raSmith

CREATIVITY BEYOND ENGINEERING

Storm Water Management Report for

Kwik Trip #970

2106 S. West Ave, Waukesha, WI

Project No. 3190495

April 27, 2020

Prepared By:

raSmith
Christopher White, P.E.
16745 W Bluemound Road
Brookfield, WI 53005-5938
Ph: 262-317-3286

Prepared For:

Kwik Trip, Inc.
P.O. Box 2107
1626 Oak Street
La Crosse, WI 54602-2107

raSmith

TABLE OF CONTENTS

raSmith

PURPOSE

raSmith has been retained by Kwik Trip to prepare a Stormwater Management Plan for redevelopment of their store #970 located at 2106 S. West Ave, Waukesha, WI. The project is located southwest of the corner of Les Paul Parkway and S. West Street in Waukesha, Wisconsin. The site is almost entirely classified by USGS Web Soil Survey as silt loam soils (hydraulic soil group D). The geotechnical report has been included in the appendix of this report for more detail. The site is currently developed with the north section of the property being a current gas station and the south section being used as a storage lot (gravel surface). The existing gas station's impervious area drains from west to east towards inlets and storm sewer that discharge directly into the wetlands onsite. The southern storage lot drains towards storm sewer in the S. West Ave ROW. This storm sewer then discharges to the wetlands. The nearest body of water is Pebble Brook and this site is within the Eagle Creek-Fox River basin.

A FEMA 100yr floodplain and wetlands have been identified on the north, west, and south sides of the property. The FEMA flood elevation varies across the site and has been depicted on the plans accordingly. The wetland limits have been delineated and they generally follow the limits of the floodplain. A separate wetland delineation report is available. Copies of the FIRMette and WDNR surface data water viewer can be found in the appendix of this report.

The proposed project consists of the construction of a new convenience store, two gas pump areas, a carwash, parking lots, landscaped areas and a wet detention pond to provide storm water quality treatment. The outfall from the wet detention pond is controlled by an outlet control structure. The outfall from the wet detention pond discharges to the wetlands identified above. The last structure in each storm sewer run has a submerged snout for oil and grease control.

Storm water management for this redevelopment site is regulated by the City of Waukesha Municipal Code Chapter 32 and the Wisconsin Department of Natural Resources NR 151. The analysis presented in this report addresses post-construction water quantity, water quality, and infiltration requirements. This report also include the site's storm sewer design.

RUNOFF MANAGEMENT REGULATIONS

The property is 5.85 acres. The total site under investigation is 3.72 acres (onsite disturbance limits). The existing site has 2.67 acres of impervious area and 2.27 acres are impervious surfaces in the proposed condition. This site is considered redevelopment as it relates to storm water requirements.

Water Quantity: Chapter 32 of the Waukesha code requires that the proposed peak discharge rate for the 1-yr, 2-yr, 10-yr, and 100-yr 24-hr storm events must be no more than the existing peak discharge rate the same storm event

Water Quality: Chapter 32 of the Waukesha code and NR 151.122, total suspended solids (TSS) in the runoff from redevelopment pavement areas from the must be reduced by 40% as compared with no controls.

Site Infiltration: Per NR 151, redevelopment sites are exempt from infiltration requirements.

METHODS OF ANALYSIS

Hydrologic analysis included in this report was performed using the HydroCAD hydrologic simulation computer model, version 10.00 by HydroCAD Software Solutions LLC. The discharges were generated using the SCS Dimensionless Unit Hydrograph Method for a 24-hour duration storm. Model parameters include drainage area, SCS runoff curve number, time of concentration and 24-hour precipitation with an MSE Type III distribution.

raSmith

Table 1 – Design Storm Events

Per Chapter 32.10 Table 3

Frequency (years)	Duration (hours)	Rainfall Depth (inches)
1	24	2.40
2	24	2.70
10	24	3.81
100	24	6.18

WATER QUANTITY DESIGN

Table 2 summarizes the pre-development site parameters and peak discharge rates for the 1-yr, 2-yr, 10-yr, and 100-yr storm events. The existing site is considered a single developed watershed that runoff eventually discharges into the wetlands adjacent to the site. See the attached hydrographs and existing hydrology exhibit for additional information.

Table 2 – Pre-Development Stormwater Quantity Summary

Watershed ID	Watershed Characteristics			Peak Discharge (cfs)			
	Area	CN	Tc	1-year	2-year	10-year	100-year
E-1	3.72	93	6.0	10.78	12.48	18.73	31.87

To meet the required discharge rates and storm water quality requirements (discussed later), a wet detention pond is proposed as the site's main BMP. An outlet control structure will detain the runoff with a steel weir plate and allow for the sediment in the runoff to settle in the permanent pool. For extreme storm events larger than the 100-yr storm event, runoff will flow over spillway in the berm towards the wetlands.

Table 3 summarizes the post-development site parameters and peak discharge rates for the studied storm events. The proposed site is split up between two watersheds. Watershed P-1 drains the majority of the redevelopment impervious area to the wet detention pond for stormwater treatment. Watershed P-2 containing the undetained areas that drain off site towards the wetlands or West Ave. See the attached hydrographs and proposed hydrology exhibit for additional information.

Table 3 – Post-Development Stormwater Quantity Summary

Watershed ID	Watershed Characteristics			Peak Discharge (cfs)			
	Area	CN	Tc	1-year	2-year	10-year	100-year
P-1	2.41	96	6.0	7.78	8.86	12.82	21.19
Bioretention Basin	-	-	-	0.73	0.80	1.02	2.92
P-2	1.31	86	6.0	2.72	3.29	5.46	10.17
Required	-	-	-	10.78	12.48	18.73	31.87
Total	3.72	-	-	3.28	3.92	6.27	11.27

raSmith

WATER QUALITY DESIGN

Water quality treatment was obtained through the use the wet detention basin. The wet detention basin was designed to reduce the average annual total suspended solids (TSS) load for the redevelopment pavement areas onsite only. Runoff from non-pavement areas such as roofs, sidewalks, and grass has been accounted for while excluding pollutant loading. Storm water quality was evaluated using the Source Loading and Management Model (WinSLAMM). The results are shown in Table 4 with the applicable computer generated information located in the appendix.

Table 4 – Post-Development TSS Load

TSS Before (lbs)	TSS After (lbs)	Removal (%)
1219	413.3	66.10%

STORM SEWER DESIGN

The site storm sewer has been designed using the rational method. Each proposed storm sewer run has been analyzed using the 10-year and 100-year storm events using “Hydraflow Storm Sewers Extension for AutoCAD Civil 3D, Version 12”. See appendix for results of the Storm Sewer Calculations and storm sewer plan.

CONSTRUCTION COST ESTIMATE OF STORMWATER BMP

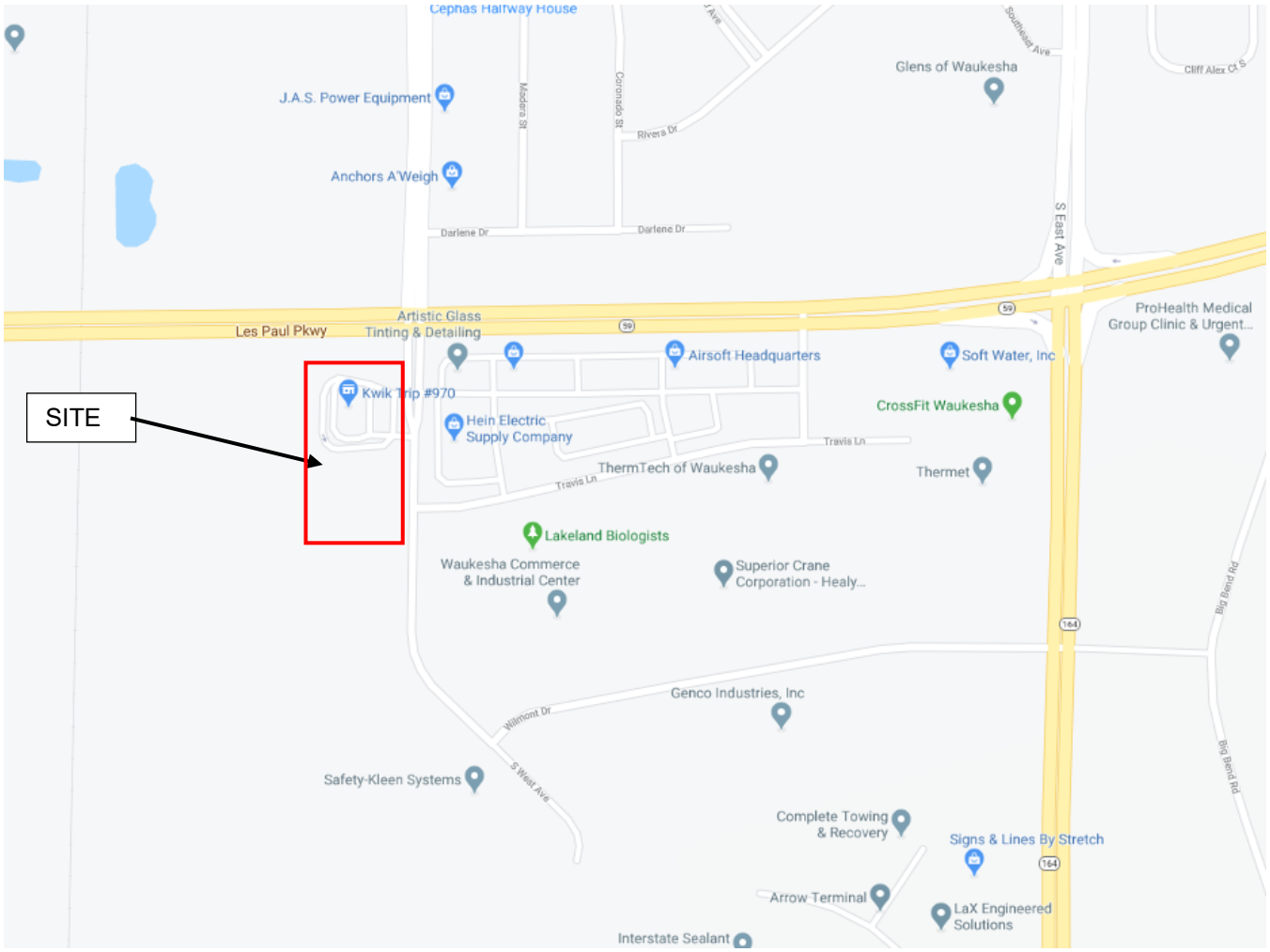
For the purpose of financial assurance per City code section 32.08(c), it is estimated that the wet detention basin shall cost $50,000. This includes grading, liner construction, and the outlet control structure.

SUMMARY

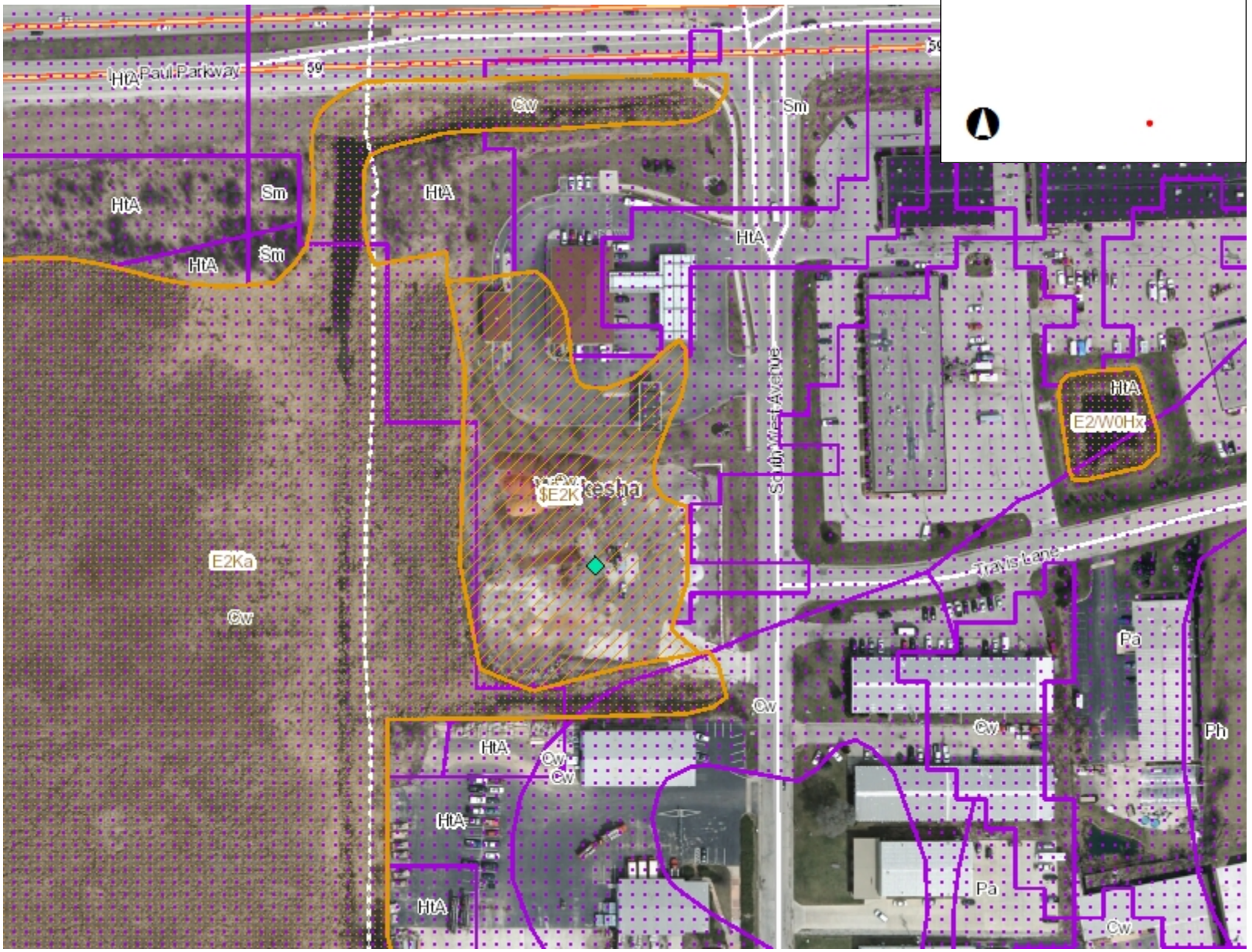
This analysis of the proposed wet detention basin indicates that the requirements of the City of Waukesha Chapter 32 and the Wisconsin Department of Natural Resources NR 151 have been satisfied.

