	8.96	micrometers per second

Peak-Flow Statistics Parameters[Peak Region 1 2013 5086]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.18	square miles	0.06	5464
I24H10Y	24 Hour 10 Year Precipitation	4.47	inches	3.58	4.5
CCM	Constant of Channel Maintenance	1.79	square mile per mile	0.11	3.87
STRMTOT	Stream Length Total	0.658	miles		

Peak-Flow Statistics Flow Report[Peak Region 1 2013 5086]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SEp
50_percent_AEP_flood	36.3	ft^3/s	17.7	74.6	41.6
20_percent_AEP_flood	90.2	ft^3/s	50.5	161	32.6
10_percent_AEP_flood	137	ft^3/s	77.3	243	31.8
4_percent_AEP_flood	199	ft^3/s	109	363	33.2
2_percent_AEP_flood	246	ft^3/s	129	468	35.6
1_percent_AEP_flood	295	ft^3/s	149	583	38

Statistic	Value	Unit	PII	Plu	SEp
0_5_percent_AEP_flood	348	ft^3/s	168	723	41
0_2_percent_AEP_flood	403	ft^3/s	182	895	45.2

Peak-Flow Statistics Citations

Eash, D.A., Barnes, K.K., and Veilleux, A.G.,2013, Methods for estimating annual exceedance-probability discharges for streams in Iowa, based on data through water year 2010: U.S. Geological Survey Scientific Investigations Report 2013-5086, 63 p. with a (http://pubs.usgs.gov/sir/2013/5086/)

Low-Flow Statistics Parameters[Low Flow Northwest annual 2012 5171]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.18	square miles	23.4	5464
BFI	Base Flow Index	0.5348	dimensionless	0.358	0.623
SSURGOA	SSURGO Percent Hydrologic Soil Type A	0.56	percent	0	7.87

Low-Flow Statistics Disclaimers[Low Flow Northwest annual 2012 5171]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report[Low Flow Northwest annual 2012 5171]

Statistic	Value	Unit
1 Day 10 Year Low Flow	0.00023	ft^3/s
7 Day 10 Year Low Flow	0.000358	ft^3/s
30 Day 10 Year Low Flow	0.00267	ft^3/s
30 Day 5 Year Low Flow	0.0112	ft^3/s

Low-Flow Statistics Citations

Eash, D.A., and Barnes, K.K.,2012, Methods for estimating selected low-flow frequency statistics and harmonic mean flows for streams in Iowa: U.S. Geological Survey Scientific Investigations Report 2012-5171, 99 p. (http://pubs.usgs.gov/sir/2012/5171/)

Flow-Duration Statistics Parameters[Statewide Flow Duration 2012 5232]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.18	square miles	15.5	7782
SSURGOC	SSURGO Percent Hydrologic Soil Type C	0	percent	0.09	83.5
PRECIP	Mean Annual Precipitation	34.34	inches	27.7	38
RSD	Relative Stream Density	2.73	dimensionless	0.22	0.49
HYSEP	Hydrograph separation percent	53.91	percent	20.3	78
STREAM_VARG	Streamflow Variability Index from Grid	0.64	dimensionless	0.21	0.76
SSURGOB	SSURGO Percent Hydrologic Soil Type B	99.4	percent	5.7	99.4
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	57

Flow-Duration Statistics Disclaimers[Statewide Flow Duration 2012 5232]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Flow-Duration Statistics Flow Report[Statewide Flow Duration 2012 5232]

Statistic	Value	Unit
1 Percent Duration	7.91	ft^3/s
5 Percent Duration	812	ft^3/s
10 Percent Duration	1340	ft^3/s
15 Percent Duration	0.709	ft^3/s
20 Percent Duration	0.584	ft^3/s
30 Percent Duration	0.45	ft^3/s
40 Percent Duration	0.334	ft^3/s
50 Percent Duration	0.265	ft^3/s
60 Percent Duration	0.192	ft^3/s
70 Percent Duration	0.116	ft^3/s
80 Percent Duration	0.0306	ft^3/s

Statistic	Value	Unit
85 Percent Duration	0.0191	ft^3/s
90 Percent Duration	0.0119	ft^3/s
95 Percent Duration	0.00433	ft^3/s
99 Percent Duration	0.000933	ft^3/s

Flow-Duration Statistics Citations

Linhart, S.M., Nania, J.F., Sanders, C.L., Jr., and Archfield, S.A.,2012, Computing daily mean streamflow at ungaged locations in Iowa by using the Flow Anywhere and Flow Duration Curve Transfer statistical methods: U.S. Geological Survey Scientific Investigations Report 2012–5232, 50 p. (http://pubs.usgs.gov/sir/2012/5232/)

Seasonal Flow Statistics Parameters[Low Flow Northwest Apr Jun 2016 5111]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.18	square miles	7.42	5460
SSURGOA	SSURGO Percent Hydrologic Soil Type A	0.56	percent	0.014	7.89
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	11.4

Seasonal Flow Statistics Parameters[Low Flow Northwest Oct Dec 2016 5111]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.18	square miles	7.42	5460
SSURGOA	SSURGO Percent Hydrologic Soil Type A	0.56	percent	0.014	7.89
SSURGOD	SSURGO Percent Hydrologic Soil Type D	0	percent	0	11.4

Seasonal Flow Statistics Disclaimers[Low Flow Northwest Apr Jun 2016 5111]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Seasonal Flow Statistics Flow Report[Low Flow Northwest Apr Jun 2016 5111]

Statistic	Value	Unit
Apr to Jun 1 Day 10 Year Low Flow	0.00118	ft^3/s
Apr to Jun 7 Day 10 Year Low Flow	0.00168	ft^3/s
Apr to Jun 30 Day 10 Year Low Flow	0.00507	ft^3/s

Seasonal Flow Statistics Disclaimers[Low Flow Northwest Oct Dec 2016 5111]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Seasonal Flow Statistics Flow Report[Low Flow Northwest Oct Dec 2016 5111]

Statistic	Value	Unit
1 Day 10 Year lowflow Oct to Dec	0.0000245	ft^3/s
7 Day 10 Year lowflow Oct to Dec	0.0000408	ft^3/s
Oct_to_Dec_30_Day_10_Year_Low_Flow	0.000164	ft^3/s

Seasonal Flow Statistics Flow Report[Area-Averaged]

Statistic	Value	Unit
Apr to Jun 1 Day 10 Year Low Flow	0.00118	ft^3/s
Apr to Jun 7 Day 10 Year Low Flow	0.00168	ft^3/s
Apr to Jun 30 Day 10 Year Low Flow	0.00507	ft^3/s
1 Day 10 Year lowflow Oct to Dec	0.0000245	ft^3/s
7 Day 10 Year lowflow Oct to Dec	0.0000408	ft^3/s
Oct_to_Dec_30_Day_10_Year_Low_Flow	0.000164	ft^3/s

Seasonal Flow Statistics Citations

Eash, D.A., Barnes, K.K., and O'Shea, P.S.,2016, Methods for estimating selected spring and fall low-flow frequency statistics for ungaged stream sites in Iowa, based on data through June 2014: U.S. Geological Survey Scientific Investigations Report 2016–5111, 32 p. (http://dx.doi.org/10.3133/sir20165111)

General Flow Statistics Parameters[Low Flow Northwest annual 2012 5171]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.18	square miles	23.4	5464
TAU_ANN_G	Tau Annual from Grid	22.45	days	21.2	35.8
RSD	Relative Stream Density	2.73	dimensionless	0.189	0.511

General Flow Statistics Disclaimers[Low Flow Northwest annual 2012 5171]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

General Flow Statistics Flow Report[Low Flow Northwest annual 2012 5171]

Statistic	Value	Unit
Harmonic Mean Streamflow	38600	ft^3/s

General Flow Statistics Citations

Eash, D.A., and Barnes, K.K.,2012, Methods for estimating selected low-flow frequency statistics and harmonic mean flows for streams in Iowa: U.S. Geological Survey Scientific Investigations Report 2012-5171, 99 p. (http://pubs.usgs.gov/sir/2012/5171/)

Application Version: 4.4.0

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Appendix A-3

West & East Drainage Ditch Analysis

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 23 2023

IA-340-4 - WEST DRAINAGE DITCH MODEL 25-YEAR FLOW

User-defined

Invert Elev (ft)	= 919.06
Slope (%)	= 0.41
N-Value	= 0.032

Calculations

Compute by:	Known Q
Known Q (cfs)	= 975.00 (25-YR FLOW FROM STREAMSTATS)

Highlighted

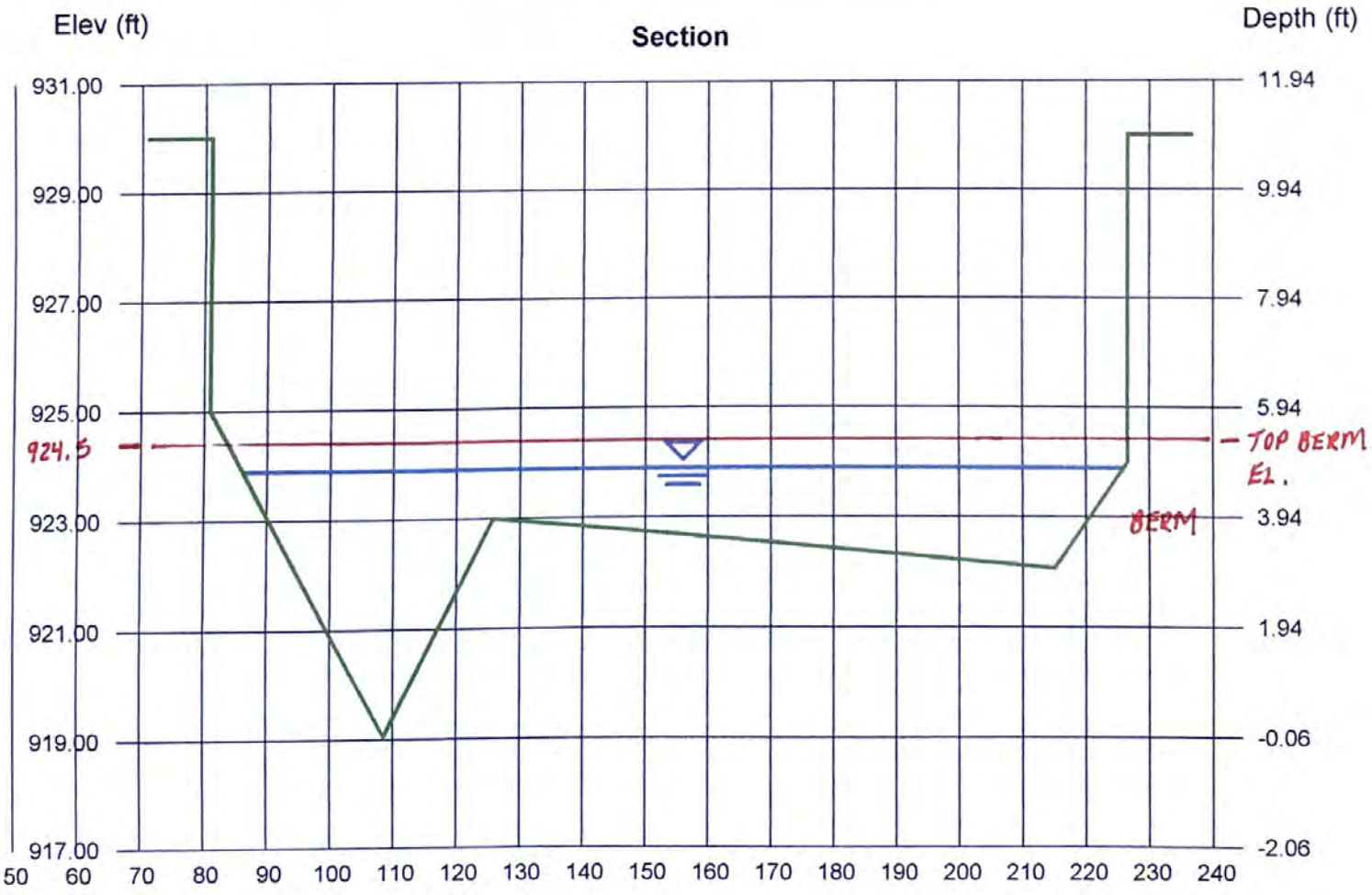
Depth (ft)	= 4.83
Q (cfs)	= 975.00
Area (sqft)	= 234.27
Velocity (ft/s)	= 4.16
Wetted Perim (ft)	= 140.89
Crit Depth, Yc (ft)	= 4.28
Top Width (ft)	= 139.78
EGL (ft)	= 5.10

(Sta, El, n)-(Sta, El, n)...

(81.02, 930.00)-(81.02, 925.00, 0.032)-(108.54, 919.06, 0.032)-(125.82, 923.00, 0.032)-(215.03, 922.07, 0.032)-(226.60, 924.00, 0.032)-(226.60, 924.00, 0.032)-(226.60, 930.00, 0.032)

RISE EL. = 923.89' (BELOW WETLAND BERM TOP)

∴ DURING 25-YEAR FLOW IN WEST DITCH (975 CFS), 0% WOULD EXCEED HEIGHT OF BERM & CONTRIBUTE TO WETLAND STORM BOUNCE.



Channel Report

IA-340-4 - DOTSON

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

Wednesday, Aug 23 2023

IA-340-4 - EAST DRAINAGE DITCH MODEL 25-YEAR FLOW

User-defined

Invert Elev (ft)	= 925.00
Slope (%)	= 1.03
N-Value	= 0.032

Calculations

Compute by:	Known Q
Known Q (cfs)	= 199.00

(25-YR FLOW FROM STREAMSTATS)

Highlighted

Depth (ft)	= 2.01
Q (cfs)	= 199.00
Area (sqft)	= 34.67
Velocity (ft/s)	= 5.74
Wetted Perim (ft)	= 25.81
Crit Depth, Yc (ft)	= 1.87
Top Width (ft)	= 25.23
EGL (ft)	= 2.52

(Sta, El, n)-(Sta, El, n)...

(64.26, 930.00)-(64.26, 927.00, 0.032)-(69.13, 925.00, 0.032)-(75.79, 925.00, 0.032)-(85.19, 926.00, 0.032)-(101.17, 929.75, 0.032)

RISE EL. = 927.01

∴ DURING 25-YR FLOW IN EAST DITCH (199 CFS), THE RISE IN THE DITCH ESSENTIALLY MATCHES THE TOP OF THE NATURAL "BERM" WEST OF THE DITCH WHERE THERE WOULD BE NEGLIGIBLE FLOW CONTRIBUTION TO THE WETLAND.

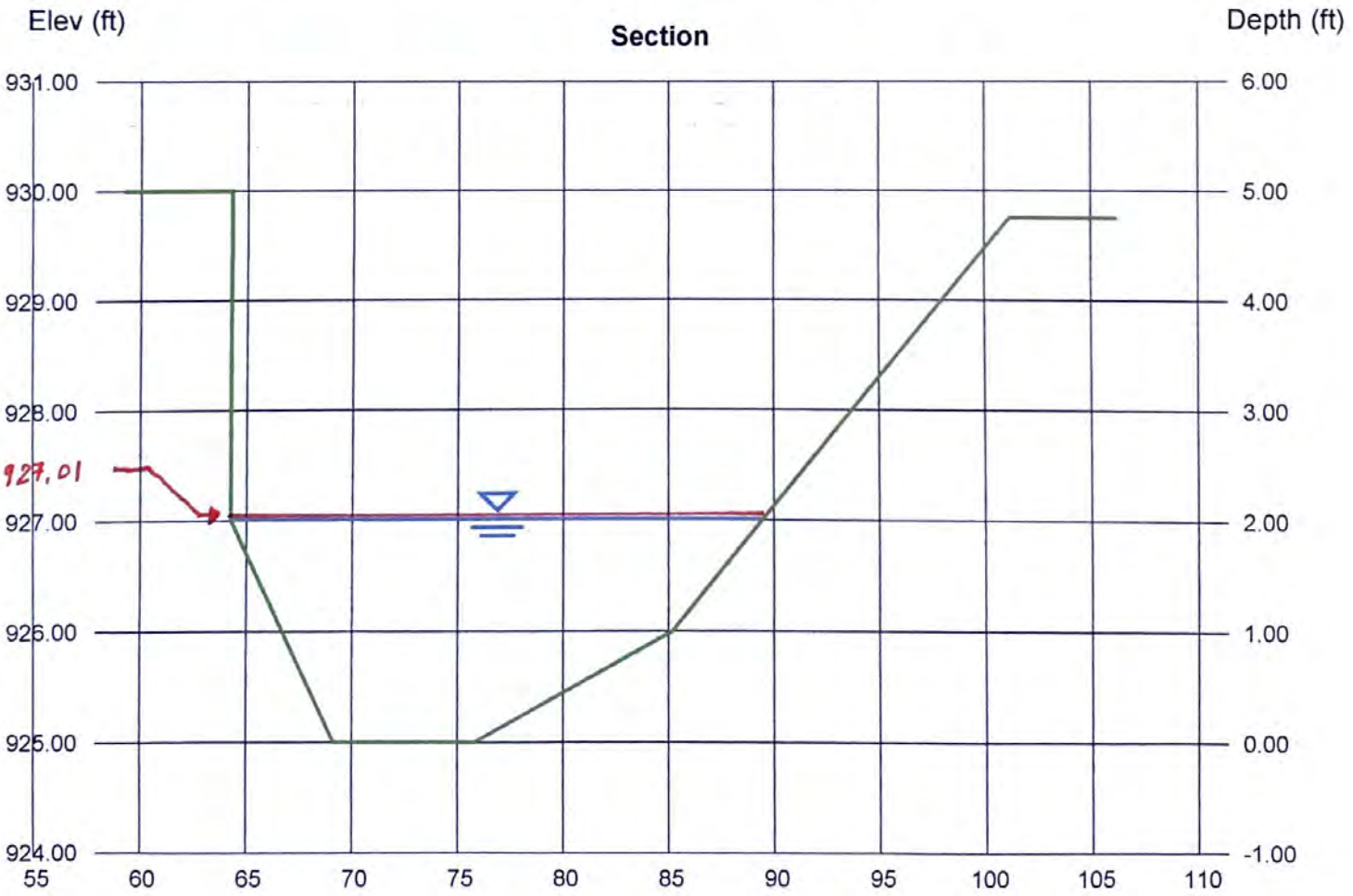


Table 1. Base values of Manning's *n*

[Modified from Aldridge and Garrett, 1973, table 1; —, no data]

Bed material	Median size of bed material (in millimeters)	Base *n* value	
		Straight uniform channel[1]	Smooth channel[2]
Sand channels			
Sand[3]	0.2	0.012	—
	.3	.017	—
	.4	.020	—
	.5	.022	—
	.6	.023	—
	.8	.025	—
	1.0	.026	—
Stable channels and flood plains			
Concrete	—	0.012–0.018	0.011
Rock cut	—	—	.025
Firm soil	—	0.025–0.032	.020
Coarse sand	1–2	0.026–0.035	—
Fine gravel	—	—	.024
Gravel	2–64	0.028–0.035	—
Coarse gravel	—	—	.026
Cobble	64–256	0.030–0.050	—
Boulder	>256	0.040–0.070	—

[1] Benson and Dalrymple (1967).
[2] For indicated material; Chow (1959).
[3] Only for upper regime flow where grain roughness is predominant.

(n = .02 - .032)

moves easily and takes on different configurations or bed forms. Bed form is a function of velocity of flow, grain size, bed shear, and temperature. The flows that produce the bed forms are classified as lower regime flow and upper regime flow, according to the relation between depth and discharge (fig. 2). The lower regime flow occurs during low discharges, and the upper regime flow occurs during high discharges. An unstable discontinuity, called a transitional zone, appears between the two regimes in the depth to discharge relation (fig. 3). In lower regime flow, the bed may have a plane surface and no movement of sediment, or the bed may be deformed and have small uniform waves or large irregular saw-toothed waves formed by sediment moving downstream. The smaller waves are known as ripples, and the larger waves are known as dunes. In upper regime flow, the bed may have a plane surface and sediment movement or long, smooth sand waves that are in phase with the surface waves. These waves are known as standing waves and antidunes. Bed forms on dry beds are remnants of the bed forms that existed during receding flows and may not represent flood stages.

The flow regime is governed by the size of the bed materials and the stream power, which is a measure of energy transfer. Stream power (*SP*) is computed by the formula:

$$SP = 62\, RS_w V \qquad (4)$$

where

62 = specific weight of water, in pounds per cubic foot,
R = hydraulic radius, in feet,
S_w = water-surface slope, in feet per foot, and
V = mean velocity, in feet per second.

The values in table 1 for sand channels are for upper regime flows and are based on extensive laboratory and field data obtained by the U.S. Geological Survey. When using these values, a check must be made to ensure that the stream power is large enough to produce upper regime flow (fig. 2). Although the base *n* values given in table 1 for stable channels are from verification studies, the values have a wide range because the effects of bed roughness are extremely difficult to separate from the effects of other roughness factors. The choice of *n* values selected from table 1 will be influenced by personal judgment and experience. The *n* values for lower and transitional-regime flows are much larger generally than the values given in table 1 for upper regime flow. Simons, Li, and Associates (1982) give a range of *n* values commonly found for different bed forms.

The *n* value for a sand channel is assigned for upper regime flow by using table 1, which shows the relation between median grain size and the *n* value. The flow regime is checked by computing the velocity and stream power that correspond to the assigned *n* value. The computed stream power is compared with the value that is necessary to cause upper regime flow (see fig. 2, from Simons and Richardson, 1966, fig. 28). If the computed stream power is not large enough to produce upper regime flow (an indication of lower regime or transitional-zone flow), a reliable value of *n* cannot be assigned. The evaluation of *n* is complicated by bed-form drag. Different equations are needed to describe the bed forms. The total *n* value for lower and transitional-regime flows can vary greatly and depends on the bed forms present at a particular time. Figure 3 illustrates how the total resistance in a channel varies for different bed forms.

Limerinos (1970) related *n* to hydraulic radius and particle size on the basis of samples from 11 stream channels having bed material ranging from small gravel to medium-sized boulders. Particles have three dimensions—length, width, and thickness—and are oriented so that length and width are parallel to the plane of the streambed. Limerinos related *n* to minimum diameter (thickness) and to intermediate diameter (width). His equation using intermediate diameter appears to be the most useful because this dimension is the most easy to measure in the field and to estimate from photographs.

The equation for *n* using intermediate diameter is

$$n = \frac{(0.0926)\, R^{1/6}}{1.16 + 2.0 \log\left(\frac{R}{d_{84}}\right)} \qquad (5)$$


EAST DRAINAGE WITH NATURAL BERM ON WEST SIDE DIVERT FLOWS PAST THE WETLAND AREA, UP TO A 25-YEAR RAIN EVENT IN THE DITCH.
WEST DRAINAGE DITCH AND WETLAND EMBANKMENT DIVERTS FLOW PAST THE WETLAND AREA, UP TO A 25-YEAR RAIN EVENT IN THE DITCH.
500th Ave
500th Ave
lowey

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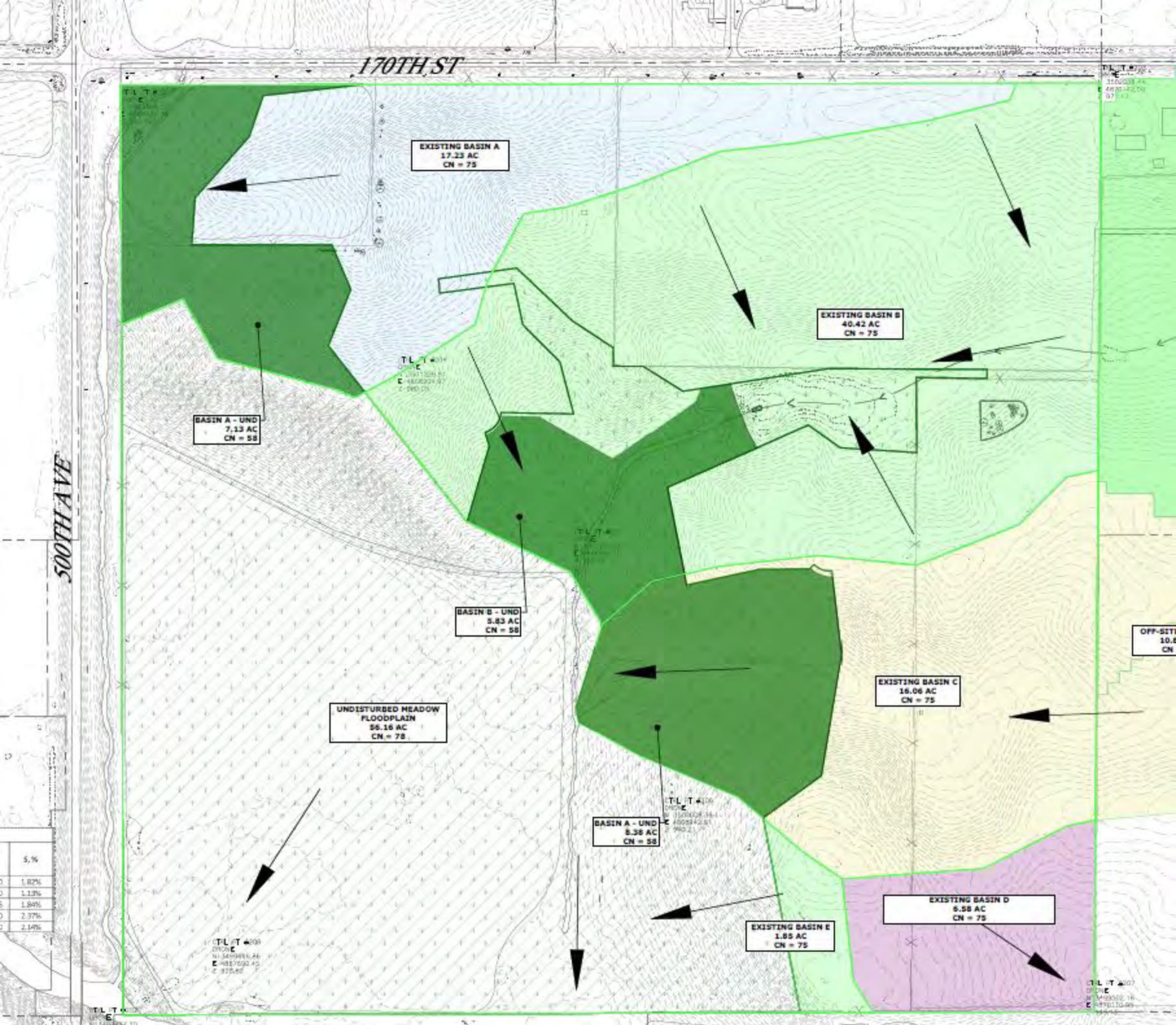
Appendix A-4