Appendix A – General Project Information

Vicinity Maps



Surface Water Data Viewer Map



Legend

- PNW-ASNRI Sensitive Areas of Lakes
- PNW-ASNRI Wild and Scenic Rivers
- PNW-ASNRI Outstanding and Exceptional Streams
- PNW-ASNRI Trout Streams
- PNW-ASNRI Wild Rice Streams
- PNW-ASNRI Outstanding and Exceptional Lakes
- PNW-ASNRI Special Area Management Plan Streams
- PNW-ASNRI Special Wetlands Inventory Study Streams
- PNW-ASNRI Coastal Wisconsin Wetlands Streams
- PNW-ASNRI Special Area Management Plan Areas
- PNW-ASNRI Special Wetlands Inventory Study Areas
- PNW-ASNRI Coastal Wisconsin Wetlands Areas
- PNW-ASNRI Wild Rice Areas
- PNW-ASNRI Trout Spring Ponds
- PNW-ASNRI State Natural Areas
- PNW-PRF Other Public Rights Features
- PNW Musky Streams
- PNW Sturgeon Streams
- PNW Musky Areas
- PNW Sturgeon Areas
- PNW Walleye Areas

Notes

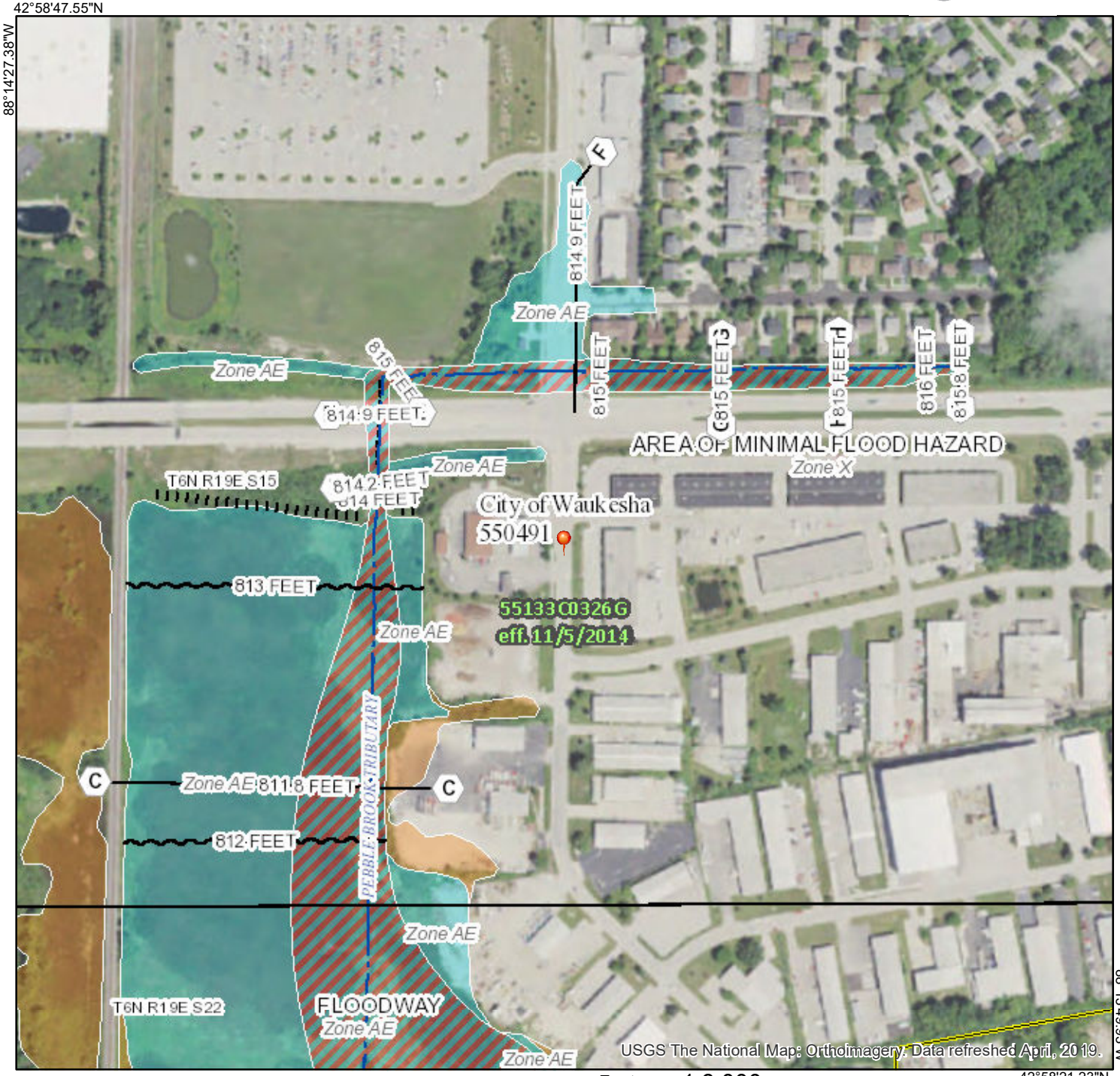
0.1 0 0.03 0.1 Miles

NAD_1983_HARN_Wisconsin_TM

1: 1,980

National Flood Hazard Layer FIRMette

FEMA



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 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 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

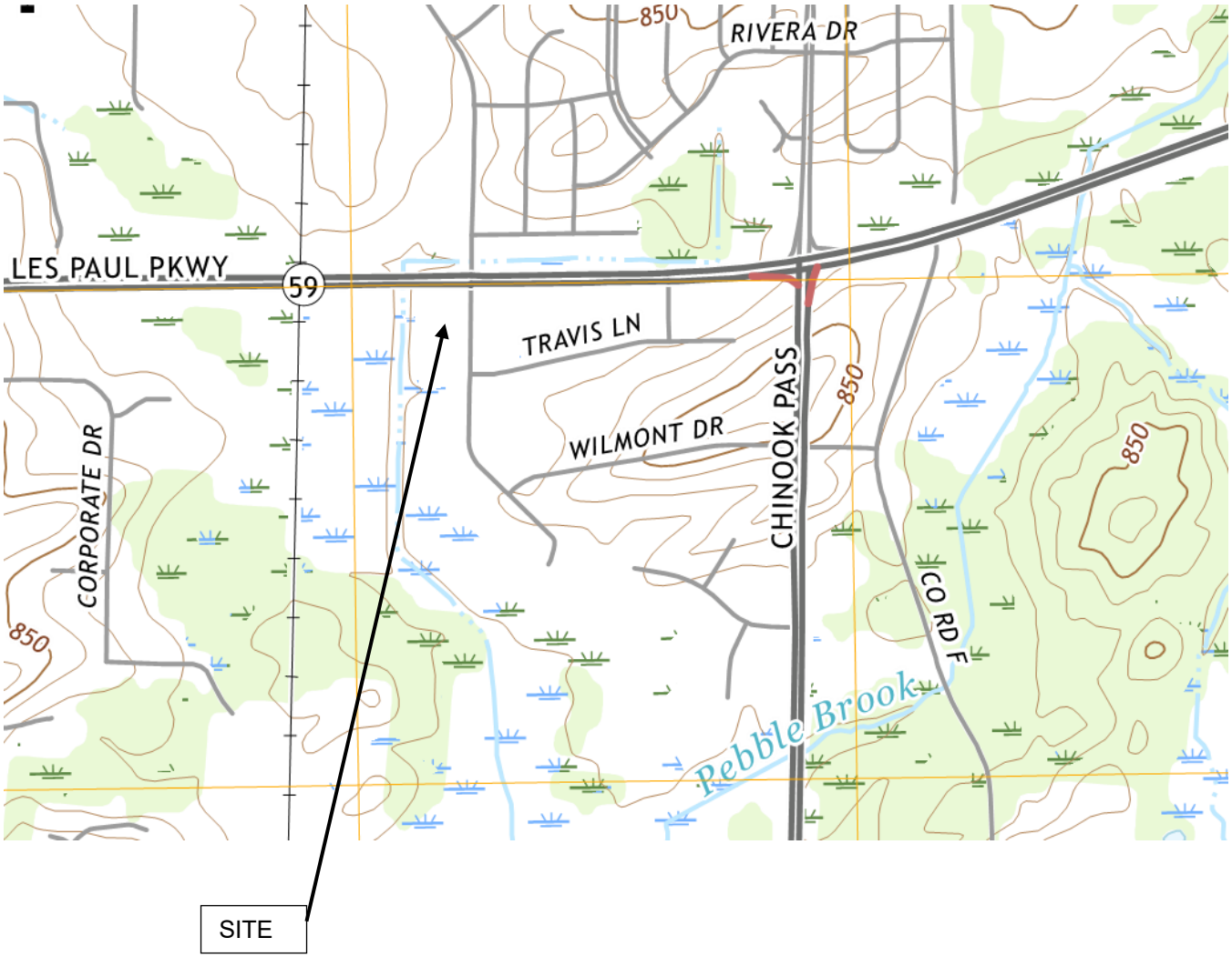
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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 2/5/2020 at 11:16:00 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.

USGS 7.5 min Map



LAND INFORMATION SYSTEMS DIVISION

Waukesha County GIS Map

Legend

- Parcels (Click for details)
- Plats (Click for details)
- Retired Parcels (Click for
- Retired Plats (Click for de
- DNR Wetlands < .25 Acre
- DNR Wetlands > .25 Acre
- Environmental Corridors 2
  - Water
  - Isolated Natural Resource A
  - Isolated Natural Resource A
  - Primary Env. Corridor
  - Primary Env. Corridor Water
  - Secondary Env. Corridor
  - Secondary Env. Corridor Wa
- Municipal Boundary_2K
- FacilitySites_2K_Labels
- Lots_2K
  - Lot
  - Outlot
- SimultaneousConveyance
  - Assessor Plat
  - CSM
  - Condominium
  - Subdivision
- Cartoline_2K
  - <all other values>
  - EA-Easement_Line
  - PL-DA
  - PL-Extended_Tie_line
  - PL-Meander_Line
  - PL-Note
  - PL-Tie
  - PL-Tie_Line
- Road Centerlines_2K
- Railroad_2K
- TaxParcel_2K
- Waterbodies_2K_Labels
- Waterlines_2K_Labels

0 141.46 Feet

Notes:

Printed: 2/14/2020

Appendix B – Soils Information

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Milwaukee and Waukesha Counties, Wisconsin

January 31, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,140 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N 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: Milwaukee and Waukesha Counties, Wisconsin
Survey Area Data: Version 15, Sep 16, 2019

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

Date(s) aerial images were photographed: Aug 1, 2019—Oct 20, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

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
Cw	Colwood silt loam, 0 to 2 percent slopes	0.2	4.4%
HtA	Houghton muck, 0 to 2 percent slopes	4.4	95.6%
Totals for Area of Interest		**4.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Milwaukee and Waukesha Counties, Wisconsin

Cw—Colwood silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2tjx2
Elevation: 570 to 1,020 feet
Mean annual precipitation: 31 to 37 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 110 to 194 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Colwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Colwood

Setting

Landform: Lakebeds (relict)
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy glaciolacustrine deposits over stratified silt and fine sand glaciolacustrine deposits

Typical profile

Ap - 0 to 10 inches: silt loam
Bg - 10 to 24 inches: sandy clay loam
2Cg - 24 to 79 inches: stratified very fine sand to silt

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Forage suitability group: High AWC, high water table (G095BY007WI)
Hydric soil rating: Yes

Minor Components

Pella

Percent of map unit: 8 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Palms

Percent of map unit: 7 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

HtA—Houghton muck, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2szff
Elevation: 600 to 1,090 feet
Mean annual precipitation: 31 to 35 inches
Mean annual air temperature: 43 to 48 degrees F
Frost-free period: 124 to 192 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Houghton, muck, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Houghton, Muck

Setting

Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material

Typical profile

Oap - 0 to 6 inches: muck
Oa - 6 to 79 inches: muck

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 4 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Hydric soil rating: Yes

Minor Components

Houghton, ponded

Percent of map unit: 4 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Palms

Percent of map unit: 2 percent
Landform: Lakebeds (relict)
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Adrian

Percent of map unit: 2 percent
Landform: Lakebeds (relict)
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Willette, muck

Percent of map unit: 1 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: Yes

Edwards

Percent of map unit: 1 percent

Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Terracon GeoReport

Preliminary Geotechnical Engineering Report

Proposed Kwik Trip Convenience Store #970
Waukesha, Wisconsin
July 23, 2019
Terracon Project No. 58195091

Prepared for:
Kwik Trip, Inc.
La Crosse, Wisconsin

Prepared by:
Terracon Consultants, Inc.
Franklin, Wisconsin

July 23, 2019

Kwik Trip, Inc.
P.O Box 2107
La Crosse, Wisconsin 54602

Attn: Troy Batzel
P: 608.793.6283
E: TBatzel@kwiktrip.com

Re: Preliminary Geotechnical Engineering Report
Proposed Kwik Trip Convenience Store #970
South West Avenue and Travis Lane
Waukesha, Wisconsin
Terracon Project No. 58195091

Dear Mr. Batzel:

Terracon Consultants, Inc. (Terracon) has completed the preliminary geotechnical engineering services for the above referenced project. These services were performed in general accordance with our Master Services Agreement (Reference Number P41120391 rev.1) dated November 6, 2013. This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations concerning earthwork, the design and construction of foundations, floor slab and pavement support, and estimates of minimum pavement thickness for the proposed project.

We appreciate the opportunity to be of service to you on this phase of your project, and look forward to providing the testing and observation services during construction. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Michael D. Mueller, E.I.T.
Geotechnical Staff Engineer

for Brett E. Bradfield, P.E.
Senior Geotechnical Consultant
Wisconsin No. 39913

Attachments

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section, and clicking on the logo in the top right corner will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Preliminary Geotechnical Engineering Report

Proposed Kwik Trip Convenience Store #970
South West Avenue and Travis Lane
Waukesha, Wisconsin

Terracon Project No. 58195091
July 23, 2019

INTRODUCTION

This report presents the results of our subsurface exploration and preliminary geotechnical engineering services performed for the proposed Kwik Trip Convenience Store #970 to be located directly west of the intersection of South West Avenue and Travis Lane in Waukesha, Wisconsin. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface conditions
- site preparation and earthwork
- foundation design and construction
- floor slab/pavement subgrade preparation
- estimates of minimum pavement thicknesses

The geotechnical engineering scope of services for this project included five (5) borings and probes extending to depths of approximately 8½ to 25 feet below existing site grades. Maps showing the site and boring locations are provided in **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on the samples obtained from the borings are included on the boring logs in **Exploration Results**.

A Phase I Environmental Site Assessment (ESA) and Limited Site Assessment (LSI) has been prepared for this project and have been issued under separate cover. The designer of any project on this site should be aware of the contents of the ESA/LSI.

SITE CONDITIONS

The following description of site conditions is derived from information provided by Kwik Trip, Inc. (Kwik Trip) and our field observations.