Fox Engineering – Adjacent Development Basin Characteristics


170TH ST
500TH AVE
EXISTING BASIN A
17.23 AC
CN = 75
EXISTING BASIN B
40.42 AC
CN = 75
BASIN A - UND
7.13 AC
CN = 58
BASIN B - UND
5.83 AC
CN = 58
UNDISTURBED MEADOW
FLOODPLAIN
56.16 AC
CN = 78
EXISTING BASIN C
16.06 AC
CN = 75
BASIN A - UND
8.38 AC
CN = 58
EXISTING BASIN D
6.58 AC
CN = 75
EXISTING BASIN E
1.85 AC
CN = 75

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Appendix A-5

FEMA Flood Map

National Flood Hazard Layer FIRMette

FEMA

93°42'4"W 42°6'16"N

93°41'26"W 42°5'49"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/16/2021 at 10:53 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

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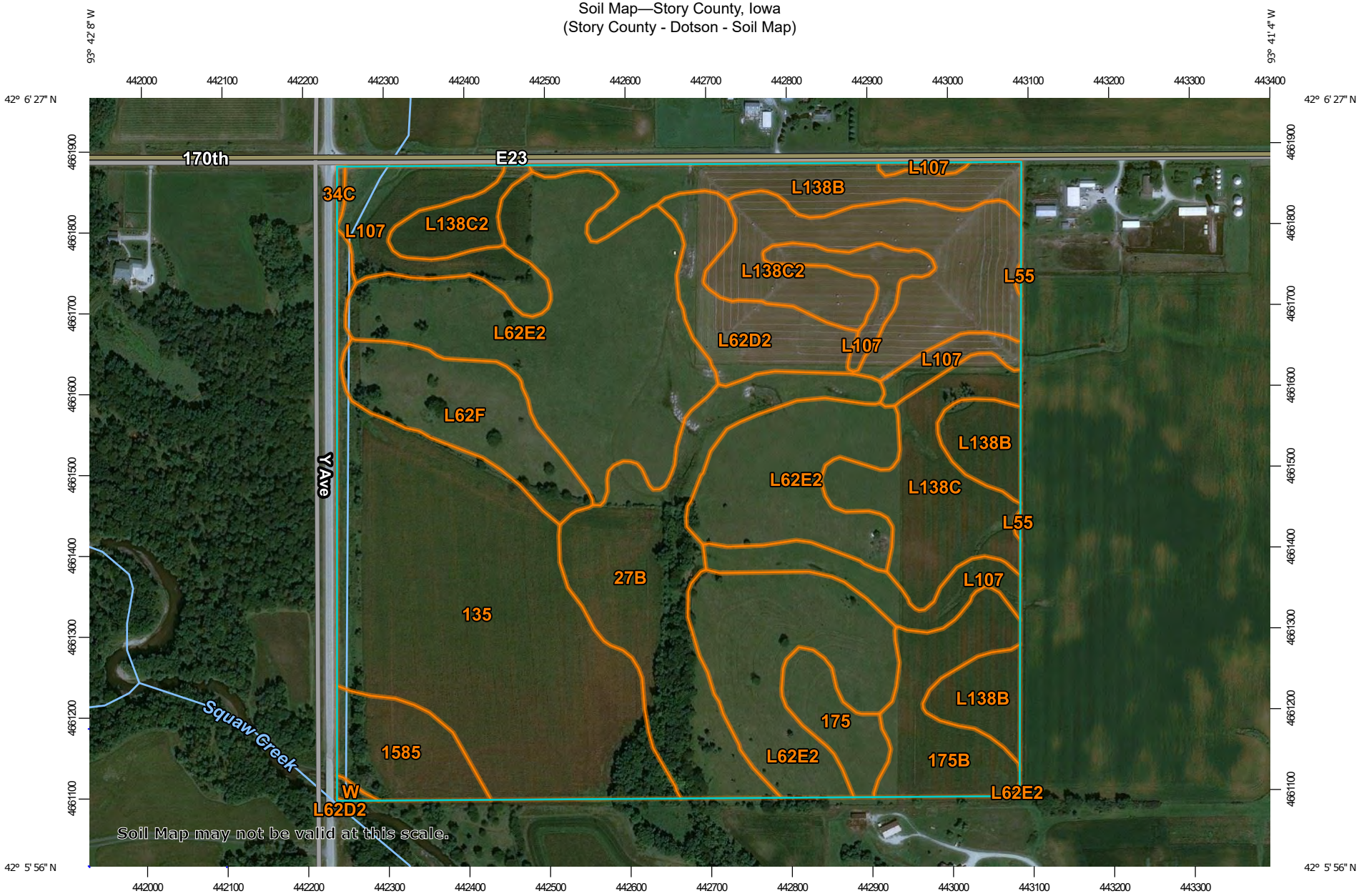
Appendix A-6

NRCS Soil Map

Soil Map—Story County, Iowa
(Story County - Dotson - Soil Map)



Map Scale: 1:6,700 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Story County, Iowa
Survey Area Data: Version 32, Jun 10, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 26, 2012—Sep 28, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
27B	Terril loam, 2 to 6 percent slopes	15.2	9.2%
34C	Estherville sandy loam, 2 to 6 percent slopes	0.1	0.1%
135	Coland clay loam, 0 to 2 percent slopes, occasionally flooded	31.6	19.1%
175	Dickinson fine sandy loam, 0 to 2 percent slopes	2.9	1.8%
175B	Dickinson fine sandy loam, 2 to 5 percent slopes	6.5	4.0%
1585	Spillville-Coland complex, channeled, 0 to 2 percent slopes	4.6	2.8%
L55	Nicollet loam, 1 to 3 percent slopes	0.1	0.1%
L62D2	Storden loam, Bemis moraine, 10 to 16 percent slopes, moderately eroded	5.8	3.5%
L62E2	Storden loam, Bemis moraine, 10 to 22 percent slopes, moderately eroded	42.1	25.5%
L62F	Belview loam, Bemis moraine, 16 to 30 percent slopes	7.5	4.5%
L107	Webster clay loam, Bemis moraine, 0 to 2 percent slopes	13.4	8.1%
L138B	Clarion loam, Bemis moraine, 2 to 6 percent slopes	11.5	7.0%
L138C	Clarion loam, Bemis moraine, 6 to 10 percent slopes	8.7	5.3%
L138C2	Clarion loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	14.8	9.0%
W	Water	0.2	0.1%
Totals for Area of Interest		**165.1**	**100.0%**

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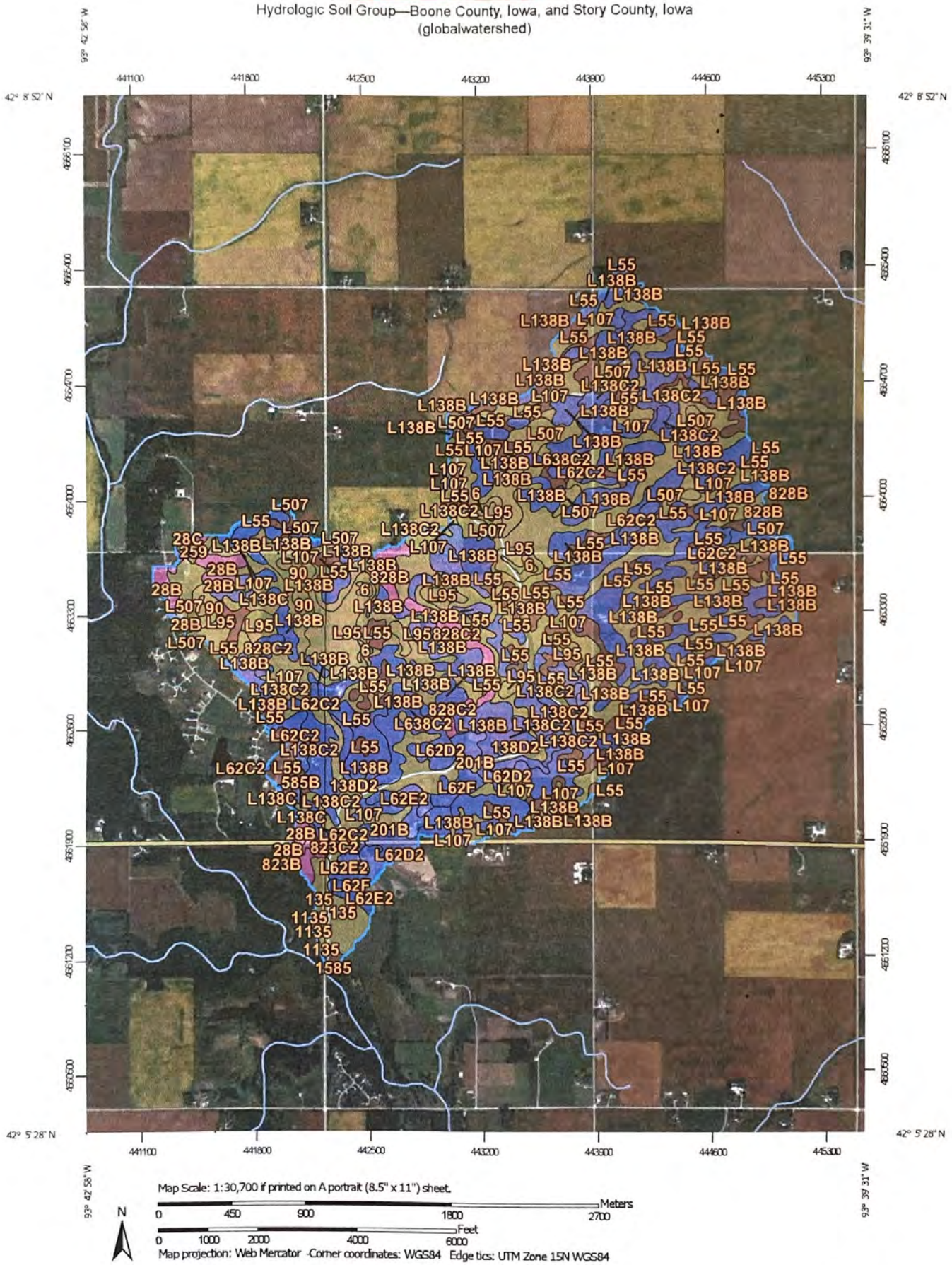
Appendix A-7

NRCS Hydrologic Soil Group Maps

NW WATERSHED

Hydrologic Soil Group—Boone County, Iowa, and Story County, Iowa
(globalwatershed)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boone County, Iowa
Survey Area Data: Version 31, Sep 12, 2023

Soil Survey Area: Story County, Iowa
Survey Area Data: Version 35, Sep 12, 2023

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 26, 2021—Sep 16, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28B	Dickman sandy loam, 2 to 6 percent slopes	A	18.9	1.0%
28C	Dickman fine sandy loam, 5 to 9 percent slopes	A	3.7	0.2%
90	Okoboji mucky silt loam, 0 to 1 percent slopes	C/D	9.5	0.5%
135	Coland clay loam, 0 to 2 percent slopes, occasionally flooded	C/D	9.4	0.5%
259	Biscay clay loam, 0 to 2 percent slopes	C/D	4.6	0.2%
585B	Coland-Spillville complex, 2 to 5 percent slopes	C/D	4.3	0.2%
823B	Ridgeport sandy loam, 2 to 5 percent slopes	A	4.6	0.2%
823C2	Ridgeport sandy loam, 5 to 9 percent slopes, moderately eroded	A	4.5	0.2%
828C2	Zenor sandy loam, 5 to 9 percent slopes, moderately eroded	B	3.6	0.2%
1135	Coland clay loam, 0 to 2 percent slopes, frequently flooded	C/D	1.0	0.1%
L55	Nicollet loam, 1 to 3 percent slopes	B/D	28.1	1.5%
L62C2	Storden loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	B	14.7	0.8%
L95	Harps clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	39.0	2.0%
L107	Webster clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	61.4	3.2%
L138B	Clarion loam, Bemis moraine, 2 to 6 percent slopes	B	38.3	2.0%
L138C	Clarion loam, Bemis moraine, 6 to 10 percent slopes	B	15.7	0.8%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
L138C2	Clarion loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	B	17.6	0.9%
L507	Canisteo clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	19.6	1.0%
Subtotals for Soil Survey Area			**298.8**	**15.4%**
Totals for Area of Interest			**1,934.8**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6	Okoboji silty clay loam, 0 to 1 percent slopes	C/D	7.5	0.4%
34C	Estherville sandy loam, 2 to 6 percent slopes	A	0.5	0.0%
135	Coland clay loam, 0 to 2 percent slopes, occasionally flooded	C/D	20.1	1.0%
138D2	Clarion loam, 9 to 14 percent slopes, moderately eroded	B	10.4	0.5%
201B	Coland-Terril complex, 1 to 5 percent slopes	C/D	35.2	1.8%
828B	Zenor sandy loam, 2 to 5 percent slopes	A	10.9	0.6%
828C2	Zenor sandy loam, 5 to 9 percent slopes, moderately eroded	A	19.8	1.0%
1585	Spillville-Coland complex, channeled, 0 to 2 percent slopes	B/D	2.3	0.1%
L55	Nicollet loam, 1 to 3 percent slopes	B/D	197.9	10.2%
L62C2	Storden loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	B	13.0	0.7%
L62D2	Storden loam, Bemis moraine, 10 to 16 percent slopes, moderately eroded	B	18.8	1.0%
L62E2	Storden loam, Bemis moraine, 10 to 22 percent slopes, moderately eroded	B	21.5	1.1%
L62F	Belview loam, Bemis moraine, 16 to 30 percent slopes	B	17.2	0.9%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
L95	Harps clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	58.6	3.0%
L107	Webster clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	453.4	23.4%
L138B	Clarion loam, Bemis moraine, 2 to 6 percent slopes	B	542.7	28.0%
L138C2	Clarion loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	B	93.0	4.8%
L507	Canisteo clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	69.5	3.6%
L638C2	Clarion-Storden complex, Bemis moraine, 6 to 10 percent slopes, moderately eroded	B	44.0	2.3%
Subtotals for Soil Survey Area			**1,636.0**	**84.6%**
Totals for Area of Interest			**1,934.8**	**100.0%**