Item	Description
Parcel information	The parcel is located west of the intersection of South West Avenue and Travis Lane in Waukesha, Wisconsin. The site Latitude/Longitude is 42.9755° and -88.2364°, respectively. See **Site Location**
Existing improvements	An existing convenience store is located on the parcel directly to the north and includes a fuel canopy to the east of the store, diesel fuel canopy to the southeast, carwash to the west, and parking lots to the north, east, and south of the building.
Current ground cover	The new parcel is currently vacant and typically gravel covered with areas of wood chips.
Existing topography	We have not been supplied a topographic survey; however, based upon our site visit, the site is relatively flat.
Site history	The parcel was agricultural land with a drainage ditch running through the southeast site area before 1941. The site remained agricultural or vacant until 1995, when indications of ground disturbance and apparent stockpiles are first visible on the east side of the site. The stockpiles along with indications that the site may have been filled are also visible in 2000. By 2005 the site had become an outdoor storage lot, which reportedly involved the storage and sales of masonry supplies and later landscaping supplies such as mulch and topsoil. The site was similarly used until it became vacant sometime within the past year.

PROJECT DESCRIPTION

Our understanding of the project is as follows:

Item	Description
Proposed structures	It is anticipated that the site will be used for a single-story convenience store building and covered canopy with possible underground fuel tanks. This site is still in the preliminary design phases and may also include a car wash.
Building construction	**Convenience Store**: masonry block with brick veneer, load bearing walls with some columns, Portland cement concrete floor slabs **Canopy**: steel frame
Grading	A grading plan has not been provided at this time; however, it is anticipated that minimal grading will be required to obtain final grade

Item	Description
Finished floor elevation	Not provided.
Maximum loads	The following maximum column and wall loads were provided by Kwik Trip; the maximum floor slab load was not provided, but the following values were used in our analysis: columns: 50 kips walls: 5 kips per linear foot (klf) slab: 200 pounds per square foot (psf)
Pavements	The following pavement loadings were provided by Kwik Trip: light-duty (car parking): 200,000 18-kip axle loads (ESALs) over 20 years heavy-duty (drive lanes): 500,000 18-kip axle loads (ESALs) over 20 years heavy-duty (truck lanes for diesel islands): 4,000,000 18-kip axle loads (ESALs) over 20 years

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. A pictorial depiction of the subsurface soil profile is included in the **Exploration Results** section of this report and is referred to as the Geotechnical Model. This model depicts the materials and soils observed within the borings and graphically are equally spaced for presentation purposes.

Fill materials were encountered within each of the borings to depths in the range of 3.5 feet to at least 8.5 feet below existing grades. Boring B-1 was terminated due to auger refusal on concrete rubble encountered at a depth of approximately 8.5 feet. These fill soils were variable in drilling resistance, standard penetration tests N-values and make up, consisting of lean clay, silt, sand, and gravel with variable gravel content throughout. Concrete pieces were also encountered within the samples obtained in boring B-3

The native soils encountered below the fill in the borings were also variable and consisted of areas of organics (peat, organic lake marl, and silty sand containing peat seams) typically in a wet condition. The strengths of these soils were generally low: soft to medium stiff within the cohesive organic soils, and loose within the granular soils containing peat seams. Below these organic soils, medium stiff to very stiff clay soils were encountered with seams of wet, loose to medium dense silt and sand to the boring termination depths (20 to 25 feet at borings B-2 through B-5).

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Subsurface Water Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized below.

Boring Number	Approximate Depth to Free Groundwater While Drilling (feet) [1]
B-1, B-3, B-4 and B-5	5 to 7
B-2	Not Observed [2]

1. Below ground surface
2. While no free water was observed to enter the borehole at B-2, very high moisture soils were observed starting at 2 to 5 feet below existing grade

Free water was generally encountered within the borings in the range of 5 to 7 feet below existing ground surface, and groundwater may be as shallow as 2 feet below existing grade based on the very high moisture soils encountered. Based on these observations, Terracon anticipates that the long-term groundwater level to be near the interface of the fill and native materials (typically between about 3.5 and 8.5 feet below existing grades), though periods of higher water levels may occur during periods of snow melt and heavy rainfall events.

Subsurface water level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, subsurface water levels during construction or at other times in the life of the structure may be different than the levels indicated on the boring logs. The possibility of subsurface water level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The results of this preliminary exploration indicate that the subsurface conditions at the site are **not** suitable for the use of typical shallow foundations for support of the proposed structural loads without implementing some method of soil improvement. The floor slab can be grade supported above the existing fill as long as the owner is willing to accept an elevated risk of settlement and cracking. The following geotechnical related issues at the site will affect construction of the proposed structure.

The variable fill materials and underlying native wet, organic cohesive and granular soils could become unstable with typical earthwork and construction traffic, especially after precipitation events. The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier time of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork** section.

The **Shallow Foundations** section addresses foundation support of the structure. Terracon does not recommend supporting shallow footings within the existing fill materials because of the potential for unpredictable excess total and differential settlement. Additionally, given the generally poor condition of the underlying granular soils, peat and organic lake marl soils, and relatively shallow groundwater table, excavations extending to reach competent bearing soils will be difficult without significant site dewatering. Therefore, it is our opinion that the structure should be supported on a ground improvement system, such as a series of aggregate piers, extending through the overlying uncontrolled fills and native organic soils to suitable native bearing soils below. Conventional spread footing foundation systems could then be constructed upon the ground improvement system.

The **Floor Slabs** section addresses slab-on-grade support of structures. The floor slabs can be grade supported over native inorganic site soils or newly placed engineered fill. An undercut of existing fill materials to develop a designated thickness of engineered fill below floor slabs is recommended.

Support of floor slabs and pavements on or above existing fill materials is discussed in this report. However, even with the recommended construction procedures, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by following the recommendations contained in this report. To take advantage of the cost benefit of not removing the entire amount of undocumented fill, the owner

must be willing to accept the risk associated with building over the undocumented fills following the recommended reworking of the material.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Prior to placing fill, any existing asphalt, debris, topsoil, and other surficial unsuitable material for an area extending at least 5 feet beyond the edges of the proposed structures' footprint should be removed. Any existing utilities that will be removed or impacted by construction should be relocated. Complete stripping of the topsoil and any loose, soft, or otherwise unsuitable materials should be performed in the proposed building and parking/driveway areas. Any existing building foundations (if present) that are discovered during site preparation can remain in place provided they do not interfere with new foundation construction, and there is at least two feet of separation between the existing foundation and any new structural element.

The removal of existing fill materials should extend to depths of at least 2 feet below bottom of floor elevations.

Following site stripping and grubbing, undercuts to designated depths and prior to placing new engineered fill, the exposed soils should be observed and tested by Terracon. A Terracon representative should observe proofrolling of the exposed soils. Proofrolling can be accomplished using a loaded tandem-axle dump truck with a gross weight of at least 25 tons, or similarly loaded equipment. Areas that display excessive deflection (pumping) or rutting during proofroll operations should be improved by scarification and compaction, or by removal and replacement with an approved gradation of crushed stone aggregate.

Existing Fill

As noted in **Geotechnical Characterization**, existing fill and possible fill was encountered within the borings to depths of approximately 3.5 to in excess of 8.5 feet below existing grade. The fill appears to have been placed in an uncontrolled manner, and was observed to contain concrete pieces and rubble, as well as intermixed organic material within several of the borings.

Additionally, layers of native organic materials (peat, lake marl, peat bearing wet sand) were observed directly below the fill material at borings B-2, B-3, and possibly B-5. Support of floor slabs and pavements on or above existing fill is discussed in this report. We do not recommend that building foundations be supported on the existing fill, without the Owner willing to assume the risk of greater than typical total and differential settlement. However, even with the recommended construction procedures, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by following the recommendations contained in this report.

If the owner elects to construct the floor slabs and pavements on the existing fill, the following protocol should be followed. Once the planned subgrade elevation has been reached the entire floor slab and pavement area should be proof-rolled. Areas of loose, soft, or otherwise unsuitable material should be undercut and replaced with new structural fill.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 feet of structures, pavements or constructed slopes. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements:

Fill Type [1, 2]	USCS Classification	Acceptable Locations for Placement
Cohesive	CL [3], CL/ML [3], ML [3] (LL ≤ 45 and PI ≤ 20)	below slabs and pavements
Granular	crushed limestone or crushed concrete meeting WISDOT Section 304 for 1¼ dense graded base	below footings aggregate base below slabs and pavements
Unsuitable	CL/CH[4], CH[4], MH[4], OL, OH[4], PT	non-structural locations

1. Engineered fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation prior to use on this site.
2. Any organic materials, rock fragments larger than 3 inches, and other unsuitable materials should be removed prior to use as engineered fill.
3. Highly susceptible to frost; unstable when wet, are commonly used for pavement support with the knowledge that additional maintenance and/or shorter pavement life are likely
4. High plasticity. Not recommended beneath movement sensitive features such as foundations, floor slabs, or pavements.

Fill Compaction Requirements

Engineered fill should meet the following compaction requirements.

Item	Description
Maximum fill lift thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum compaction requirements [1, 2, 3]	95% beneath the design foundation base elevation and within the 1 foot of finished pavement subgrade elevation; the compaction effort should extend laterally beyond the pavement and/or footing edge at least 8 inches for every foot of fill placed below the pavement subgrade and foundation bearing elevations 93% above foundations, below floor slabs, and more than 1 foot below finished pavement subgrade
Moisture content range [1]	within 2% below to 3% above the modified proctor optimum moisture content at the time of placement and compaction granular materials should be compacted within workable moisture levels

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. If the granular material is a coarse sand, crushed limestone, or gravel, is of a uniform size, or has a low fines content, compaction comparison to relative density (ASTM D 4253 and D 4254) may be more appropriate. In this case, granular materials should be compacted to at least 60% and 65% of the material's maximum relative density for the 93% and 95% modified Proctor recommendations, respectively.
3. Specifically, moisture levels should be maintained to achieved compaction without bulking during placement or pumping when proofrolled.

Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. Utility trenches that penetrate beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective "trench plug" that extends at least 5 feet out from the face of the building exterior. The plug material should consist of cementitious "flowable fill" or impervious clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the moisture content and compaction recommendations provided in this report.

Grading and Drainage

All grades should provide effective drainage away from the building during and after construction. Water permitted to pond next to the building can result in soil movements greater than those discussed in this report. These greater movements can result in unacceptable differential floor

slab and/or foundation movements, cracked slabs and walls, and roof leaks. Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained. The roof should have gutters/drains with downspouts that discharge into storm sewer or onto splash blocks at a distance of at least 10 feet from the building.

After building construction and landscaping, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the structure we recommend a maintenance program to effectively seal and maintain joints to prevent surface water infiltration.

Earthwork Construction Considerations

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proofrolling, placement and compaction of controlled compacted fills, backfilling of excavations into the completed subgrade, and just prior to construction of building floor slabs.

Upon completion of filling and grading, care should be taken to maintain the soil subgrades moisture content. Construction traffic over completed soil subgrades should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Any water that collects over or adjacent to construction areas should be promptly removed. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction and observed by Terracon. Where present, care should be taken to avoid disturbance of prepared subgrade soils. The native soils and new engineered fill soils are very easily disturbed, especially by construction traffic. Construction traffic should not operate directly on saturated or low strength soils. If the subgrade becomes saturated, desiccated, or disturbed, the affected materials should either be scarified and compacted or be removed and replaced as previously discussed. Subgrades should be observed and tested by Terracon prior to construction.

Any water that collects in excavations should be removed prior to placement of foundation concrete or engineered fill. Although the contractor is responsible for the means and methods to dewater excavations, in our opinion, water that accumulates in excavations can generally be removed using sump pits and pumps;

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, as well as other applicable codes, and in accordance with any applicable local, state, and federal safety regulations. The contractor should be aware that slope height, slope inclination, and excavation depth should in no instance exceed those

specified by these safety regulations. Flatter slopes than those dictated by these regulations may be required depending upon the soil conditions encountered and other external factors. These regulations are strictly enforced and if they are not followed, the owner, the contractor, and/or earthwork and utility subcontractor could be liable and subject to substantial penalties. Under no circumstances should the information provided in this report be interpreted to mean that Terracon is responsible for construction site safety or the contractor's activities. Construction site safety is the sole responsibility of the contractor who shall also be solely responsible for the means, methods, and sequencing of the construction operations.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations. Shallow foundations bearing within the existing fill or on/above the organic soils at this site are **not** recommended. A proprietary ground improvement system is recommended to develop support for conventional spread footing foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum net allowable bearing pressure [1]	To be determined by proprietary ground improvement designer. Can be specified to achieve 2,000 to 5,000 psf for foundations supported on soil improved by the installation of aggregate piers.
Minimum embedment below finished grade for frost protection [2]	4 feet
Approximate total settlement from structural loads [3]	To be determined by proprietary ground improvement designer. Can be specified to be less than 1 inch
Approximate differential settlement [3]	1/2 to 2/3 of the total settlement
Minimum foundation dimensions	Isolated spread footings: 30 inches Continuous footings: 18 inches

Item	Description
1.	The recommended maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the foundation base elevation. This pressure may be increased by ⅓ for temporary loads such as wind.
2.	For perimeter foundations beneath heated structures. It should be noted that the maximum frost penetration in unheated areas can extend to depths on the order of about 5 feet below grade. If it is desired to reduce the potential for frost heave, foundations below unheated areas, such as the canopy foundations, or that will be exposed to freezing conditions during construction, should extend to at least this depth.
3.	Foundation settlements will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of engineered fill, and the quality of the earthwork operations and footing construction, frequent control joints should be provided for walls.

Ground Improvement

Variable fill containing intermixed construction debris and areas of intermixed topsoil and organic materials, peat, organic lake marl, and loose granular soils containing organic seams are present within the upper 10 to 15 feet of the soil profile before suitable soils are reached which can support the desired bearing pressure. Foundations bearing on the existing uncontrolled fills or above organic materials could experience greater than typical total and differential settlement, the magnitude of which is difficult to predict. Therefore, we recommend that aground improvement system consisting of aggregate piers. Ground improvement systems are an intermediate design-build soil reinforcement system that is commonly used to support structures as an alternative to soil over-excavation. The system allows the use of conventional spread footings and slabs cast on-grade, and typically provides settlement control to within 1-inch or less.

The rammed aggregate piers are installed by densifying lifts of aggregate into a cavity that is created by either drilling (top fed aggregate in an open borehole) or displacement methods (bottom fed aggregate while the probe retains the sides of the hole). Densification takes place with a high-energy beveled tamper or vibratory probe that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in surrounding soil, thereby further stiffening the stabilized composite soil mass. The result of ground improvement system installation is a significant strengthening and stiffening of subsurface soils that then support slabs and conventional shallow spread footings. For the proposed structure, we recommend that the individual aggregate pier elements extend through the existing fill, organic materials, and weaker native soils encountered in the upper 10 to 15 feet of the profile and terminate in the underlying stiff to very stiff native clay or medium dense silt or sand.

Excavation of rubble materials that would hinder advancement of the aggregate pier equipment is often necessary at the ground improvement locations. These pot-holes are then backfilled with suitable fill materials. We anticipate installation will require temporary casings or sleeved portals for the aggregate placement as the existing fill, sand and organic soils will be prone to caving and sloughing in drilled holes. A displacement system of installation might be appropriate.

The ground improvement designs are based on a two-layer settlement analysis. Settlements within the "upper zone" (zone of soil that is reinforced with aggregate pier elements) are computed using a weighted modulus method that accounts for the stiffness of the aggregate pier elements, the stiffness of the matrix soil, and the area coverage of aggregate pier elements below supported footings. Settlements within the "lower zone" (zone of soils beneath the upper zone which receives lower intensity footing stresses) are computed using conventional geotechnical settlement methods.

Ground improvement systems are typically proprietary designs, and are designed and installed by a specialty contractor. The proprietary designer provides an allowable bearing pressure for the design of the foundation and provides an estimate of overall settlement performance. Due to the specialty of these soil improvement procedures, we recommend that a performance specification be used for these types of system. After reinforcement with the ground improvement system, we anticipate that the building foundations may be designed as a conventional spread footing, sized for an allowable bearing pressure on the order of 2,000 to 5,000 psf. The above estimate should be considered preliminary and is based on our previous experience with aggregate pier systems in similar soils. The allowable bearing pressure will vary depending on the size, installation methods and spacing of the individual piers. Thus, the actual allowable bearing pressure used in footing design should be developed by an experienced design-build aggregate pier contractor based on the actual pier geometry to be used for construction. We are able to provide a list of qualified aggregate pier design-build contractors at your request.

If the aggregate pier system is selected, quality assurance testing should be performed during installation, including documentation of the soil conditions encountered, the shaft lengths, amount of aggregate used, and tests on the completed aggregate pier elements. Terracon can provide these services if requested.

Uplift and Lateral Loading Considerations

Footing foundations supporting the canopy columns should be embedded sufficiently to resist uplift and lateral loads. Uplift loads on the canopy footings may be resisted by the compressive load, weight of the footing, and weight of the soil directly above the footing. A total unit weight of 120 pounds per cubic foot (pcf) may be used for engineered fill placed above foundations. Horizontal loads acting on earth-formed canopy foundations or canopy foundations backfilled with engineered fill may be resisted by a combination of passive pressure on the sides of the footing and sliding friction at the base of the footing. An ultimate coefficient of sliding friction of 0.3 (based on footings placed on ground improvement systems) may be assigned to the base of the footings. If uplift loads will accompany horizontal loads, the contribution of sliding friction to the horizontal load capacity should be neglected. Passive resistance for canopy foundations backfilled with engineered fill may be calculated using an equivalent fluid density of 300 pcf. Regardless of depth, the passive pressure should not exceed 2,000 psf. Passive pressure should be ignored within 5

feet of the ground surface due to potential frost disturbance. Appropriate safety factors should be applied to the ultimate friction and equivalent fluid unit weight values provided.

FLOOR SLABS

The recommendations provided in the following sections are based on supporting the floor slab over the native clay soils that have been prepared as recommended in the **Earthwork** section of this report.

Floor Slab Design Parameters

Item	Description
Floor slab support [1, 2]	At least 2 feet of engineered fill placed over tested and evaluated existing fill materials or suitable native soils. Engineered fill placed and compacted in accordance with **Earthwork**
Granular leveling course [3]	6 inches of well-graded granular material
Modulus of subgrade reaction [4]	75 pounds per square inch per inch (psi/in) Note: a value of 100 pci can be used at the top of the compacted granular leveling course

1. Differential movement between foundations and grade-supported floors should be considered by the structural engineer.
2. Joints should be constructed at regular intervals as recommended by the American Concrete Institute (ACI) to help control the location of cracking.
3. The floor slab should be placed on a leveling course comprised of well-graded granular material compacted to at least 95% of the modified proctor maximum dry density (ASTM D 1557).
4. For point loading; based on the use of a 6 inch compacted granular leveling course

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Settlement of floor slabs supported on existing fill materials or buried organic soils cannot be accurately predicted, but could be larger than normal and result in some cracking. Mitigation

measures as noted in **Existing Fill** within **Earthwork** are critical to the performance of floor slabs. In addition to the mitigation measures, the floor slab can be stiffened by adding steel reinforcement, grade beams and/or post-tensioned elements.

Floor Slab Construction Considerations

Floor slab subgrade soils should be prepared as discussed in the **Earthwork** section of this report. On most project sites, site grading is generally accomplished early in the construction phase; however, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of the granular layer and concrete, and corrective measures will be required.

Terracon should review the condition of the floor slab subgrades immediately prior to placement of the granular leveling course and construction of the slabs. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas containing backfilled trenches. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill.

PAVEMENTS

General Pavement Comments

Estimates of minimum pavement thicknesses are provided for the traffic conditions and pavement life referenced in **Project Description**. A critical aspect of pavement performance is site preparation. The minimum pavement thicknesses are based on the subgrade being prepared as recommended in the **Earthwork** section.

There is often a time lapse between the end of grading operations and the commencement of paving. Subgrades prepared early in the construction process can become disturbed by construction traffic. Non-uniform subgrades often result in poor pavement performance and local failures relatively soon after pavements are constructed. Depending on the paving equipment used by the contractor, measures may be required to improve subgrade strength to greater depths for support of heavily loaded trucks. Improvements should be made as recommended in **Earthwork**.

Before paving, and where recommended by Terracon, pavement subgrades should be proofrolled in the presence of a Terracon representative. Proofrolling of the subgrade should help locate soft, yielding, or otherwise unsuitable soil at or just below the exposed subgrade level. Unsuitable areas observed at this time should be improved by scarification and compaction or be removed and replaced with engineered fill. Proofrolling should be accomplished with a fully loaded, tandem-

axle dump truck with a minimum gross weight of 25 tons or other equipment providing an equivalent subgrade loading.

Designs for new pavement sections for this project have been based on the procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993). Pavement design methods are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support.

Pavement Section Thicknesses

Based on the traffic information provided to us, the design traffic values in 18-kip equivalent single axle loads (18-kip ESALs) are presented in the table below. Based on our laboratory test results, previous experience with soils similar to those encountered at the boring locations, and pavement subgrades prepared as discussed in this report, a modulus of subgrade reaction value (k) of 100 pci and a California Bearing Ratio (CBR) value of 3 was used in evaluating minimum pavement thicknesses. Terracon should also be notified to review the design and make supplementary recommendations should any changes in the design traffic occurs. The design is also based on effective surface drainage.

The traffic patterns and anticipated loading conditions provided by Kwik Trip are as follows:

Design Traffic	
Location	**Design ESAL's Values**
light duty (car parking)	200,000
heavy duty (drive lanes)	500,000
heavy duty (truck lanes)	4,000,000

The following pavement design parameters were used in our evaluation of estimating minimum pavement sections for the project.

PAVEMENT DESIGN INPUT		
Input Parameter	**Asphalt**	**Concrete**
reliability	85%	85%
initial serviceability	4.2	4.5
terminal serviceability	2.0	2.0
standard deviation	0.45	0.35
load transfer	---	3.0
drainage	1.0	1.0

Based upon the expected traffic and subgrades being prepared as recommended in this report, the following estimated minimum pavement thicknesses should be considered as the minimum sections.

Pavement Area	Pavement Type	Thickness (in)			
		Surface Course[1]	Asphalt Binder[2]	Base Course[3]	Total
light duty (car parking)	Rigid (Concrete)	6	- -	6	12
	Flexible (Bituminous)	2	2	9	13
heavy duty (drive lanes)	Rigid (Concrete)	6	- -	6	13
	Flexible (Bituminous)	2	2.5	10	14.5
heavy duty (truck lanes)	Rigid (Concrete)	8	- -	6	14
	Flexible (Bituminous)	2	4	14	20

1. Surface course, WisDOT Specifications for No. 4 (12.5 mm) Hot Mix Asphalt (HMA)
2. Binder course, WisDOT Specifications for No. 3 (19.0 mm) HMA
3. The base course aggregate beneath the new pavement should conform to the 1-1/4-inch Dense Graded Base listed in Section 305 of the WisDOT Standard Specifications (current edition). The base course material should be compacted to a minimum of 95% of the modified Proctor density within -2 to +4% of the optimum moisture content.
4. The trash container pad should be large enough to support the container and the tipping axle of the trash collection vehicle. Areas subjected to heavy static loads such as the trash container pad should be constructed with at least 7 inches of concrete pavement.

Construction traffic on the pavements was not considered in developing the estimated minimum pavement thicknesses. If the pavements will be subject to construction equipment/vehicles, the pavement section should be revised to consider the additional loading.

The following comments should be considered for the indicated concrete pavement design options.

- Control joints should have a maximum spacing of about 30 times the thickness of the concrete slab, as per American Concrete Institute (ACI) recommendations, and should be placed in a roughly square pattern (where possible).
- At construction joints, an adequately designed keyed construction joint or a butt end construction joint is recommended. For a butt end construction joint, an adequate number of deformed tie bars should be provided.
- Tie bars are also recommended along the first longitudinal joint from the pavement edge to keep the outside slab from separating from the pavement.

- Isolation joints are recommended where concrete pavements abut fixed objects such as light poles, curb inlets, etc.

Pavement Drainage Considerations

The pavement sections provided above are based on no significant increase in the subgrade soils' moisture contents. Paved areas should be sloped to provide rapid drainage of surface water and to drain water away from the pavement edges. Water should not be allowed to accumulate on or adjacent to the pavement, since this could saturate and soften the subgrade soils and subsequently accelerate pavement deterioration. Periodic maintenance of the pavements will be required. Cracks should be sealed, and areas exhibiting distress should be repaired promptly to help prevent further deterioration. Even with periodic maintenance, some movement and related cracking may still occur and repairs may be required.

Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses, and for this reason, periodic maintenance should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration. Preventive maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance.

TANK BALLAST RECOMMENDATIONS

Underground fuel tanks should be designed to resist uplift pressures due to hydrostatic loading. Uplift pressure would be greatest when the tanks are empty and water levels rise above the bottom of the tanks. The fuel tanks and tie-down mats can be designed to resist uplift forces through the dead weight of the mat and tanks, and the effective weight of backfill placed above the tank and foundations. A backfill weight of 110 pcf could be used above the design high groundwater table and 50 pcf for backfill below the water table. We recommend that the tank backfill be placed and compacted in accordance with the recommendations provided in the **Site Preparation** section of this report. A sump pit and pump system can be provided to remove seepage from the granular fill around the tanks to reduce uplift pressures. A backup pump and emergency power source should be part of any sump design.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the geotechnical conditions in the area, the data obtained from the site exploration performed and from our understanding of the project. Variations will occur between boring locations, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of geotechnical services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. It is understood that Terracon is performing or has performed environmental studies at this site under a different cover.

Our services and any correspondence are intended for the exclusive use of Kwik Trip for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for that specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. In the event that changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

SITE LOCATION AND EXPLORATION PLAN

SITE LOCATION

Kwik Trip #970 Adjacent Lot ■ Waukesha, Wisconsin
July 23, 2019 ■ Terracon Project No. 58195091

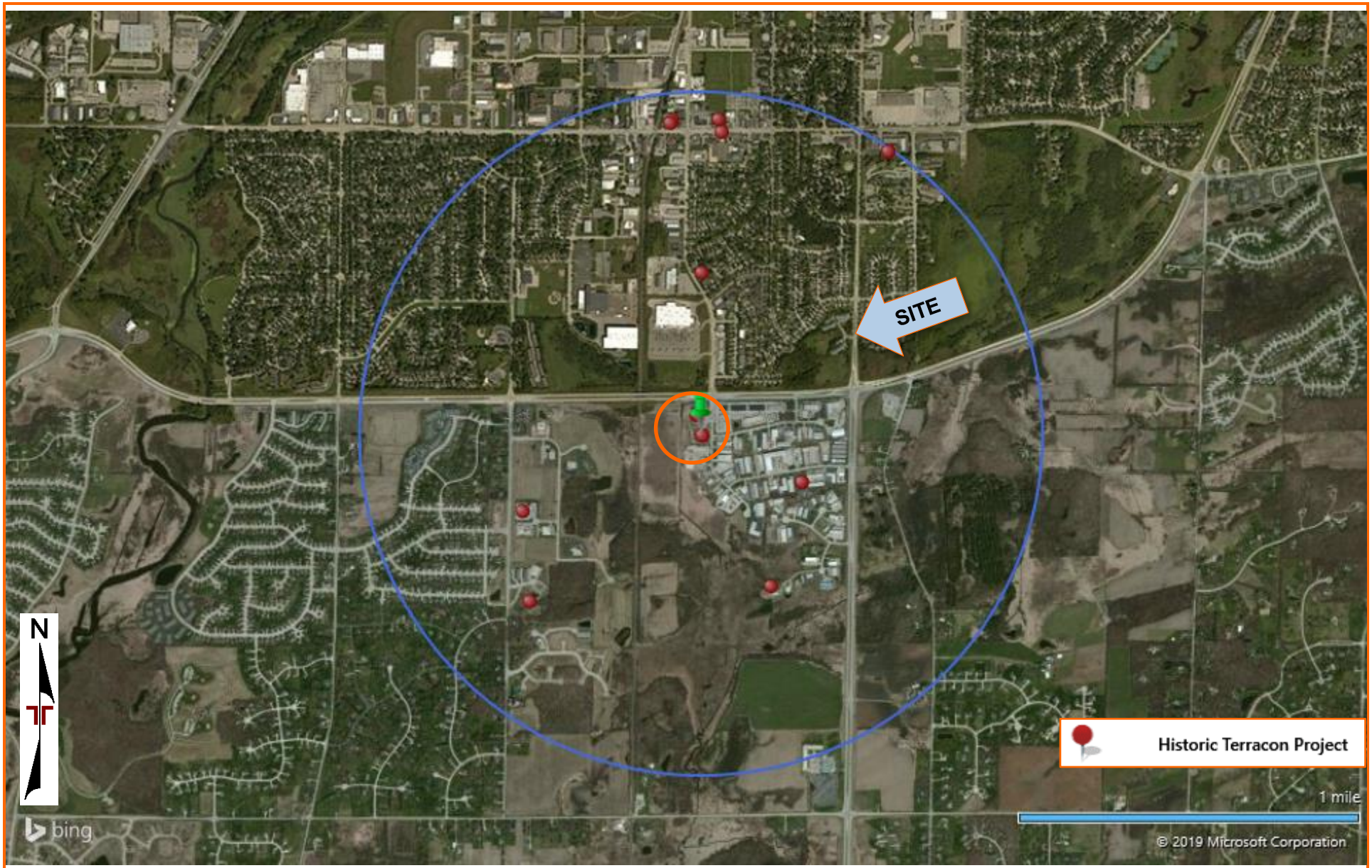


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Kwik Trip #970 Adjacent Lot ■ Waukesha, Wisconsin
July 23, 2019 ■ Terracon Project No. 58195091