WEST WATERSHED:

A = 62.9

B = 850.5

C = 0

D = 1,021.4

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

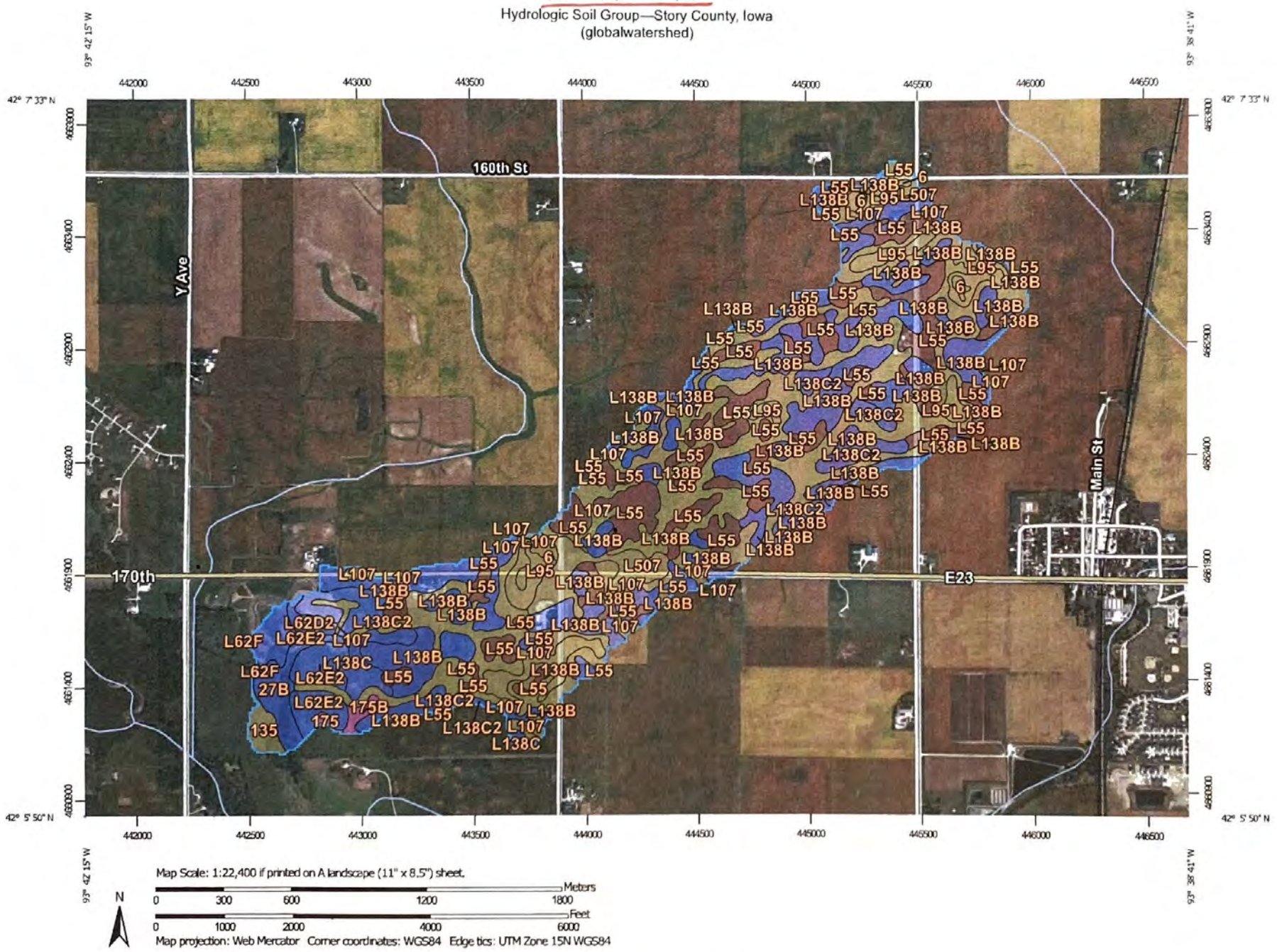
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NE WATERSHED

Hydrologic Soil Group—Story County, Iowa
(globalwatershed)



Map Scale: 1:22,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 300 600 1200 1800

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Story County, Iowa
Survey Area Data: Version 35, Sep 12, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 26, 2021—Sep 16, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

A - 4.3
B - 307
C - 0
D - 443.6

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6	Okoboji silty clay loam, 0 to 1 percent slopes	C/D	5.3	0.7%
27B	Terril loam, 2 to 6 percent slopes	B	14.3	1.9%
135	Coland clay loam, 0 to 2 percent slopes, occasionally flooded	C/D	6.3	0.8%
175	Dickinson fine sandy loam, 0 to 2 percent slopes	A	1.0	0.1%
175B	Dickinson fine sandy loam, 2 to 5 percent slopes	A	3.3	0.4%
L55	Nicollet loam, 1 to 3 percent slopes	B/D	132.0	17.5%
L62D2	Storden loam, Bemis moraine, 10 to 16 percent slopes, moderately eroded	B	4.7	0.6%
L62E2	Storden loam, Bemis moraine, 10 to 22 percent slopes, moderately eroded	B	27.6	3.7%
L62F	Belview loam, Bemis moraine, 16 to 30 percent slopes	B	0.3	0.0%
L95	Harps clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	44.2	5.8%
L107	Webster clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	234.4	31.0%
L138B	Clarion loam, Bemis moraine, 2 to 6 percent slopes	B	215.0	28.5%
L138C	Clarion loam, Bemis moraine, 6 to 10 percent slopes	B	12.0	1.6%
L138C2	Clarion loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	B	33.1	4.4%
L507	Canisteo clay loam, Bemis moraine, 0 to 2 percent slopes	C/D	21.4	2.8%
Totals for Area of Interest			**754.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

TOTALS BOTH WATERSHEDS

A - 67.2 / 2,689.7 = .02
B - 1,157.5/" " = .43
C - 0 / " " = 0
D - 1,465/" " = .55

ROW CROPS, SR, GOOD

A - 67 × .02 = 1.34
B - 78 × .43 = 33.54
C - 85 × 0 = 0
D - 89 × .55 = 48.95
= 83.83 ~ 84 WEIGHTED AVERAGE

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Appendix A-8

Outlet Channel Calculations

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **IA-340-4 - DOTSON** Location: STORY COUNTY

By: A.S. Date: 6/29/2023

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

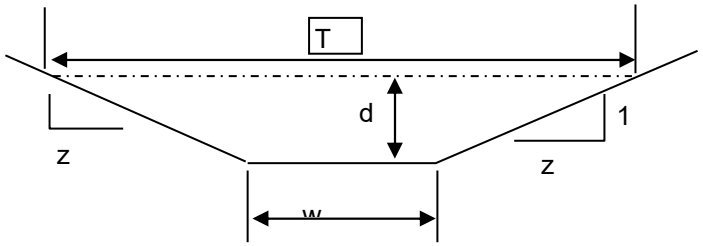
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	3
z (sideslope)=	3
b (btm width, ft)=	14
d (depth, ft)=	1.7
S (slope, ft/ft)	0.007
n_{low} =	0.033
n_{high} =	0.033

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
1.7	32.47	24.75	1.31	4.51483768	146.597	4.514838	146.597	T =	24.2
								Dm =	1.342
				Sc low =	0.0148	Sc high =	0.0148		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0104	0.0193	0.0104	0.0193		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

Created by: Mike O'Shea

1.7' EXPECTED WATER DEPTH IN OUTET CHANNEL (W/ 3' SIDES) DURING DESIGN RAIN EVENT (10-YEAR EVENT).

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **IA-340-4 - DOTSON** Location: STORY COUNTY

By: A.S. Date: 6/29/2023

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

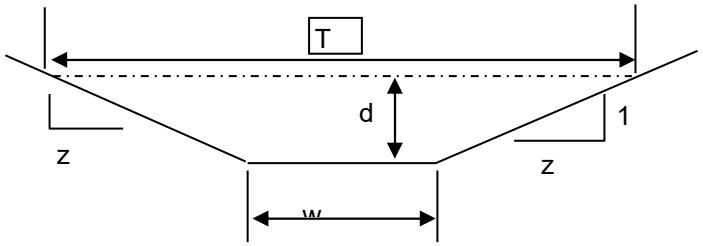
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	3
z (sideslope)=	3
b (btm width, ft)=	14
d (depth, ft)=	3
S (slope, ft/ft)	0.007
n_{low} =	0.033
n_{high} =	0.033

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
3	69.00	32.97	2.09	6.16385599	425.306	6.163856	425.306	T =	32
								Dm =	2.156
				Sc low =	0.0128	Sc high =	0.0128		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0089	0.0166	0.0089	0.0166		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

Created by: Mike O'Shea

THIS MODELS WATER DEPTH TO TOP OF CHANNEL BANK IN OUTLET CHANNEL (3'), WHICH ALLOWS 425 CFS. THE 25-YEAR RAIN EVENT IN THE WETLAND OUTLETS 205.74 CFS THROUGH THE SPILLWAY. THIS PROVIDES A FACTOR OF SAFETY OF 2 FOR OVERTOPPING THE OUTLET CHANNEL.

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Appendix A-9

Spillway Rock Size Calculations

IBASH METHOD: (210-VI-NEH, AUGUST 2007, TS14C-3)

$$V_c = C \times \left(2 \times g \times \frac{\gamma_s - \gamma_w}{\gamma_w}\right)^{0.5} \times (D_{50})^{0.5}$$

$$D_{50} = \left[\frac{V_c}{C \times \left(2 \times g \times \frac{\gamma_s - \gamma_w}{\gamma_w}\right)^{0.5}}\right]^2$$

$V_c = 2.79$ ft/s (25-YR EVENT)
$C = 0.86$ High Turb.
1.20 Low Turb.
$g = 32.2$ ft/s^2
γ_s = Stone Density = 165 lb./ft.^{3}
γ_w = Water Density = 62.4 lb./ft.^{2}

$$D_{50} = \left[\frac{2.79}{0.86 \times \left(2 \times 32.2 \times \frac{165 - 62.4}{62.4}\right)^{0.5}}\right]^2$$

$D_{50} = 0.10$ ft. ~ 1.2" ROCK (AVG.)

FOR EROSION STONE (IA DOT), $D_{50} = 0.5$ ft.

$$V_c = .86 \left(2 \times 32.2 \times \frac{165 - 62.4}{62.4}\right)^{0.5} \times (0.5)^{0.5}$$

$V_c = 6.26$ ft/s > 2.79 w/ F.S. = 2.2 ✓ (NOT INCLUDING GROUT)

FOR IA DOT CLASS E RIPRAP, $D_{50} = 1.0$ ft

$$V_c = .86 \left(2 \times 32.2 \times \frac{165 - 62.4}{62.4}\right)^{0.5} \times (1.0)^{0.5}$$

$V_c = 8.85$ ft/s > 2.79 w/ F.S. = 3.2 ✓ (NOT INCLUDING GROUT)

DUCKS UNLIMITED

DESIGN NOTES

PROJECT IA-340-4 - DOTSON
SUBJECT RIPRAP SPILLWAY - STONE SIZING
FILE NO. _____ DATE 10/2/23
BY A.S. CHECKED _____ SHEET 1 OF 1

Q0351

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Feb 8 2024

IA-340-4 - Ioway Creek Velocity Check

User-defined

Invert Elev (ft)	= 914.00
Slope (%)	= 0.18
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10300.00