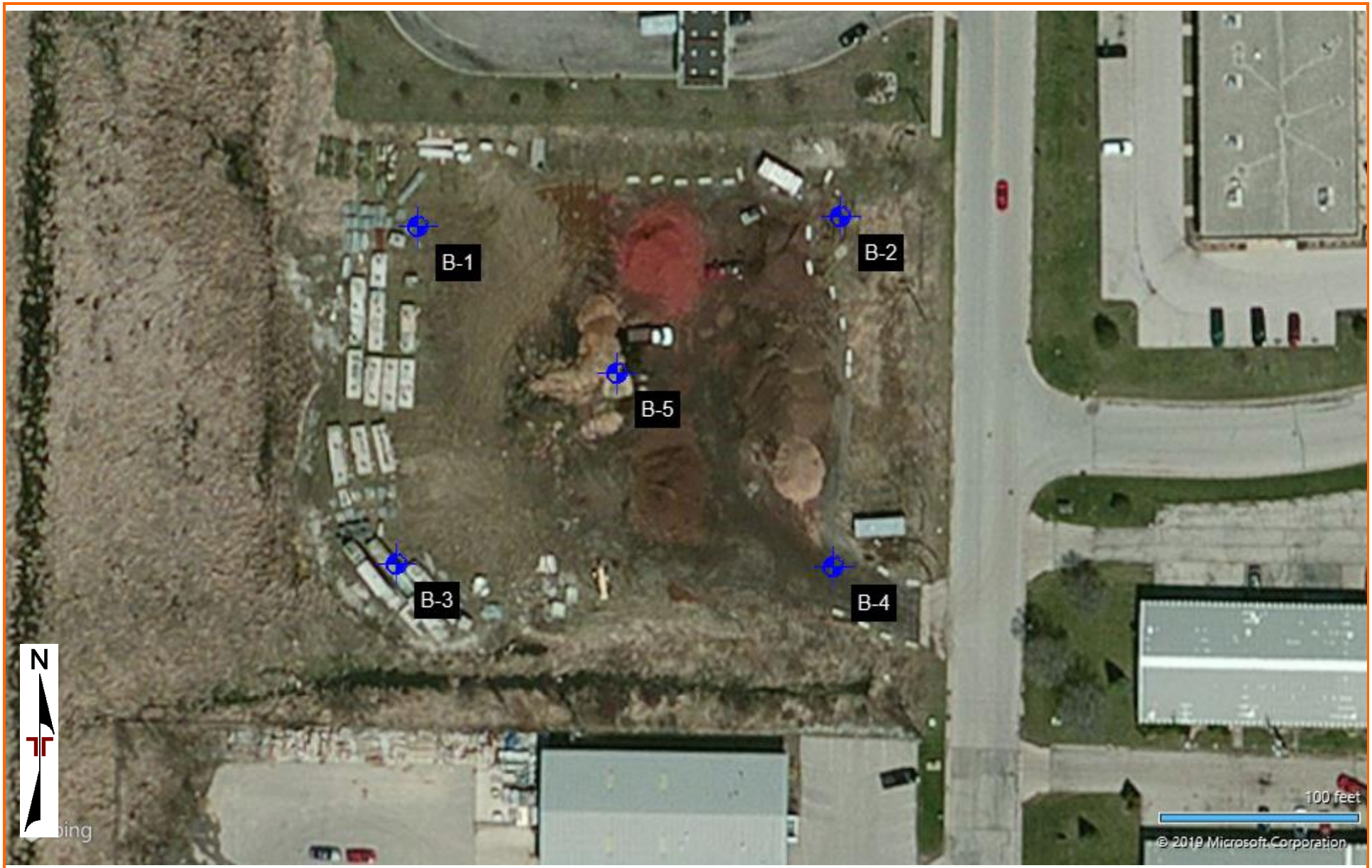


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

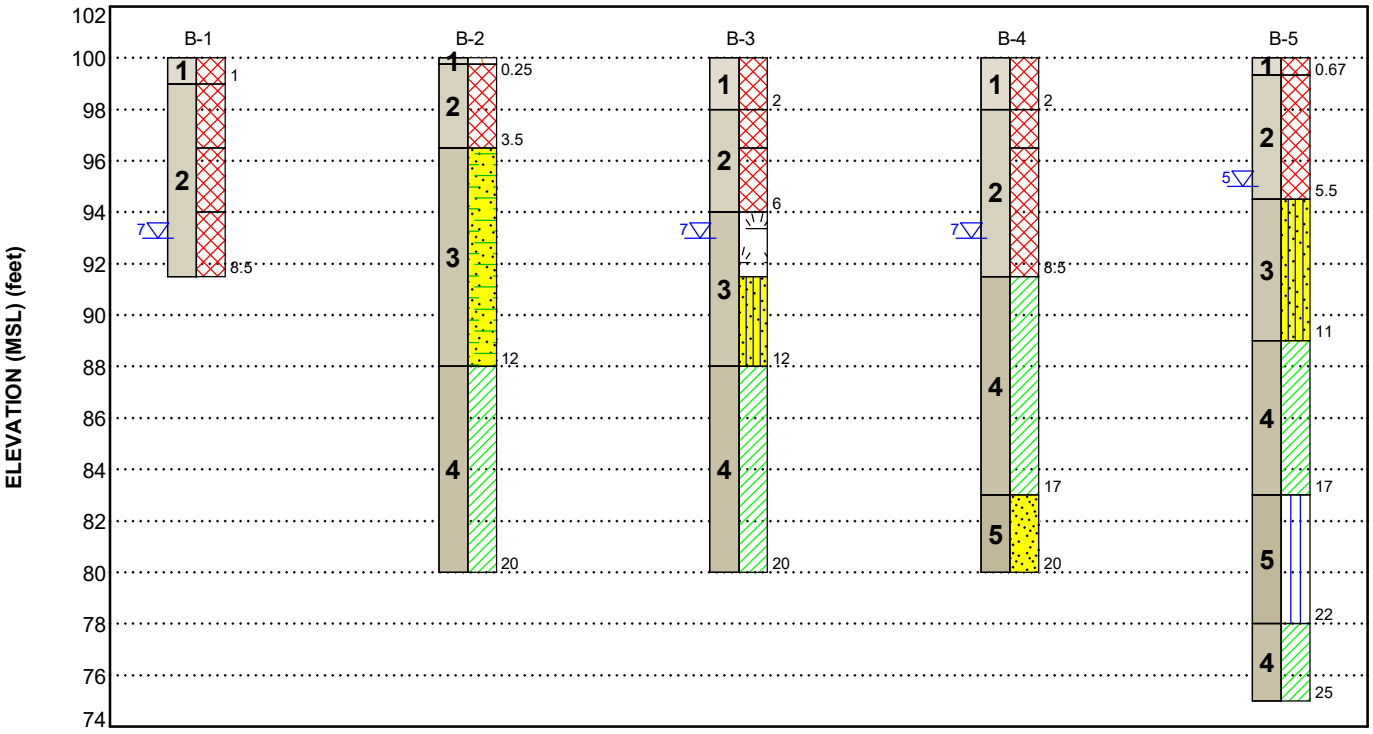
MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

GEOMODEL

Kwik Trip #970 - Adjacent Lot ■ Waukesha, Wisconsin
7/23/2019 ■ Terracon Project No. 58195091

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Surficial Material**	Wood Chips and Gravel
2	**Fill and Possible Fill Materials**	Variable fill soils containing gravel, gravelly lean clay, gravelly sand, lean clay, gravelly silt, and areas of intermixed peat and construction rubble (concrete).
3	**Native Organic Materials**	Peat, Lake Marls (Silty Clay and/or Silt with Clay) containing organics, and cohesive/granular soils with Peat seams. Very high moisture content, low strength materials
4	**Native Cohesive Soils**	Native Lean Clay soils containing silt seams. Often with relatively high moisture contents and typically in a medium stiff to hard condition.
5	**Native Granular Soils**	Native Sand, Silty Sand, and Silt soils. Some Clay seaming. Observed in a wet condition with loose to medium dense relative density.

LEGEND

- Fill
- Lean Clay
- Poorly-graded Sand
- Well-graded Gravel
- Peat
- Silt
- Sandy Organic Lean Clay
- Silty Sand

- First Water Observation
- Second Water Observation
- Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

BORING LOG NO. B-1

PROJECT: Kwik Trip #970 - Adjacent Lot

CLIENT: Kwik Trip Inc
La Crosse, Wisconsin

SITE: 2106 S. West Avenue
Waukesha, Wisconsin

LOCATION
Latitude: 42.9757° Longitude: -88.2368°

GRAPHIC LOG	DEPTH		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ORGANIC CONTENT (%)
	1.0	**FILL - WOOD CHIPS**								
		FILL - GRAVELLY LEAN CLAY, with silt and sand, brown								
					X	4	4-6-4 N=10	1.5 (HP)	10	
	3.5									
		FILL - GRAVELLY SILT, trace sand, tan, moist			X	11	3-10-11 N=21	2.0 (HP)	9	
	6.0		5							
		FILL - CONCRETE RUBBLE, gray, wet		▽						
					X	9	14-50/3" N= 50/3"	0.5 (HP)	17	
	8.5									
		Auger Refusal on Concrete Rubble at 8.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 7 feet while drilling.*

Terracon
9856 S 57th St
Franklin, WI

Boring Started: 05-29-2019	Boring Completed: 05-29-2019
Drill Rig: 7822DT	Driller: DH/TERRACON
Project No.: 58195091	

BORING LOG NO. B-2

PROJECT: Kwik Trip #970 - Adjacent Lot

CLIENT: Kwik Trip Inc
La Crosse, Wisconsin

SITE: 2106 S. West Avenue
Waukesha, Wisconsin

LOCATION
Latitude: 42.9757° Longitude: -88.236°

DEPTH		WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ORGANIC CONTENT (%)
0.3	**GRAVEL**, (3" thick)							
	FILL - LEAN CLAY, with intermixed peat, gray and black							
			X	10	3-2-3 N=5	0.25 (HP)	46	
3.5			X	18	3-2-2 N=4	0.75 (HP)	109	
	LAKE MARL (CL-ML), trace to with shells, trace to with organics, with peat seams, gray mottled brown, soft to medium stiff							
5								
			X	17	0-1-1 N=2	0.25 (HP)	84	8
			X	12	0-1-1 N=2	1.0 (HP)	36	
10								
12.0								
	LEAN CLAY (CL), with silt seams, trace sand, brownish gray, very stiff							
15								
			X	18	3-5-6 N=11	2.0 (HP)	23	
20.0			X	18	3-3-4 N=7	3.25 (HP)	19	
20	***Boring Terminated at 20 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed while drilling

Terracon
9856 S 57th St
Franklin, WI

Boring Started: 05-29-2019 | Boring Completed: 05-29-2019
Drill Rig: 7822DT | Driller: DH/TERRACON
Project No.: 58195091

BORING LOG NO. B-3

PROJECT: Kwik Trip #970 - Adjacent Lot

CLIENT: Kwik Trip Inc
La Crosse, Wisconsin

SITE: 2106 S. West Avenue
Waukesha, Wisconsin

LOCATION
Latitude: 42.9752° Longitude: -88.2369°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ORGANIC CONTENT (%)
		FILL - GRAVEL								
2.0										
		FILL - SAND AND GRAVEL, brown			X	1	9-4-4 N=8		6	
3.5										
		FILL - CLAYEY GRAVEL, with concrete pieces, brown and gray			X	10	5-6-14 N=20	1.0 (HP)	27	
6.0			5							
		PEAT (PT), with clay seams, fibrous, black and gray, soft to medium stiff		▽	X	18	0-2-2 N=4	0.75 (HP)	58	46
8.5					X	18	5-2-2 N=4		55	10
		SILTY SAND (SM), with peat seams, gray and black, wet, loose	10							
12.0										
		LEAN CLAY (CL), with silt and sand seams, gray, medium stiff to stiff			X	18	3-3-3 N=6	1.25 (HP)	16	
			15							
20.0					X	18	2-2-3 N=5	0.5 (HP)	23	
		Boring Terminated at 20 Feet	20							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 7 feet while drilling.*

Terracon
9856 S 57th St
Franklin, WI

Boring Started: 05-29-2019	Boring Completed: 05-29-2019
Drill Rig: 7822DT	Driller: DH/TERRACON
Project No.: 58195091	

BORING LOG NO. B-4

PROJECT: Kwik Trip #970 - Adjacent Lot

CLIENT: Kwik Trip Inc
La Crosse, Wisconsin

SITE: 2106 S. West Avenue
Waukesha, Wisconsin

LOCATION
Latitude: 42.9752° Longitude: -88.236°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ORGANIC CONTENT (%)
		FILL - GRAVEL								
2.0										
		FILL - GRAVELLY LEAN CLAY, brown				6	3-3-2 N=5	1.25 (HP)	15	
3.5										
		FILL - SANDY LEAN CLAY, trace to with gravel, dark brown				6	3-2-3 N=5	0.5 (HP)	20	
			5							
				▽						
						2	2-3-4 N=7		20	
8.5										
		LEAN CLAY (CL), trace to with sand and gravel, trace silt seams, brownish gray, medium stiff to stiff				12	5-4-4 N=8	1.25 (HP)	9	
			10							
						18	0-5-3 N=8	0.5 (HP)	15	
			15							
17.0										
		POORLY GRADED SAND (SP), trace silt, trace gravel, medium to coarse grained, gray, wet, loose				12	1-1-3 N=4		25	
20.0			20							
		Boring Terminated at 20 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 7 feet while drilling.*

Terracon
9856 S 57th St
Franklin, WI

Boring Started: 05-29-2019 | Boring Completed: 05-29-2019

Drill Rig: 7822DT | Driller: DH/TERRACON

Project No.: 58195091

BORING LOG NO. B-5

PROJECT: Kwik Trip #970 - Adjacent Lot

CLIENT: Kwik Trip Inc
La Crosse, Wisconsin

SITE: 2106 S. West Avenue
Waukesha, Wisconsin

LOCATION
Latitude: 42.9755° Longitude: -88.2364°

DEPTH		GRAPHIC LOG	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ORGANIC CONTENT (%)
0.7	**FILL - GRAVEL**								
	FILL - GRAVELLY LEAN CLAY, with sand and intermixed topsoil, dark brown and brown			X	8	12-7-7 N=14	1.5 (HP)	14	
			▽	X	12	2-6-3 N=9	1.0 (HP)	15	
5.5									
	SILTY SAND (SM), possible peat seams, medium grained, brownish gray, wet, loose to medium dense			X	12	6-8-5 N=13		27	
				X	0	2-2-2 N=4			
11.0									
	LEAN CLAY (CL), with silt seams, gray, stiff			X	18	3-3-5 N=8	1.5 (HP)	19	
17.0									
	SILT (ML), with clay seams, gray, medium dense			X	18	5-6-6 N=12	1.75 (HP)	26	
22.0									
	LEAN CLAY (CL), with silt seams, brown gray, very stiff			X	18	1-1-2 N=3	1.5 (HP)		
25.0									
	Boring Terminated at 25 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 5 feet while drilling.*

Terracon
9856 S 57th St
Franklin, WI

Boring Started: 05-29-2019 | Boring Completed: 05-29-2019

Drill Rig: 7822DT | Driller: DH/TERRACON

Project No.: 58195091

EXPLORATION AND TESTING PROCEDURES

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring Number	Planned Boring Depth (feet) [1]	Location
B-1 to B-4	20 [2]	General Site Borings
B-5	25	Central Site Boring

1. Below ground surface.
2. Boring B-1 was terminated prior to the planned termination depth of 8.5 feet, as auger refusal was encountered on concrete rubble within the existing fill

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±20 feet). If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced soil borings B-1 through B-5 using continuous flight augers (hollow stem, as necessary, depending on soil conditions). Four samples were obtained in the upper 10 feet of each boring, and at 5-foot intervals thereafter to termination depths. Boring B-1 was terminated prior to the planned termination depth of 20 feet, as auger refusal was encountered at a depth of 8½ feet. The samples were placed in appropriate containers, taken to our laboratory for testing, and classified by the project engineer. In addition, we observed and recorded subsurface water levels during drilling and after boring completion. The borings were backfilled with bentonite chips after drilling.