Highlighted

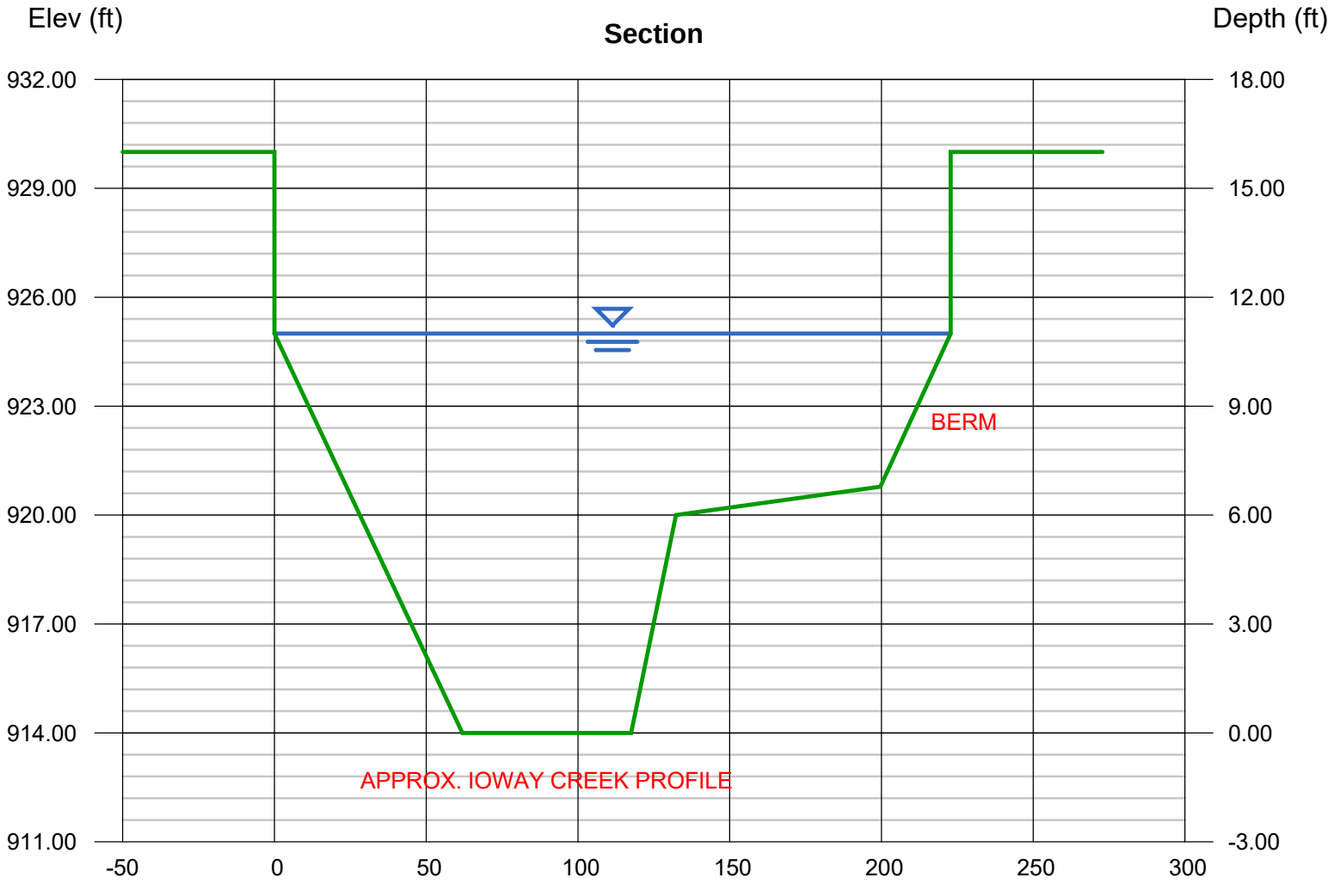
Depth (ft)	= 11.00
Q (cfs)	= 10,300
Area (sqft)	= 1429.67
Velocity (ft/s)	= 7.20
Wetted Perim (ft)	= 225.33
Crit Depth, Yc (ft)	= 8.26
Top Width (ft)	= 222.80
EGL (ft)	= 11.81

(FROM STREAMSTATS 100-YEAR EVENT

(Sta, El, n)-(Sta, El, n)...

(0.00, 930.00)-(61.95, 914.00, 0.030)-(117.52, 914.00, 0.030)-(132.32, 920.00, 0.030)-(199.65, 920.78, 0.030)-(222.80, 925.00, 0.030)-(222.80, 930.00, 0.030)

AN APPROXIMATE PROFILE WAS DETERMINED USING LIDAR DATA FROM ACROSS IOWAY CREEK AT A CROSS SECTION THAT EXTENDS THROUGH THE PROPOSED SPILLWAY OF THE WETLAND. SEVERAL VARIABLES WERE ADJUSTED IN THIS SIMPLIFIED MODEL IN ORDER TO CAUSE A 100-YEAR CREEK RISE CONSISTENT WITH FEMA. THIS WAS DONE IN ORDER TO APPROXIMATE THE VELOCITY OF THE WATER FROM IOWAY CREEK DURING THE 100-YEAR EVENT ADJACENT TO THE SPILLWAY, WHICH IS 7.2 FT/S (SHOWN ABOVE). THE CLASS E RIPRAP (UNGROUTED) THRESHOLD IS ABOVE 7.2 FT/S, WHILE THE EROSION STONE IS SLIGHTY UNDER (6.3 FT/S). HOWEVER, THE EROSION STONE AND THE CLASS E RIPRAP WILL BE GROUTED, AND THE EROSION STONE WILL BE "LOCKED" BETWEEN CLASS E RIPRAP AT THE ENDS. ACCORDINGLY, THE ALLOWABLE VELOCITY FOR BOTH THE GROUTED CLASS E RIPRAP AND THE GROUTED EROSION STONE (LOCKED IN PLACE) WILL BE MUCH HIGHER THAN THE ANTICIPATED VELOCITY FROM IOWAY CREEK.



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Appendix A-10

Swale to Southeast Calculations

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **Dotson Wetland** Location: Story County

By: A.S. Date: 12/17/2021

Chk By: Date:

version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

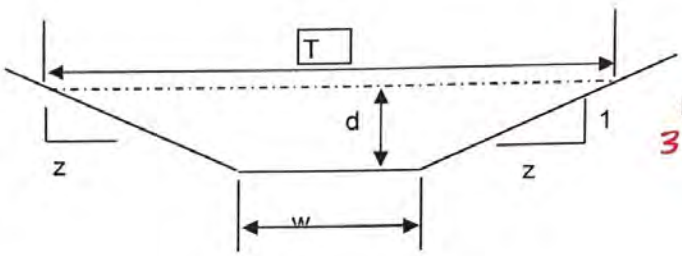
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	4
3" d (depth, ft)=	0.25
S (slope, ft/ft)	0.0036
n_{low} =	0.02
n_{high} =	0.032

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
0.25	1.25	6.06	0.21	1.5559702	1.94496	0.972481	1.2156	T =	6
								Dm =	0.208

Sc low = 0.0100 Sc high = 0.0255

.7 Sc	1.3 Sc	.7 Sc	1.3 Sc
0.0070	0.0129	0.0178	0.0331

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

→ MATCH Q_{in} FROM WETLAND (2 CFS)

→ 1.56 FPS VELOCITY O.K.

(ADD SOME RIPRAP AT DISCHARGE)

Created by: Mike O'Shea

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **Dotson Wetland** Location: Story County

By: A.S. Date: 12/20/2021

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

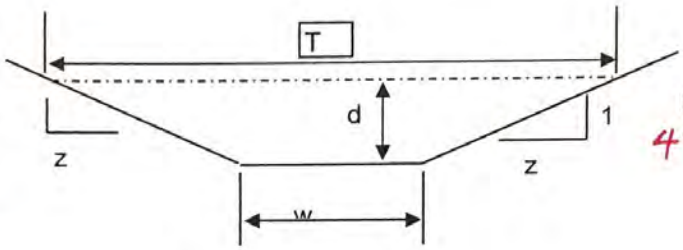
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	4
4" d (depth, ft)=	0.33
S (slope, ft/ft)	0.0036
n_{low} =	0.02
n_{high} =	0.032

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
0.33	1.76	6.72	0.26	1.8215356	3.19789	ok 1.13846	1.99868	T =	6.64
								Dm =	0.264

Sc low = 0.0092 Sc high = 0.0236

.7 Sc	1.3 Sc	.7 Sc	1.3 Sc
0.0065	0.0120	0.0165	0.0307

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

MATCH Q_{in} FROM WETLAND (2 CFS) @ 4" DEPTH

Created by: Mike O'Shea

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **Dotson Wetland** Location: Story County

By: A.S. Date: 12/20/2021

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

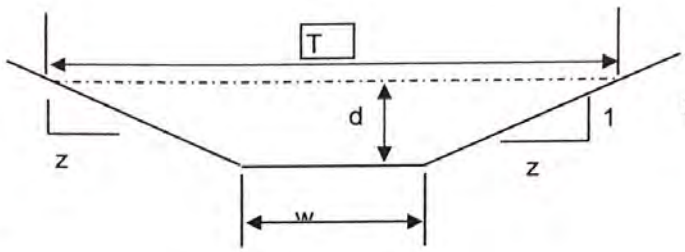
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	4
d (depth, ft)=	1
S (slope, ft/ft)	0.0036
n_{low} =	0.02
n_{high} =	0.032

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
1	8.00	12.25	0.65	3.3562893	26.8503	2.097681	16.7814	T =	12
								Dm =	0.667

Sc low = 0.0068 Sc high = 0.0175

.7 Sc	1.3 Sc	.7 Sc	1.3 Sc
0.0048	0.0089	0.0123	0.0228

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

MAX. CAPACITY OF SWALE → O.K.

Created by: Mike O'Shea

Table 1. Base values of Manning's *n*

[Modified from Aldridge and Garrett, 1973, table 1; —, no data]

Bed material	Median size of bed material (in millimeters)	Base *n* value: Straight uniform channel[1]	Base *n* value: Smooth channel[2]
Sand channels			
Sand[3]	0.2	0.012	—
	.3	.017	—
	.4	.020	—
	.5	.022	—
	.6	.023	—
	.8	.025	—
	1.0	.026	—
Stable channels and flood plains			
Concrete	—	0.012–0.018	0.011
Rock cut	—	—	.025
Firm soil	—	0.025–0.032	.020
Coarse sand	1–2	0.026–0.035	—
Fine gravel	—	—	.024
Gravel	2–64	0.028–0.035	—
Coarse gravel	—	—	.026
Cobble	64–256	0.030–0.050	—
Boulder	>256	0.040–0.070	—

[1] Benson and Dalrymple (1967).
[2] For indicated material; Chow (1959).
[3] Only for upper regime flow where grain roughness is predominant.

(n = .02 - .032)

moves easily and takes on different configurations or bed forms. Bed form is a function of velocity of flow, grain size, bed shear, and temperature. The flows that produce the bed forms are classified as lower regime flow and upper regime flow, according to the relation between depth and discharge (fig. 2). The lower regime flow occurs during low discharges, and the upper regime flow occurs during high discharges. An unstable discontinuity, called a transitional zone, appears between the two regimes in the depth to discharge relation (fig. 3). In lower regime flow, the bed may have a plane surface and no movement of sediment, or the bed may be deformed and have small uniform waves or large irregular saw-toothed waves formed by sediment moving downstream. The smaller waves are known as ripples, and the larger waves are known as dunes. In upper regime flow, the bed may have a plane surface and sediment movement or long, smooth sand waves that are in phase with the surface waves. These waves are known as standing waves and antidunes. Bed forms on dry beds are remnants of the bed forms that existed during receding flows and may not represent flood stages.

The flow regime is governed by the size of the bed materials and the stream power, which is a measure of energy transfer. Stream power (*SP*) is computed by the formula:

$$SP = 62\,RS_wV \qquad (4)$$

where

62 = specific weight of water, in pounds per cubic foot,
R = hydraulic radius, in feet,
S_w = water-surface slope, in feet per foot, and
V = mean velocity, in feet per second.

The values in table 1 for sand channels are for upper regime flows and are based on extensive laboratory and field data obtained by the U.S. Geological Survey. When using these values, a check must be made to ensure that the stream power is large enough to produce upper regime flow (fig. 2). Although the base *n* values given in table 1 for stable channels are from verification studies, the values have a wide range because the effects of bed roughness are extremely difficult to separate from the effects of other roughness factors. The choice of *n* values selected from table 1 will be influenced by personal judgment and experience. The *n* values for lower and transitional-regime flows are much larger generally than the values given in table 1 for upper regime flow. Simons, Li, and Associates (1982) give a range of *n* values commonly found for different bed forms.

The *n* value for a sand channel is assigned for upper regime flow by using table 1, which shows the relation between median grain size and the *n* value. The flow regime is checked by computing the velocity and stream power that correspond to the assigned *n* value. The computed stream power is compared with the value that is necessary to cause upper regime flow (see fig. 2, from Simons and Richardson, 1966, fig. 28). If the computed stream power is not large enough to produce upper regime flow (an indication of lower regime or transitional-zone flow), a reliable value of *n* cannot be assigned. The evaluation of *n* is complicated by bed-form drag. Different equations are needed to describe the bed forms. The total *n* value for lower and transitional-regime flows can vary greatly and depends on the bed forms present at a particular time. Figure 3 illustrates how the total resistance in a channel varies for different bed forms.

Limerinos (1970) related *n* to hydraulic radius and particle size on the basis of samples from 11 stream channels having bed material ranging from small gravel to medium-sized boulders. Particles have three dimensions—length, width, and thickness—and are oriented so that length and width are parallel to the plane of the streambed. Limerinos related *n* to minimum diameter (thickness) and to intermediate diameter (width). His equation using intermediate diameter appears to be the most useful because this dimension is the most easy to measure in the field and to estimate from photographs.

The equation for *n* using intermediate diameter is

$$n = \frac{(0.0926)\,R^{1/6}}{1.16 + 2.0 \log\left(\frac{R}{d_{84}}\right)} \qquad (5)$$

3) Calculate the allowable release rate from the site, based on two conditions:
   a) After development, the release rate of runoff for rainfall events having an expected return frequency of 2 years and 5 years should not exceed the existing, pre-developed peak runoff rate from those same storms.
   b) For rainfall events having an expected return frequency of 10 years to 100 years, inclusive, the rate of runoff from the developed site should not exceed the existing, pre-developed peak runoff from a 5 year frequency storm of the same duration. The allowable discharge rate may be restricted due to downstream capacity. Include this calculation in the Executive Summary.
4) Describe assumptions made for portions of the drainage area that are not included in the current development area.