Our exploration team prepared field boring logs as part of standard drilling operations. These logs include sampling depths, penetration distances, and other relevant sampling information, visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Report logs were prepared from the field logs and incorporated the project engineer's interpretation of the field logs and include modifications based on observations and laboratory tests of the samples in our laboratory.

Laboratory Testing

The samples were tested in the laboratory to measure their natural water content, which are provided on the boring logs in **Exploration Results**. The samples were also classified in the laboratory based on visual observation, texture, and plasticity. The soil descriptions presented on the boring logs are in accordance with the General Notes and Unified Soil Classification System (USCS) included in **Supporting Information**. The estimated USCS group symbols for native soil samples are shown on the boring logs, and a brief description of the USCS is included in **Supporting Information**.

SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Proposed Kwik Trip Convenience Store #970 ■ Waukesha, Wisconsin

July 23, 2019 ■ Terracon Project No. 58195091

SAMPLING	WATER LEVEL	FIELD TESTS
 Auger  Split Spoon  Shelby Tube  Macro Core  Ring Sampler  Rock Core  Grab Sample  No Recovery	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Subsurface water level variations will occur over time. In low permeability soils, accurate determination of subsurface water levels is not possible with short term water level observations.	**(HP)** Hand Penetrometer **(T)** Torvane **(b/f)** Standard Penetration Test (blows per foot) **(PID)** Photo-Ionization Detector **(OVA)** Organic Vapor Analyzer **(DCP)** Dynamic Cone Penetrometer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve) Consistency determined by laboratory shear strength testing, field visual-manual procedures, or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, tsf**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 – 3	Very Soft	Less than 0.25	0 – 1
Loose	4 – 9	Soft	0.25 to 0.50	2 – 4
Medium Dense	10 – 29	Medium Stiff	0.50 to 1.00	4 – 8
Dense	30 – 50	Stiff	1.00 to 2.00	8 – 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 – 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL	
Descriptive term(s) of other constituents	**Percent (%) of dry weight**
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY	
Major component of sample	**Particle size**
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES	
Descriptive term(s) of other constituents	**Percent (%) of dry weight**
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION	
Term	**Plasticity Index**
Non plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Proposed Kwik Trip Convenience Store #970 ■ Waukesha, Wisconsin

July 23, 2019 ■ Terracon Project No. 58195091

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

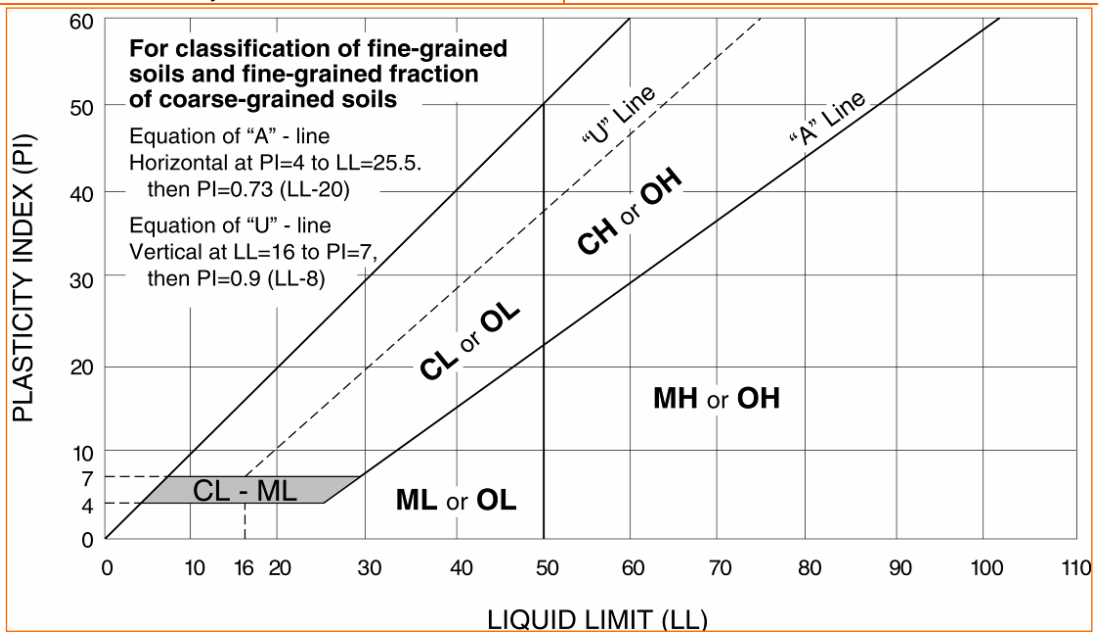
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Appendix C – Storm Water Quantity Calculations

HydroCAD - Existing Conditions

1, 2, 10, & 100 Year Storm Events

Summary for Subcatchment 5S: E-1

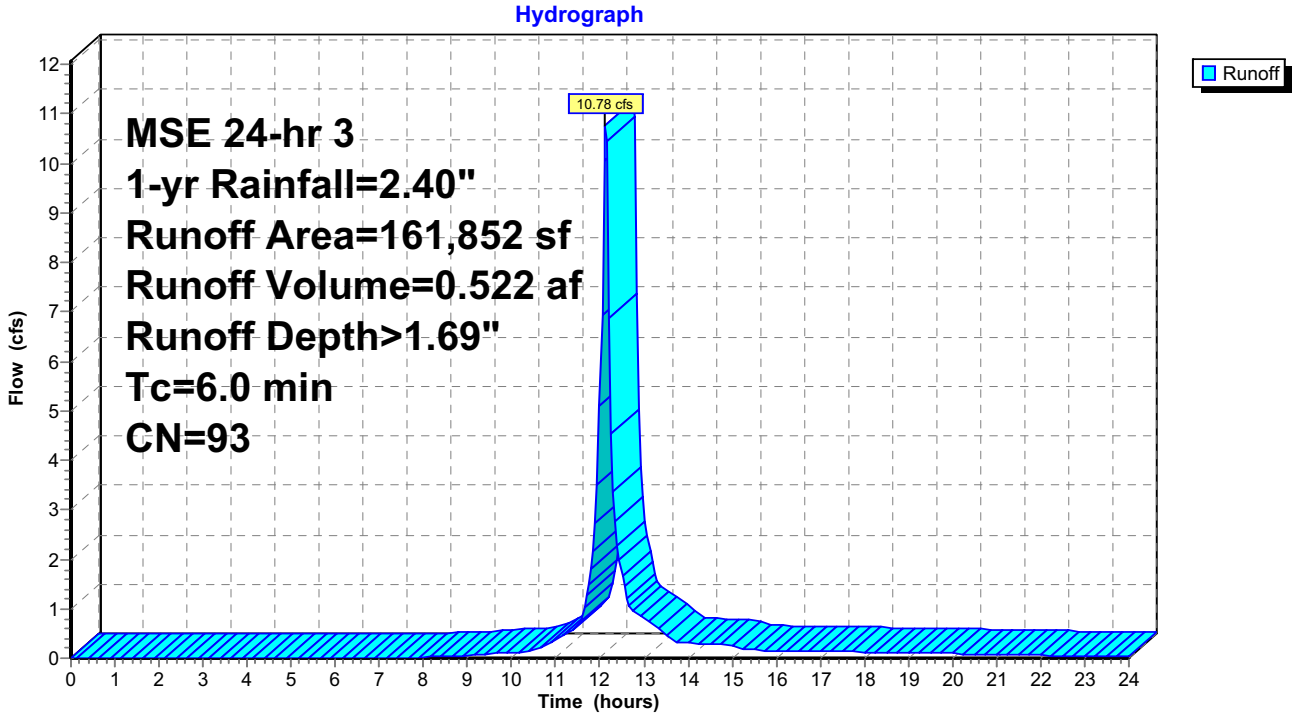
Runoff = 10.78 cfs @ 12.13 hrs, Volume= 0.522 af, Depth> 1.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-yr Rainfall=2.40"

Area (sf)	CN	Description
45,767	80	>75% Grass cover, Good, HSG D
116,085	98	Paved parking, HSG D
161,852	93	Weighted Average
45,767		28.28% Pervious Area
116,085		71.72% Impervious Area

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

Subcatchment 5S: E-1



Summary for Subcatchment 5S: E-1

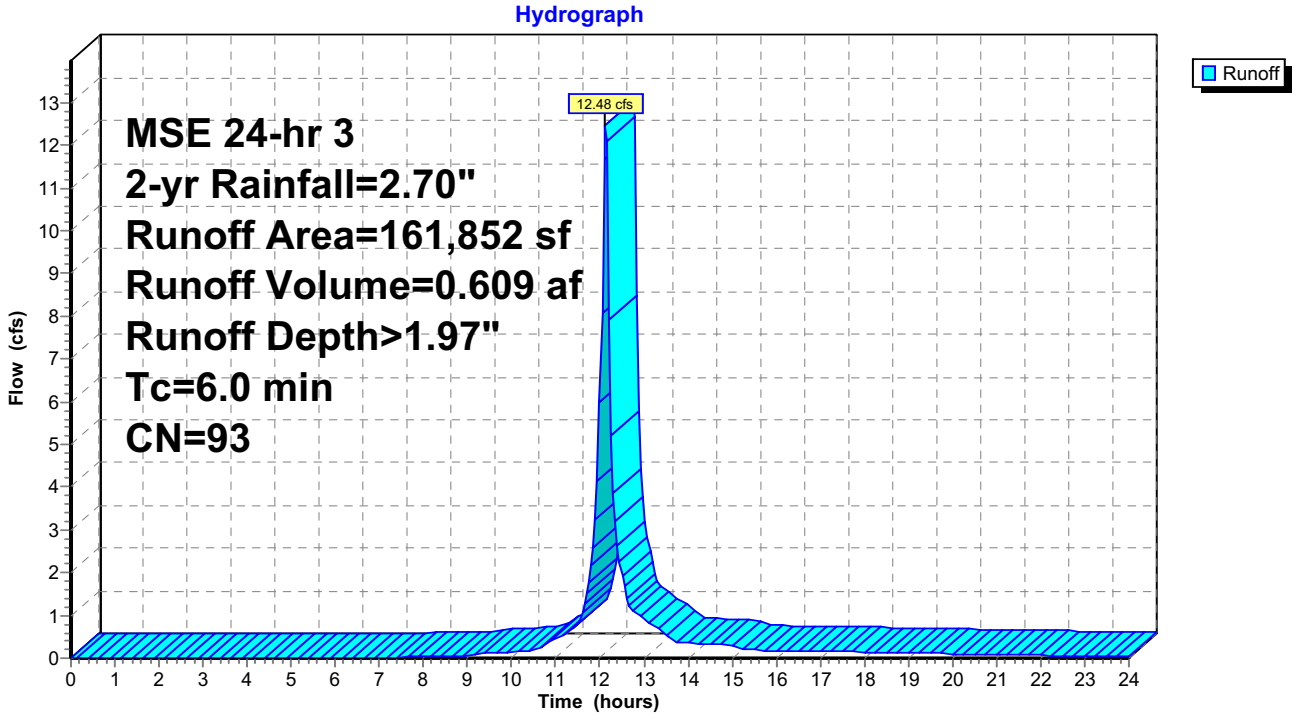
Runoff = 12.48 cfs @ 12.13 hrs, Volume= 0.609 af, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-yr Rainfall=2.70"

Area (sf)	CN	Description
45,767	80	>75% Grass cover, Good, HSG D
116,085	98	Paved parking, HSG D
161,852	93	Weighted Average
45,767		28.28% Pervious Area
116,085		71.72% Impervious Area

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

Subcatchment 5S: E-1



Summary for Subcatchment 5S: E-1

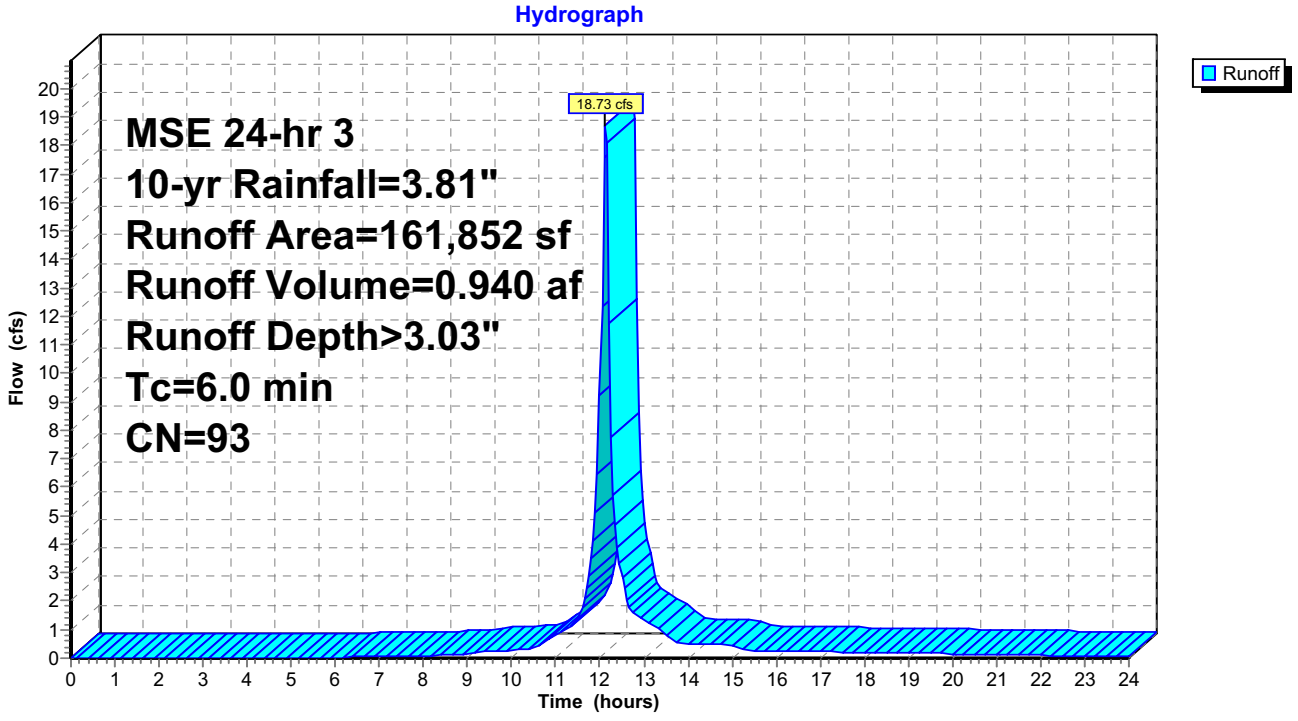
Runoff = 18.73 cfs @ 12.13 hrs, Volume= 0.940 af, Depth> 3.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yr Rainfall=3.81"

Area (sf)	CN	Description
45,767	80	>75% Grass cover, Good, HSG D
116,085	98	Paved parking, HSG D
161,852	93	Weighted Average
45,767		28.28% Pervious Area
116,085		71.72% Impervious Area

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

Subcatchment 5S: E-1



Summary for Subcatchment 5S: E-1

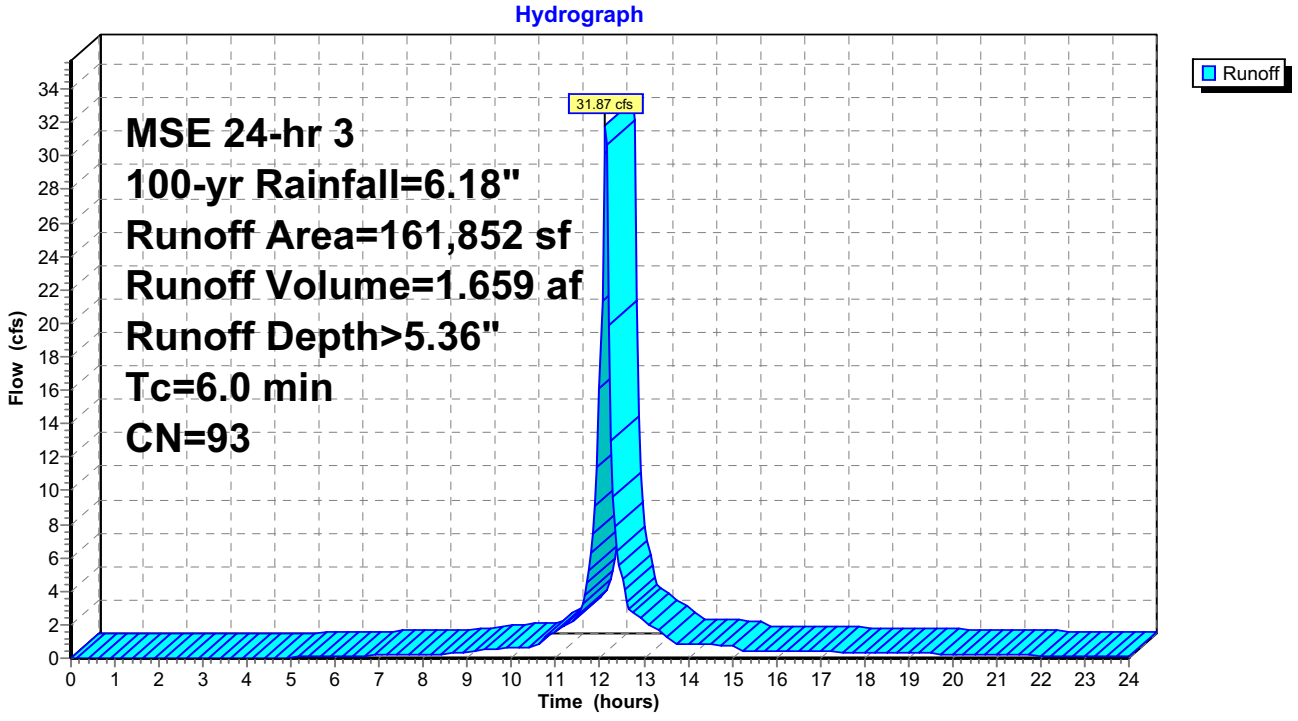
Runoff = 31.87 cfs @ 12.13 hrs, Volume= 1.659 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-yr Rainfall=6.18"

Area (sf)	CN	Description
45,767	80	>75% Grass cover, Good, HSG D
116,085	98	Paved parking, HSG D
161,852	93	Weighted Average
45,767		28.28% Pervious Area
116,085		71.72% Impervious Area

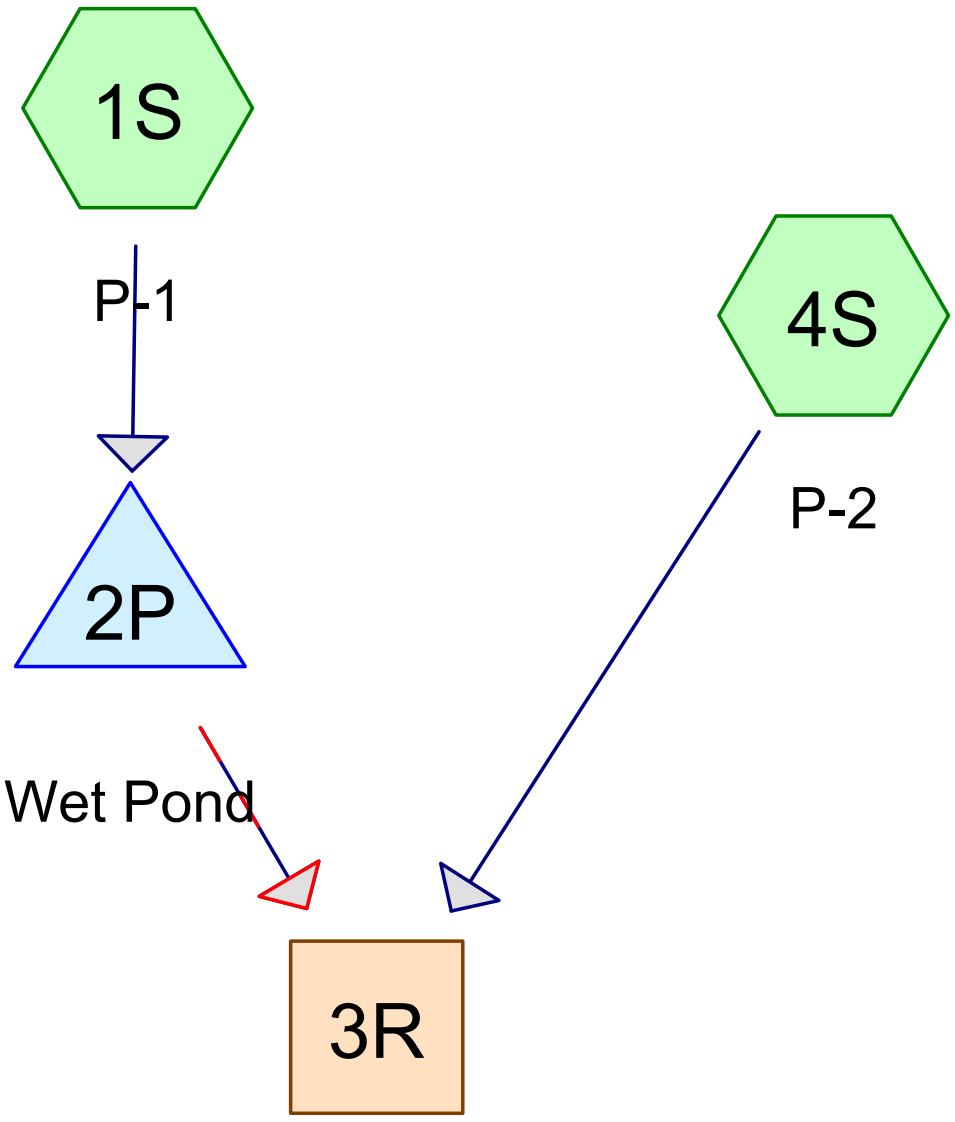
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 5S: E-1



HydroCAD - Proposed Conditions

1, 2, 10, & 100 Year Storm Events



Proposed Conditions

Subcat Reach Pond Link

Routing Diagram for 3190495_KT 970
Prepared by R.A. Smith, Inc., Printed 4/23/2020

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.176	80	>75% Grass cover, Good, HSG D (1S, 4S)
0.400	98	Paved parking (4S)
1.501	98	Paved parking, HSG D (1S)
0.255	98	Roofs, HSG D (1S)
0.028	98	Sidewalk (4S)
0.086	98	Sidewalk, HSG D (1S)
0.269	98	Water Surface, HSG D (1S)
3.716	**92**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
3.287	HSG D	1S, 4S
0.428	Other	4S
3.716		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	1.176	0.000	1.176	>75% Grass cover, Good	1S, 4S
0.000	0.000	0.000	1.501	0.400	1.901	Paved parking	1S, 4S
0.000	0.000	0.000	0.255	0.000	0.255	Roofs	1S
0.000	0.000	0.000	0.086	0.028	0.114	Sidewalk	1S, 4S
0.000	0.000	0.000	0.269	0.000	0.269	Water Surface	1S
0.000	**0.000**	**0.000**	**3.287**	**0.428**	**3.716**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	2P	813.25	813.00	111.4	0.0022	0.015	12.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: P-1 Runoff Area=104,958 sf 87.63% Impervious Runoff Depth>1.96"
Tc=6.0 min CN=96 Runoff=7.78 cfs 0.394 af

Subcatchment4S: P-2 Runoff Area=56,894 sf 32.80% Impervious Runoff Depth>1.16"
Tc=6.0 min CN=86 Runoff=2.72 cfs 0.126 af

Reach 3R: Proposed Conditions Inflow=3.28 cfs 0.467 af
Outflow=3.28 cfs 0.467 af

Pond 2P: Wet Pond Peak Elev=814.09' Storage=10,397 cf Inflow=7.78 cfs 0.394 af
Primary=0.73 cfs 0.341 af Secondary=0.00 cfs 0.000 af Outflow=0.73 cfs 0.341 af

Total Runoff Area = 3.716 ac Runoff Volume = 0.521 af Average Runoff Depth = 1.68"
31.65% Pervious = 1.176 ac 68.35% Impervious = 2.540 ac

Summary for Subcatchment 1S: P-1

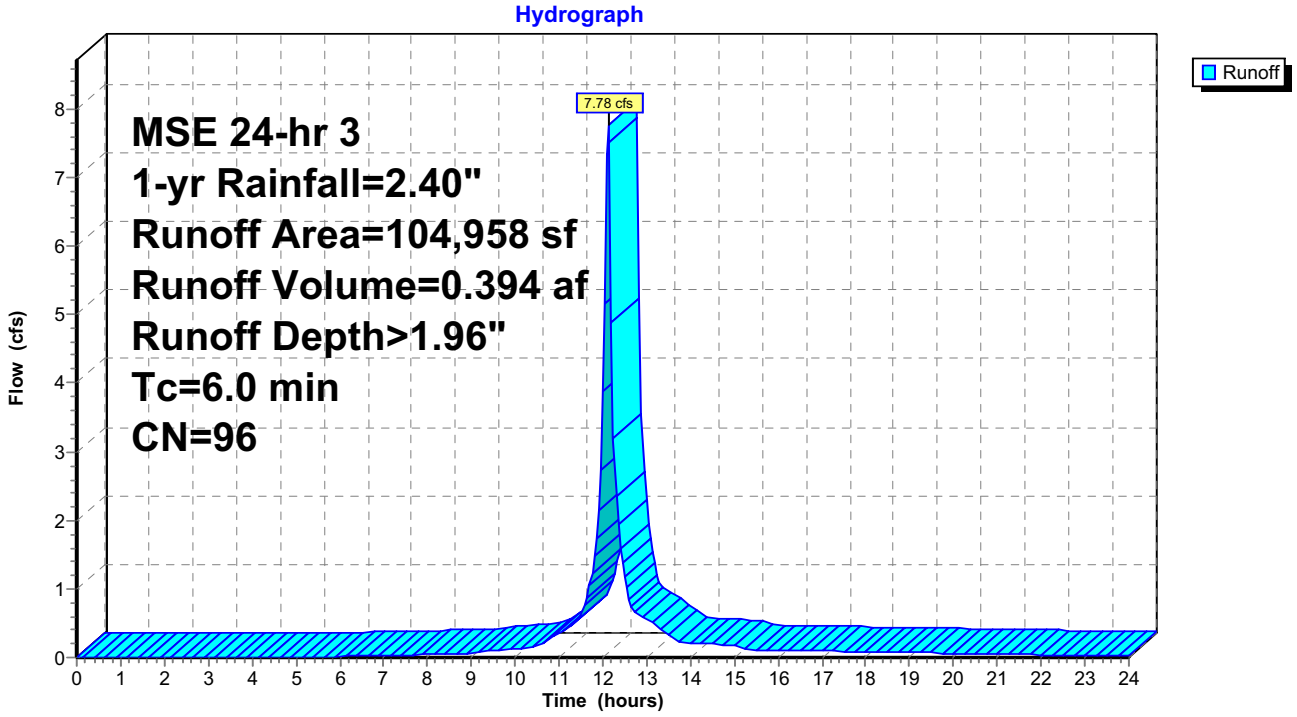
Runoff = 7.78 cfs @ 12.13 hrs, Volume= 0.394 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-yr Rainfall=2.40"

	Area (sf)	CN	Description
	12,988	80	>75% Grass cover, Good, HSG D
	11,122	98	Roofs, HSG D
	65,380	98	Paved parking, HSG D
	11,737	98	Water Surface, HSG D
*	3,731	98	Sidewalk, HSG D
	104,958	96	Weighted Average
	12,988		12.37% Pervious Area
	91,970		87.63% Impervious Area