3. Stormwater Conveyance Design:

a. Design Information References: At a minimum, all stormwater conveyances will be designed according to this manual. The following references may be used for supplemental design information:
1) Federal Highway Administration (2009) *Urban Drainage Design Manual*. Hydraulic Engineering Circular No. 22, Washington D.C.
2) Federal Highway Administration (2005) *Design of Roadside Channels with Flexible Linings*. Hydraulic Engineering Circular No. 15, Washington D.C.
3) Federal Highway Administration (2005) *Hydraulic Design of Highway Culverts*. Hydrologic Design Series Number 5, Washington D.C.
4) US Geological Survey (1968) *Measurement of Peak Discharge at Culverts by Indirect Methods*. Book 3, Applications of Hydraulics, Washington D.C.
5) American Society of Civil Engineers (1993) *Design and Construction of Urban Stormwater Management Systems* Manual of Practice No. 77, New York, N.Y.

b. Storm Sewer:
1) List design criteria, including storm event and runoff model. Describe the hydraulic grade line and whether pressure flow or surcharging is possible. Provide a graphic of the hydraulic grade line.
2) List design criteria for intake size and spacing. Describe the anticipated gutter flow and spread at intakes.
3) List any special considerations for subdrain design, such as high water tables.
4) Provide tables of storm sewer (inlet and pipe) and intake design data.
5) Water spread on the street for intake design year and 100 year elevation in all streets in which the curb is overtopped.

c. Culverts:
1) Describe culvert capacity, inlet or outlet control conditions, and estimated tailwater and headwater. Determine if 100 year or lesser storm event will flood roadway over culvert.
2) Sketch a contour of the 100 year headwater elevation on a topographic map and/or grading plan. This delineated 100 year flood elevation is used to determine drainage easement and site grading requirements.

d. Open Channel Flow - Swales and Ditches:
1) Describe swale and ditch design. State the assumed Manning's roughness coefficients. State the anticipated flow velocity and whether it exceeds the permissible velocity based on soil types and/or ground coverage. If the permissible velocity is exceeded, describe channel lining or energy dissipation.

A. Description/Uses

Diversion structures consist of swales or berms that are used to temporarily divert water around an area that is under construction or is being stabilized. Specific applications include perimeter control, diversion away from disturbed slopes, and diversion of sediment-laden water to treatment facilities.

As a perimeter control, temporary swales and/or berms may be constructed above a large disturbed area to divert upstream run-on around the site. This serves several purposes. First, the amount of runoff flowing over the disturbed area is reduced, thereby reducing the erosion potential. Secondly, clean water can be separated from the sediment-laden water and can be passed through or around the site. Sediment-laden water can be directed to a sediment trap or basin for treatment. Separating the upstream runoff from the sediment-laden water allows the designer to reduce the required size of the sediment removal structure, and allows the structure to work more efficiently.

Another specific use of a diversion structure is to keep upstream stormwater off of disturbed slopes or to safely carry it down the slope. This is accomplished by constructing a swale and/or berm at the top of the slope, and conveying it to a letdown structure or stable outlet. On long slopes, they can be placed at regular intervals to trap and divert sheet flow before it concentrates and causes rill and gully erosion.

B. Design Considerations

Diversion structures should be designed to carry peak flows from the 2 year, 24 hour storm. The maximum drainage area conveyed through a diversion structure should be 5 acres.

The depth of the diversion should be based upon the design capacity, plus an additional 4 inches of freeboard. The minimum depth provided should be 18 inches. This may be provided solely by a berm or swale or may be developed with a combination of berm and swale. The shape of the diversion may be parabolic, trapezoidal, or V-shaped, with side slopes of 2:1 or flatter.

The minimum slope of the diversion structure should be sufficient to carry the design flow. The maximum slope of the diversion is limited by the permissible velocities of flows within the structure, as shown in the following table. Since any existing vegetation will likely be destroyed upon construction of the diversion structure, the bare surface situation should be considered for most applications.

Table 7E-8.01: Diversion Structure Slopes by Soil Type

Soil Type	Permissible Velocity (fps)			
	Channel Vegetation			
	Bare	*Poor*	*Fair*	*Good*
Sand, silt, sandy loam, and silty, loam	1.5	1.5	2.0	3.0
Sandy clay, loam, and sandy clay, loam	2.0	2.5	3.0	4.0
Clay	2.5	3.0	4.0	5.0

Source: Smoot, 1999

MOST CONSERVATIVE

After construction of the diversion structure, it is important to stabilize the surface immediately with seed and mulch, sod, or other means.

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Appendix A-11

Tile Main Expected Tile Flow Analysis

STORY - DOTSON

4/7/2021

A.A.S.

PROJECTED EXPECTED AVERAGE TILE FLOW (ANALYSIS #1)

FLOW DURATION → DAILY MEAN FLOW VALUES MEASURED OVER A SPECIFIED TIME INTERVAL THAT HAVE BEEN EXCEEDED VARIOUS PERCENTAGES OF THE SPECIFIED TIME INTERVAL.

5% EXCEEDANCE PROB. MEANS THE FLOW HAS ONLY BEEN EXCEEDED 5% OF ALL DAYS OF THE FLOW RECORD.

USE 15% PERCENT DURATION: **2.02 $ft.^3/s$** (STREAMSTATS)

- 15% OF 365 = 54.75 ⇒ ROUGHLY 1 DAY PER WEEK (AVG!), A FLOW EXCEEDS 2.02 $ft.^3/s$
- 95% ⇒ 4/7 DAYS OF WEEK, FLOW EXCEEDS 0.0603 $ft.^3/s$
- 5% ⇒ 1.5 TIMES PER MONTH, FLOW EXCEEDS 3.77 $ft.^3/s$
- 1% ⇒ 1 TIME EVERY 3-4 MONTHS, FLOW EXCEEDS 19.7 $ft.^3/s$

PEAK VALUES:

- 25 yr. = 975 $ft.^3/s$
- 100 yr. = 1560 $ft.^3/s$

STANDARD DESIGN RANGE FOR EXPECTED FLOWS ⇒ 0.06 - 19.7 $ft.^3/s$

4/19/2021

A.A.S.

STORY COUNTY - DOTSON

WEIGHTED DRAINAGE AREA METHOD

DRAINAGE AREA = 3.02 square miles

3.02 × 0.50 = 1.51

3.02 × 1.50 = 4.53

(Look for comparible Drainage Area 1.51 - 4.53 square miles)

CLOSEST GAUGED STATIONS W/ DRAINAGE AREA RANGE +/-

~~Long Dick Creek (USGS Sta.# 05469970)~~

~~Description: Upstream (not on same Stream)~~

~~Drainage Area = 6.08 square miles~~

(~~No~~ Stats Available)

- Squaw Creek at Ames, IA (USGS Sta.# 05470500)
  Drainage Area = 204 square miles ; Avg. Daily Streamflow = 137.433 ft.^{3}/s
  (o/s of range, but still analyze for comparison)
- ✓ South Branch Ditch of Walnut Creek at Kelley, IA (USGS Sta.# 05471010)
  Drainage Area = 1.41 square miles ; Avg. Daily Streamflow = 0.173 ft.^{3}/s

W/IN DRAINAGE AREA OF S. SKUNK RIVER ALL D.S. OF SITE

- ✓ Walnut Creek at Kelley, IA
  Drainage Area = 9.85 square miles ; Avg. Daily Streamflow = 9.047 ft.^{3}/s
- ✓ Walnut Creek near Kelley, IA (USGS Sta.# 05471013)
  Drainage Area = 14.7 square miles ; Avg. Daily Streamflow = 13.292 ft.^{3}/s
- ✓ Walnut Creek near Cambridge, IA
  Drainage Area = 17.6 square miles ; Avg. Daily Streamflow = 17.139 ft.^{3}/s

STORY COUNTY – DOTSON

4/19/2021

A.A.S.

1) $\frac{137.433\ ft.^3/s}{204\ s.m.} = \frac{X}{3.02\ s.m.}$ s.m. = square miles

$X = 2.035\ ft.^3/s$

2) $\frac{0.173\ ft.^3/s}{1.41\ s.m.} = \frac{X}{3.02\ s.m.}$

$X = 0.371\ ft.^3/s$

3) $\frac{9.047\ ft.^3/s}{9.85\ s.m.} = \frac{X}{3.02\ s.m.}$

$X = 2.774\ ft.^3/s$

4) $\frac{13.292\ ft.^3/s}{14.7\ s.m.} = \frac{X}{3.02\ s.m.}$

$X = 2.731\ ft.^3/s$

5) $\frac{17.139\ ft.^3/s}{17.6\ s.m.} = \frac{X}{3.02\ s.m.}$

$X = 2.941\ ft.^3/s$

AVERAGE DAILY STREAMFLOWS FOR THESE 5 DIFF. STATIONS RANGE $0.37 - 2.941\ ft.^3/s$

AVERAGE BTW ALL 5 $\approx 2.17\ ft.^3/s$

∴ PUMP SYSTEM THAT CAN DELIVER $0-5\ ft.^3/s$ WOULD SUFFICE FOR TYP. EXP. FLOWS

$5\ ft.^3/s \rightarrow 2,244$ gpm US

$4\ ft.^3/s \rightarrow 1,795$ gpm US

$1\ ft.^3/s \rightarrow 448$ gpm US

9/15/2021
A.A.S.

DOTSON WETLAND

PROJECTED EXPECTED AVERAGE TILE FLOW (ANALYSIS #2)

(DOTSON W. DITCH FLOWS BASED ON VARIOUS STREAM GAGES & WATERSHEDS)

1) • BOONE RIVER NEAR WEBSTER CITY, IA
   - MEAN ANNUAL ≅ 1.80 cfs
   - 3-MONTH HIGH MEAN AVG. = 2.76 cfs

2) • DES MOINES RIVER AT 2ND AVE.
   - MEAN ANNUAL = 1.24 cfs.
   - 3-MONTH HIGH MEAN AVG. = 1.92 cfs,

3) • IOWA RIVER AT MARSHALLTOWN
   - MEAN ANNUAL = 1.85 cfs.
   - 3-MONTH HIGH MEAN AVG. = 2.84 cfs.

4) • NORTH RACCOON RIVER NEAR JEFFERSON, IA
   - MEAN ANNUAL = 1.59 cfs.
   - 3-MONTH HIGH MEAN AVG. = 2.40 cfs.

5) • SOUTH SKUNK RIVER BELOW SQUAW CREEK NEAR AMES, IA
   - MEAN ANNUAL = 1.99 cfs.
   - 3-MONTH HIGH MEAN AVG. = 2.62 cfs.

4) • SOUTH SKUNK RIVER NEAR AMES
   - MEAN ANNUAL = 1.82 cfs.
   - 3-MONTH HIGH MEAN AVG. = 2.50 cfs.

7) • SQUAW CREEK AT AMES
   - MEAN ANNUAL = 1.86 cfs.
   - 3-MONTH HIGH MEAN AVG. = 1.76 cfs.

8) • TIMBER CREEK NEAR MARSHALLTOWN, IA
   - MEAN ANNUAL = 2.28 cfs.
   - 3-MONTH HIGH MEAN AVG. = 2.90 cfs.

MEAN ANNUAL AVG. = 1.80 cfs.
3-MONTH HIGH MEAN AVG. AVG. = 2.46 cfs.

AVERAGE BTW TWO = 2.13 cfs

★ THIS SECONDARY ANALYSIS UTILIZES DRAINAGE AREA RATIO METHOD AS A SUPPLEMENTAL COMPARATIVE ANALYSIS, EVEN THOUGH DRAINAGE AREAS OF GAUGED STATIONS >> AOI

∴ USE 2 CFS DESIGN PUMPING CAPACITY TO ALIGN PUMPING SYSTEM W/ EXPECTED AVERAGE WATER SUPPLY FROM TILE. UTILIZE VFD TO "THROTTLE" DOWN PUMP W/ LOWER FLOWS TO PROVIDE PUMPING RANGE OF 0.5-2 CFS.

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Appendix A-12
15-Inch HDPE Pipe Calculations
(From Manhole to Lift Station)

United States Department of Agriculture
Natural Resources Conservation Service

Partially Full Pipe Flow Calculations
Pipes > 1/2 Full

Landowner:	*********	**Project:**	*****			**Field:**	*****
County:	*********	**State:**	*****	**Tract ID:**	*****	**Reach:**	*****
By:	*********	**Date:**	*****	**Checked:**	*****	**Date:**	*****
Subject :	*********						

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V

for pipes more than half full

Instructions: *Enter values in blue boxes. Spreadsheet calculates values in yellow boxes*

Inputs

Pipe Diameter, **D** =	15	in
Depth of flow, **y** = (must have y ≥ D/2)	13.95	in
Full Pipe Manning roughness, n_{full} =	0.012	
Channel bottom slope, **S** =	0.003	ft/ft

Calculations

n/n_{full} =	1.035	

Calculations

Pipe Diameter, **D** =	1.25	ft
Pipe Radius, **r** =	0.625	ft
Circ. Segment Height, **h** =	0.088	ft
Central Angle, θ =	1.07	radians
Cross-Sect. Area, **A** =	1.19	ft^2
Wetted Perimeter, **P** =	3.3	ft
Hydraulic Radius, **R** =	0.37	ft
Discharge, **Q** =	3.99	cfs

Equations used for calculations:

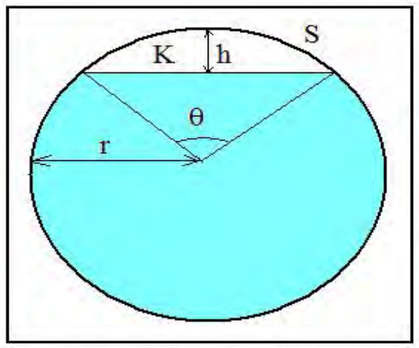
r = D/2

h = 2r - y

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$



Partially Full Pipe Flow Parameters
(More Than Half Full)

R = A/P (hydraulic radius)

Q = (1.49/n)(A)($R^{2/3}$)($S^{1/2}$) (Manning Equation)

V = Q/A

United States Department of Agriculture
Natural Resources Conservation Service

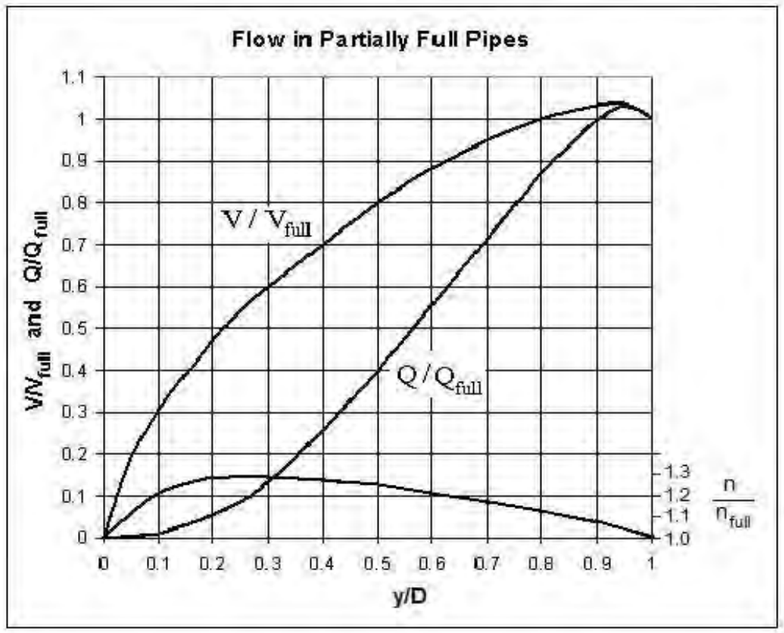
Partially Full Pipe Flow Calculations
Pipes > 1/2 Full

Partially Full Manning roughness, **n** = 0.012

Ave. Velocity, **V** = 3.36 ft/sec

pipe % full [$(A/A_{full})*100\%$] = 96.9%

Equation used for n/n_{full}: **$n/n_{full} = 1.25 - (y/D - 0.5)*0.5$** (for $0.5 \leq y/D \leq 1$)



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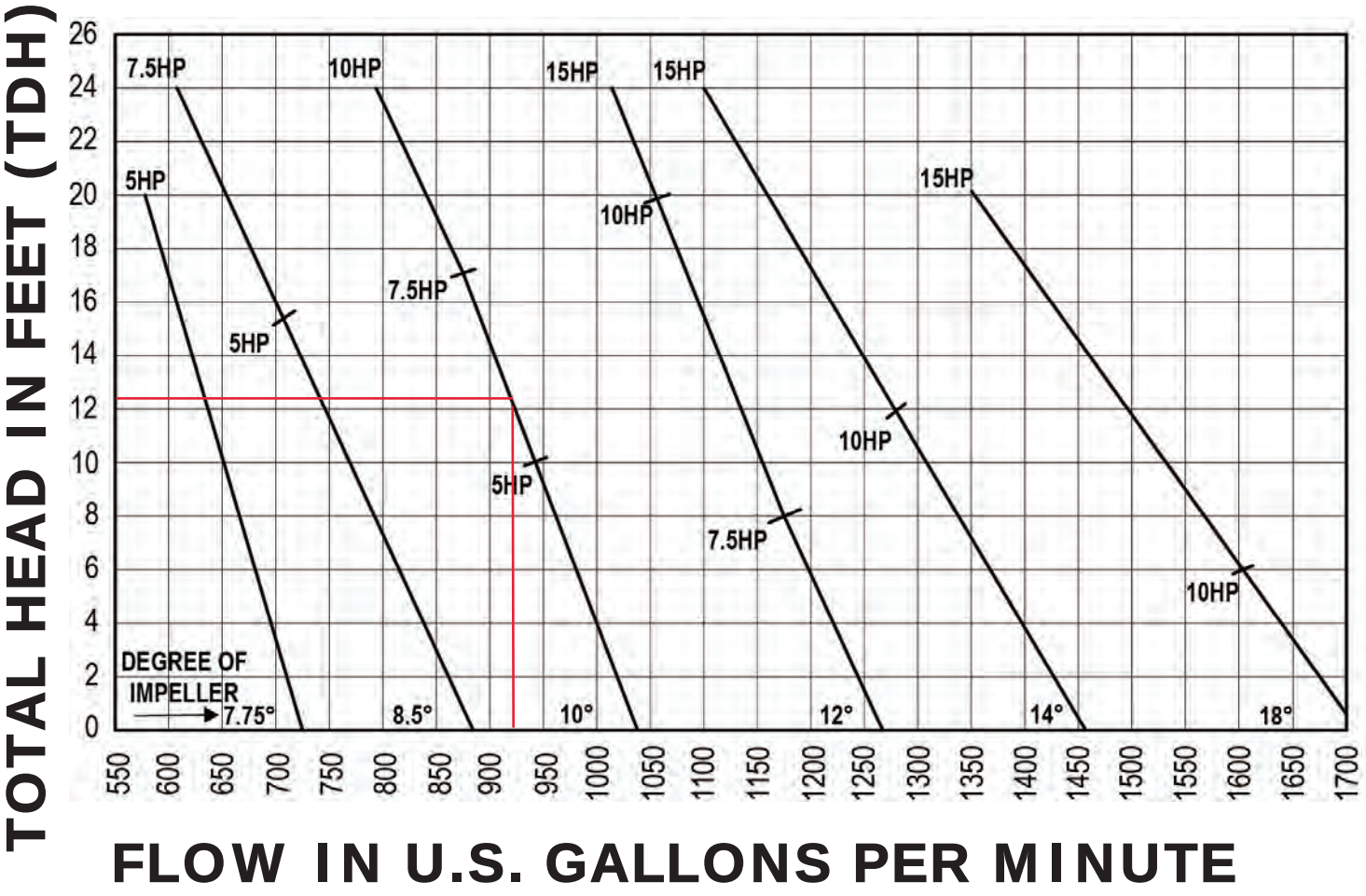
Appendix A-13

Pump Calculations

CP06 SERIES
AXIAL-FLOW PUMP
PERFORMANCE CURVES



FLOW IN U.S. GALLONS PER MINUTE

8" Discharge/Pipe recommended for best performance.

PLOT YOUR POINT

Follow the flow in U.S. Gallons Per Minute (GPM) required horizontally on the chart to your GPM flow rate required; then follow the chart up to your total head in feet required.

The location of the point plotted on the chart determines the pump horsepower and impeller degree required.

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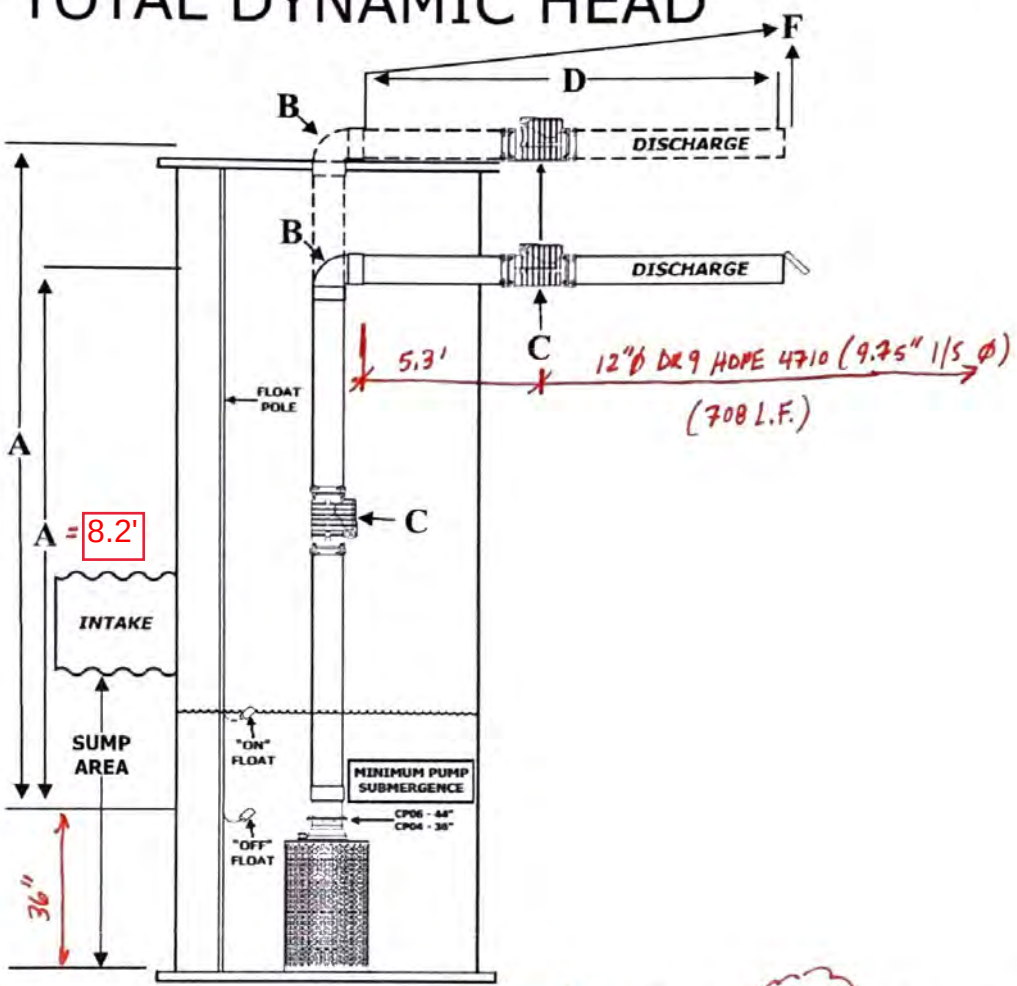
Rev, 3-14-23
A.S.

CARRY PUMPS
REFERENCE CHART
TOTAL DYNAMIC HEAD



INV. TO CL 923.99'

IMPELLER ELEV. 915.83'

BTM SUMP INV. 912.83'

A. Vertical Lift (in feet) from top of pump to 90° elbow: → Total: 8.2' Feet **A.**

B. Standard 90° Elbow 4", 6", 8", 10" or 12": 21 Feet (SEE CHART)

C. Swing Check Valve 4", 6", 8", or 10": 53 Feet (SEE CHART)

D. Horizontal Run (in feet) from 90° elbow to discharge: 5.3 Feet

12"Ø DR 9 HDPE 4710 = 708 FEET
÷ 100
7.08
× .438
3.101'

(SECONDARY SOURCE = 3.023' ≈ =

Total of B., C., D.: 79.3 Feet
÷ 100
Subtotal E.: .793 Feet

Subtotal E.: .793 Feet
(Insert Head Loss number from Reference Chart) × 1.297
Total Friction Loss Head = 1.0285 → 1.03 Feet **E.**

F. Vertical Rise (in feet) of horizontal discharge: → Total: -.66 (NEGLECT) Feet **F.**

ADD A. + E. + F. TO GET TOTAL DYNAMIC HEAD: 8.2' + 1.03 + 3.1' = 12.33'

T.D.H.

CARRY PUMPS

FRICTION LOSS CHART
PIPE SIZES 4" TO 12"

FITTINGS	HEAD LOSS 4" PIPE	6" PIPE	8" PIPE	10" PIPE	12" PIPE
90° ELBOW	11 FT	16 FT	21 FT	26 FT	30 FT
SWING CHECK VALVE	27 FT	40 FT	53 FT	67 FT	82 FT

FLOW U.S. GPM	HEAD LOSS PER 100 FT 4" PIPE	6" PIPE	8" PIPE	10" PIPE	12" PIPE
100	0.640	0.088			
150	1.370	0.187			
200	2.320	0.319			
250	3.510	0.482			
300	4.910	0.676			
350	6.540	0.900			
400		1.152	0.289		
450		1.433	0.359	0.121	
500		1.741	0.437	0.147	
550		2.078	0.521	0.176	
600			0.612	0.207	0.085
650			0.710	0.240	0.099
700			0.814	0.275	0.113
750			0.925	0.312	0.129
800			1.043	0.352	0.145
850			1.167	0.394	0.162
≈ (2 CFS) 900			1.297	0.438	0.180
950				0.484	0.199
1000				0.532	0.219
1050				0.583	0.240
1100				0.635	0.262
1150				0.690	0.284
1200				0.746	0.307
1250				0.805	0.331
1300				0.865	0.356
1350				0.928	0.382
1400				0.993	0.409
1450				1.059	0.436
1500				1.128	0.465
1550					0.494
1600					0.524
1650					0.554
1700					0.586
1750					0.618
1800					0.651
1850					0.685
1900					0.720
1950					0.755
2000					0.791
2050					0.829
2100					0.866
2150					0.905
2200					0.944
2250					0.984
2300					1.025
2350					1.067
2400					1.109

(PVC)

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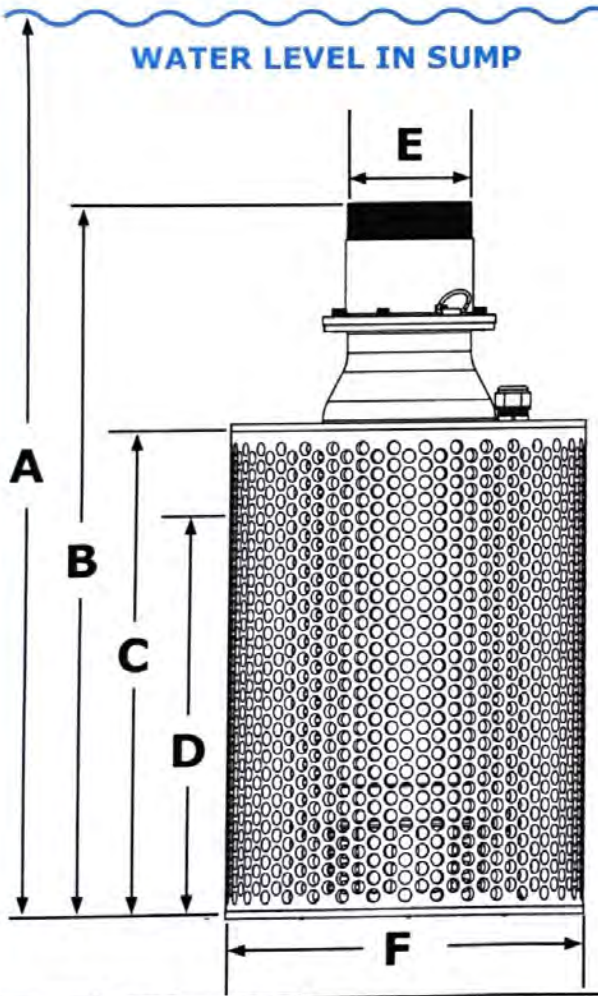
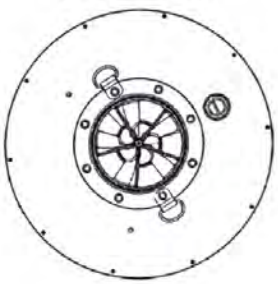
CARRY PUMPS

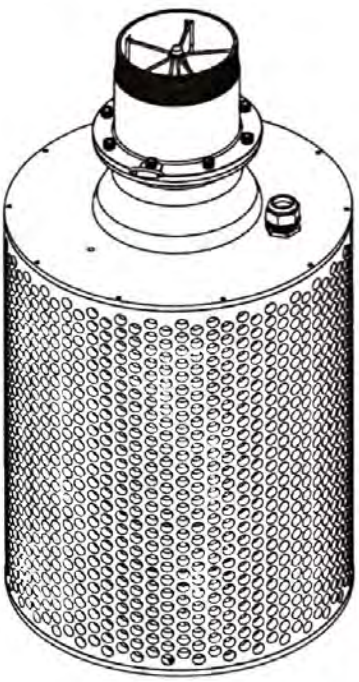
CP06 SERIES - 3 PHASE PUMP SPECIFICATIONS



8" DISCHARGE RECOMMENDED FOR BEST PERFORMANCE

TOP VIEW





HP	MINIMUM WATER PUMP ON (A)	OVERALL HEIGHT (B)	SCREEN HEIGHT (C)	MINIMUM WATER PUMP OFF (D)	NPT DIAMETER (E)	OVERALL DIAMETER (F)	WEIGHT
5	42"	36"	24"	18"	6"	18"	185 LBS
7.5	44"	38"	26"	20"	6"	18"	205 LBS
10	45"	39"	27"	21"	6"	18"	215 LBS
15	47"	41"	30"	24"	6"	18"	240 LBS

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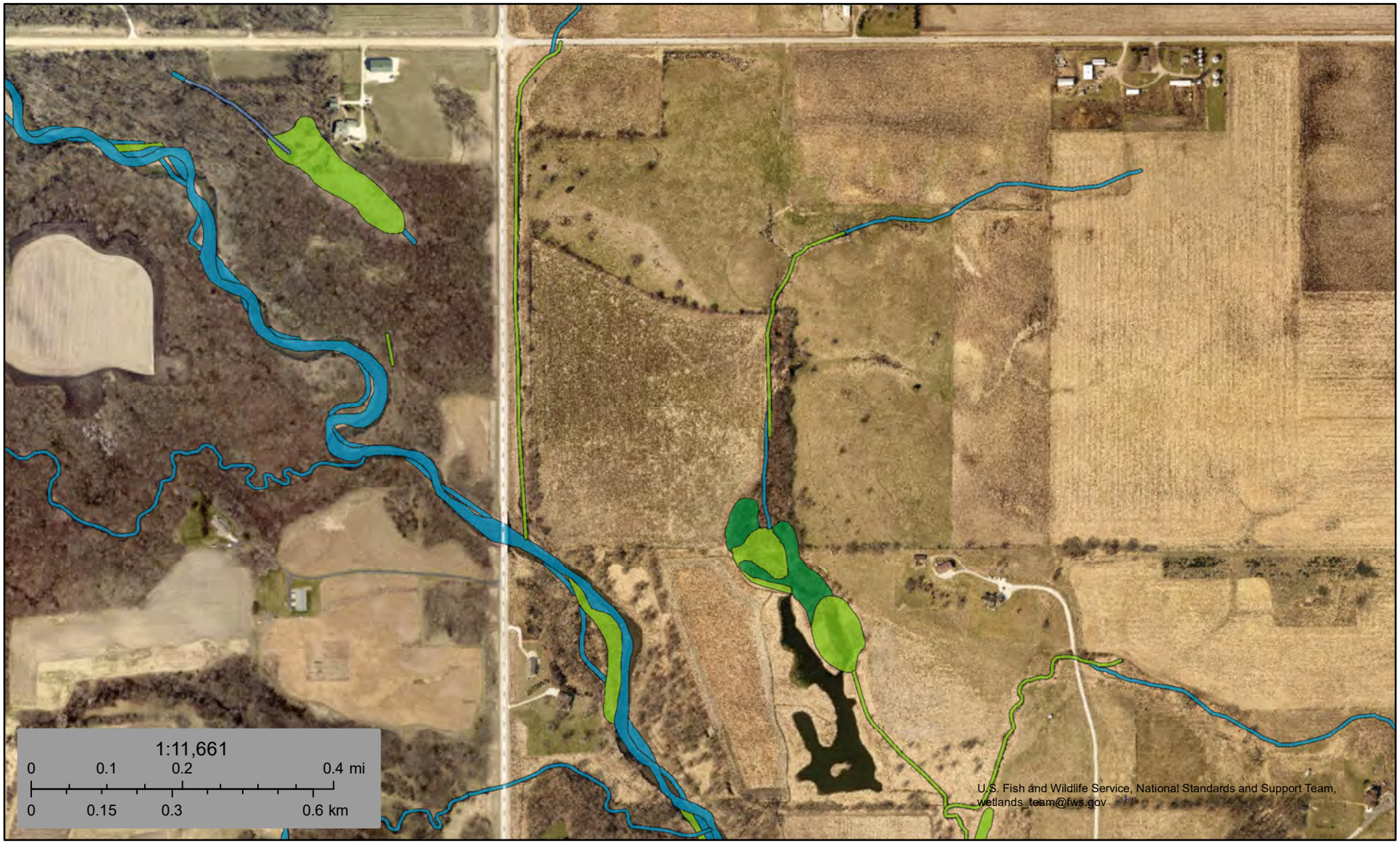
Appendix A-14

FWS Wetland Map

U.S. Fish and Wildlife Service
National Wetlands Inventory

IA-340-4 - FWS WETLAND MAP



October 2, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

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Appendix A-15

ISU – Professor Crumpton Wetland Scenario Analysis

Andrew Schippers

From: Andrew Schippers
Sent: Tuesday, October 26, 2021 9:37 AM
To: Thomas Pluemer PE; Richard Verchota
Subject: FW: Dotson Wetland - Scenarios

From: Crumpton, William G [EEOB] <crumpton@iastate.edu>
Sent: Thursday, October 21, 2021 12:58 PM
To: Andrew Schippers <aschippers@ducks.org>
Subject: RE: Dotson Wetland - Scenarios

Hi Andrew,

Here are results for the scenarios requested.

For this site, I would expect Story County to balance water quality performance with potential habitat and recreational value. For those purposes, something closer to the 9.7 acre pool might be preferred. One of the plans near that size had a more sinuous pool with lots of edges and a substantial prairie buffer. I would be concerned about the lack of prairie buffer around the 20.9 acre pool.

9.7 Acre Pool

Maximum Pumping Rate (cfs)	Nitrogen Mass Removal Rate (lbs/yr)	Nitrogen Areal Mass Removal Rate (lbs/ac/yr)	Percent of Catchment Nitrogen Load Captured[1]	Percent of "Breakpoint" Performance[2]	Average Annual Power Consumption (kWh)	Pu
1.34	13944	1437	31	73	28014	
1.5	14509	1496	34	76	30254	
2	15803	1629	42	82	36419	
3	17187	1772	53	90	45453	
Complete Load Capture	19198	1979				

20.9 Acre Pool

Maximum Pumping Rate (cfs)	Nitrogen Mass Removal Rate (lbs/yr)	Nitrogen Areal Mass Removal Rate (lbs/ac/yr)	Percent of Catchment Nitrogen Load Captured[1]	Percent of "Breakpoint" Performance[2]	Average Annual Power Consumption (kWh)	Pu
1.34	18182	870	31	60	28014	
1.5	19284	923	34	63	30254	
2	21991	1052	42	72	36419	
3	25199	1205	53	83	45453	
Complete Load Capture	30494	1459				

Notes:
[1]Represents the percent of the total catchment nitrogen load that was routed into the wetland.
[2]Represents the estimated nitrogen removal performance relative to the estimated theoretical performance for the site if it were developed as a breakpoint-style system (i.e. if all of the load from the catchment were routed into the wetland).
[3]Pumping costs are estimated assuming a rate of $0.12 per kWh.
[4]Includes only the average annual cost to operate the pump(s).

Subject: Dotson Wetland - Scenarios

William,

I was wondering if you could run some additional scenarios for us on Dotson? Specifically, I wanted to look at a 9.7 acre pool with pumping rates of 1.34 cfs, 1.5 cfs, 2 cfs, and 3 cfs. Also, I would like to see the results for a pool size of 20.9 acres at 1.34 cfs, 1.5 cfs, 2 cfs, and 3 cfs. Please let me know if you are able to assist with this.

Thank you!

ANDREW SCHIPPERS, P.E.
Regional Engineer
Great Lakes Atlantic Regional Office
3300 SE Glenstone Drive, Unit I
Grimes, IA
(832) 704-3286
aschippers@ducks.org
To learn more about Ducks Unlimited
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www.ducks.org/conservation/glaro/engineering

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Appendix A-16

Sediment Accumulation Calculations

DU PROJECT NO.: IA-340-4
IDALS PROJECT NO.: Sto842407B
DESIGNED BY: A.S.
DATE: 10/3/2023

SEDIMENT ACCUMULATION

CONTRIBUTING DRAINAGE AREA[1]:	17	ACRES	0.027	SQMI
STORAGE VOLUME AT NWL[1]:			22.81	AC-FT
TRAP EFFICIENCY[2]:			90	PERCENT
AVG. ANNUAL SHEET AND RILL EROSION[3]:			5.0	TONS/AC/YR
AREA OF DEPRESSIONS NOT SUBJECT TO SEDIMENT DELIVERY[1]:			0	ACRES
AREA SUBJECT TO SHEET AND RILL EROSION[1]:			17	ACRES
AVG. ANNUAL SHEET AND RILL EROSION:			85	TONS/YR
DELIVERY RATIO[2]:			6.0	PERCENT
SHEET AND RILL EROSION DELIVERED TO SITE:			5	TONS/YR
ADJUSTMENT FOR LRA 103[4]:			1.3	FACTOR
ADJUSTED SHEET AND RILL EROSION DELIVERED:			7	TONS/YR
LENGTH OF GULLY EROSION[1]:			1,500	FT
AVG. ANNUAL GULLY EROSION RATE[2]:			0.25	FT^3/FT
IN-PLACE DENSITY OF GULLY MATERIAL[2]:			90	LB/FT^3
AVG. ANNUAL GULLY EROSION (100% DELIVERED):			17	TON/YR
TOTAL SEDIMENT DELIVERED:			24	TON/YR
WEIGHT OF SEDIMENT RETAINED IN WETLAND AT	90	PERCENT TRAPPED:	21	TON/YR
SEDIMENT ACCUMULATION DURING	150	YEAR PERIOD:	3,173	TONS
ESTIMATE 80 PERCENT OF DELIVERED SEDIMENT WILL BE SUBMERGED[5]:			2,539	TONS
VOLUME OF SUBMERGED SEDIMENT[5] AT	1,307	TON/AC-FT[2]:	1.94	AC-FT
NORMAL POOL VOLUME 22.807 AC-FT	WETLAND STORAGE NOT EXCEEDED			
ESTIMATE 20 PRECENT OF DELIVERED SEDIMENT WILL BE AERATED[5]:			635	TONS
VOLUME OF AERATED SEDIMENT[5] AT	1,742	TON/AC-FT[2]:	0.36	AC-FT

REFERENCES:

[1] DETERMINED BY ENGINEER.

[2] NRCS, FIELD OFFICE TECHNICAL GUIDE, IOWA, "EROSION AND SEDIMENT DELIVERY", MARCH 1998.

[3] NATIONAL ACADEMICS PRESS, "SOIL CONSERVATION", CHAPTER 1, PG. 8.

[4] NATIONAL ACADEMICS PRESS, "SOIL CONSERVATION", CHAPTER 3, PG. 51.

[5] NATIONAL ENGINEERING HANDBOOK, CHAPTER 8, SEDIMENT-STORAGE DESIGN CRITERIA.

NOTE:
THIS CALCULATION IS BASED ON THE 17 ACRES OF LAND THAT DIRECTLY ROUTES TO THE WETLAND FROM THE NORTH AND DOES NOT INCLUDE SEDIMENT THAT MAY BE DELIVERED FROM THE PUMP SYSTEM TO THE WETLAND.