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

Subcatchment 1S: P-1



Summary for Subcatchment 4S: P-2

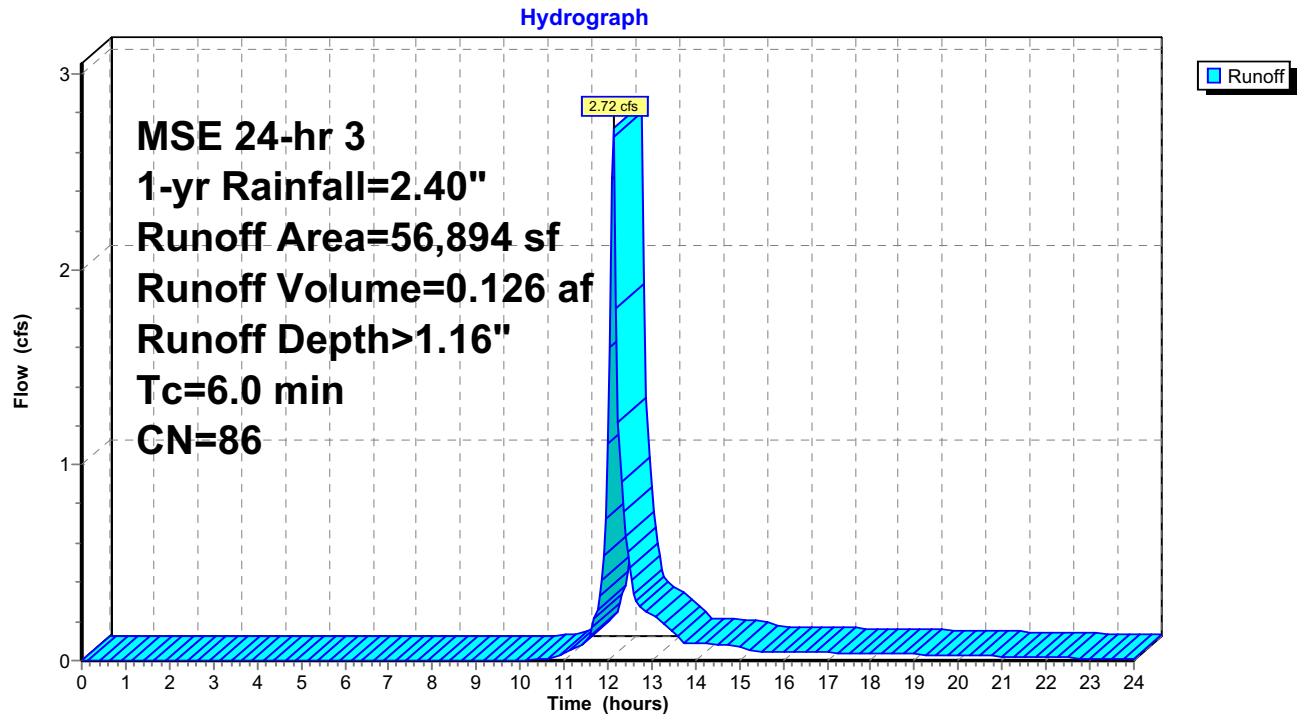
Runoff = 2.72 cfs @ 12.13 hrs, Volume= 0.126 af, Depth> 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-yr Rainfall=2.40"

	Area (sf)	CN	Description
	38,233	80	>75% Grass cover, Good, HSG D
*	17,444	98	Paved parking
*	1,217	98	Sidewalk
	56,894	86	Weighted Average
	38,233		67.20% Pervious Area
	18,661		32.80% Impervious Area

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

Subcatchment 4S: P-2



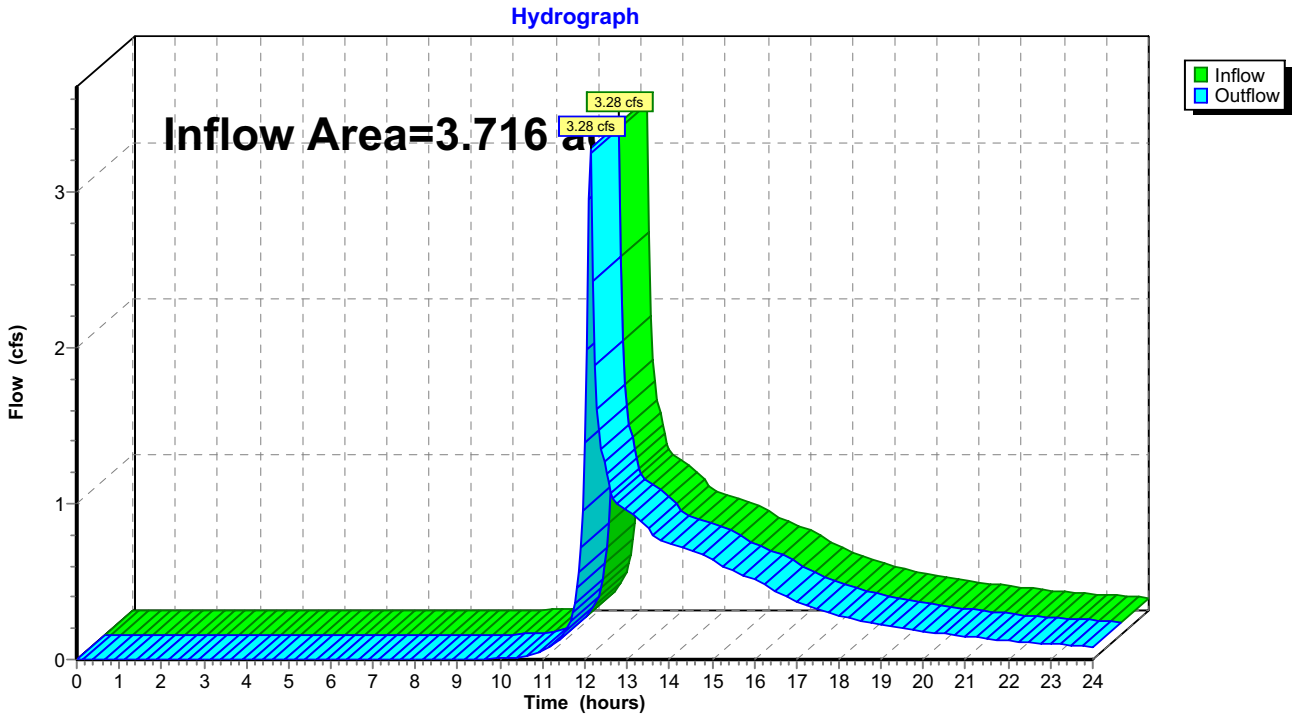
Summary for Reach 3R: Proposed Conditions

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.716 ac, 68.35% Impervious, Inflow Depth > 1.51" for 1-yr event
Inflow = 3.28 cfs @ 12.14 hrs, Volume= 0.467 af
Outflow = 3.28 cfs @ 12.14 hrs, Volume= 0.467 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3R: Proposed Conditions



Summary for Pond 2P: Wet Pond

Inflow Area = 2.410 ac, 87.63% Impervious, Inflow Depth > 1.96" for 1-yr event
Inflow = 7.78 cfs @ 12.13 hrs, Volume= 0.394 af
Outflow = 0.73 cfs @ 12.66 hrs, Volume= 0.341 af, Atten= 91%, Lag= 32.1 min
Primary = 0.73 cfs @ 12.66 hrs, Volume= 0.341 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 814.09' @ 12.66 hrs Surf.Area= 12,873 sf Storage= 10,397 cf

Plug-Flow detention time= 215.2 min calculated for 0.340 af (86% of inflow)
Center-of-Mass det. time= 166.8 min (938.3 - 771.5)

Volume	Invert	Avail.Storage	Storage Description
#1	813.25'	67,028 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

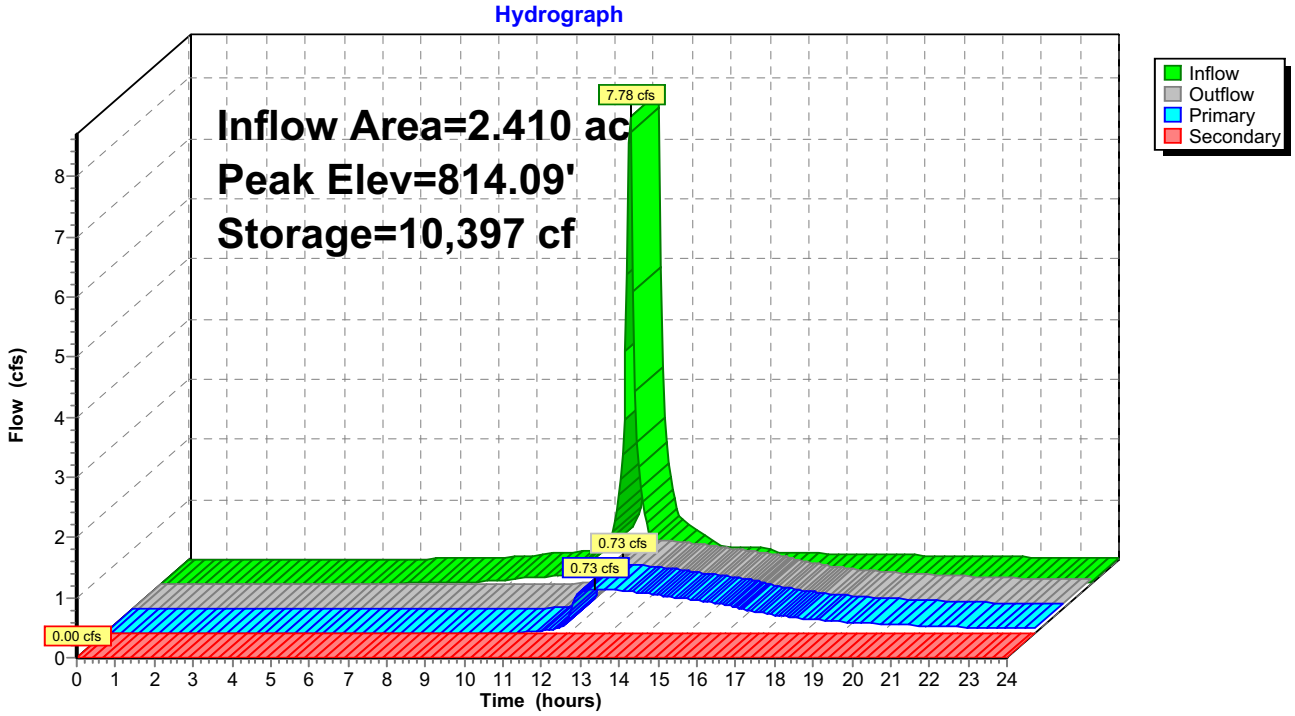
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
813.25	11,737	0	0
814.25	13,082	12,410	12,410
815.25	14,484	13,783	26,193
816.25	15,942	15,213	41,406
817.25	17,457	16,700	58,105
817.75	18,236	8,923	67,028

Device	Routing	Invert	Outlet Devices
#1	Primary	813.25'	**12.0" Round Culvert** L= 111.4' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 813.25' / 813.00' S= 0.0022 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#2	Device 1	813.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	815.25'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	816.75'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.73 cfs @ 12.66 hrs HW=814.09' (Free Discharge)
└**1=Culvert** (Passes 0.73 cfs of 1.26 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.73 cfs @ 3.71 fps)
  └**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=813.25' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Wet Pond



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: P-1 Runoff Area=104,958 sf 87.63% Impervious Runoff Depth>2.26"
Tc=6.0 min CN=96 Runoff=8.86 cfs 0.453 af

Subcatchment4S: P-2 Runoff Area=56,894 sf 32.80% Impervious Runoff Depth>1.41"
Tc=6.0 min CN=86 Runoff=3.29 cfs 0.153 af

Reach 3R: Proposed Conditions Inflow=3.92 cfs 0.550 af
Outflow=3.92 cfs 0.550 af

Pond 2P: Wet Pond Peak Elev=814.22' Storage=11,986 cf Inflow=8.86 cfs 0.453 af
Primary=0.80 cfs 0.397 af Secondary=0.00 cfs 0.000 af Outflow=0.80 cfs 0.397 af

Total Runoff Area = 3.716 ac Runoff Volume = 0.606 af Average Runoff Depth = 1.96"
31.65% Pervious = 1.176 ac 68.35% Impervious = 2.540 ac

Summary for Subcatchment 1S: P-1

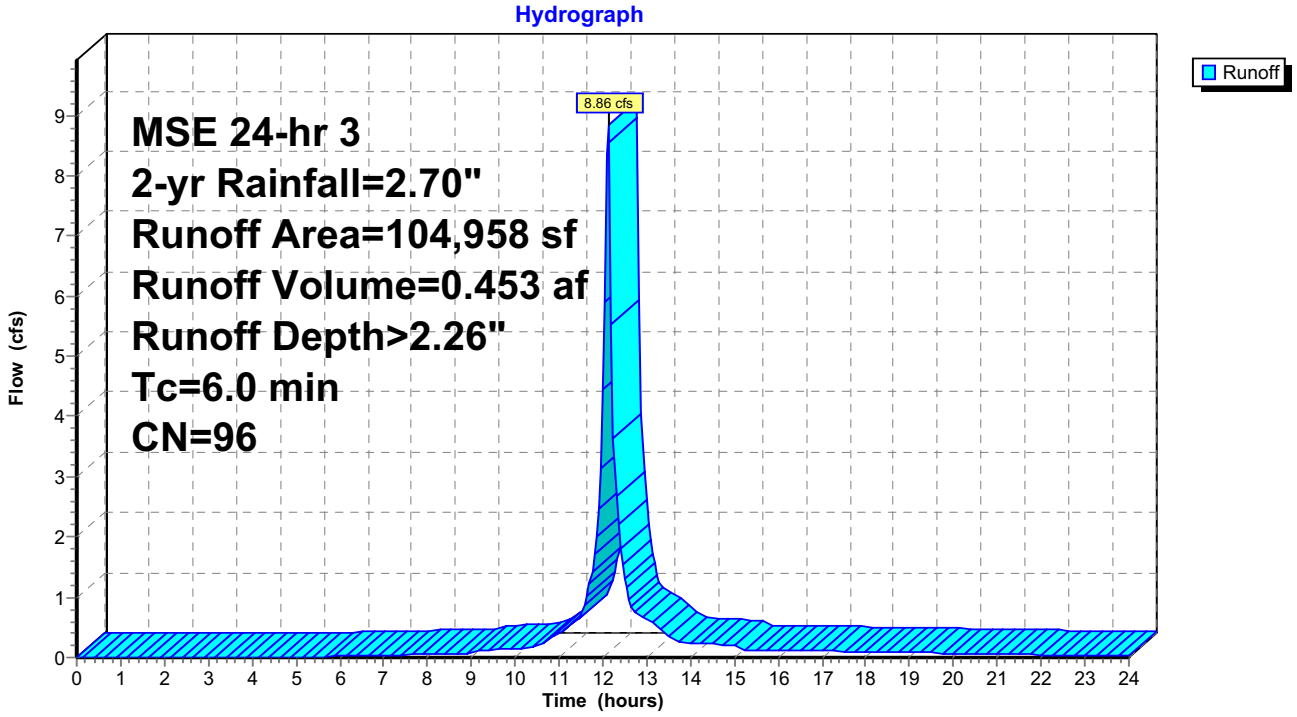
Runoff = 8.86 cfs @ 12.13 hrs, Volume= 0.453 af, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-yr Rainfall=2.70"

	Area (sf)	CN	Description
	12,988	80	>75% Grass cover, Good, HSG D
	11,122	98	Roofs, HSG D
	65,380	98	Paved parking, HSG D
	11,737	98	Water Surface, HSG D
*	3,731	98	Sidewalk, HSG D
	104,958	96	Weighted Average
	12,988		12.37% Pervious Area
	91,970		87.63% Impervious Area

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

Subcatchment 1S: P-1



Summary for Subcatchment 4S: P-2

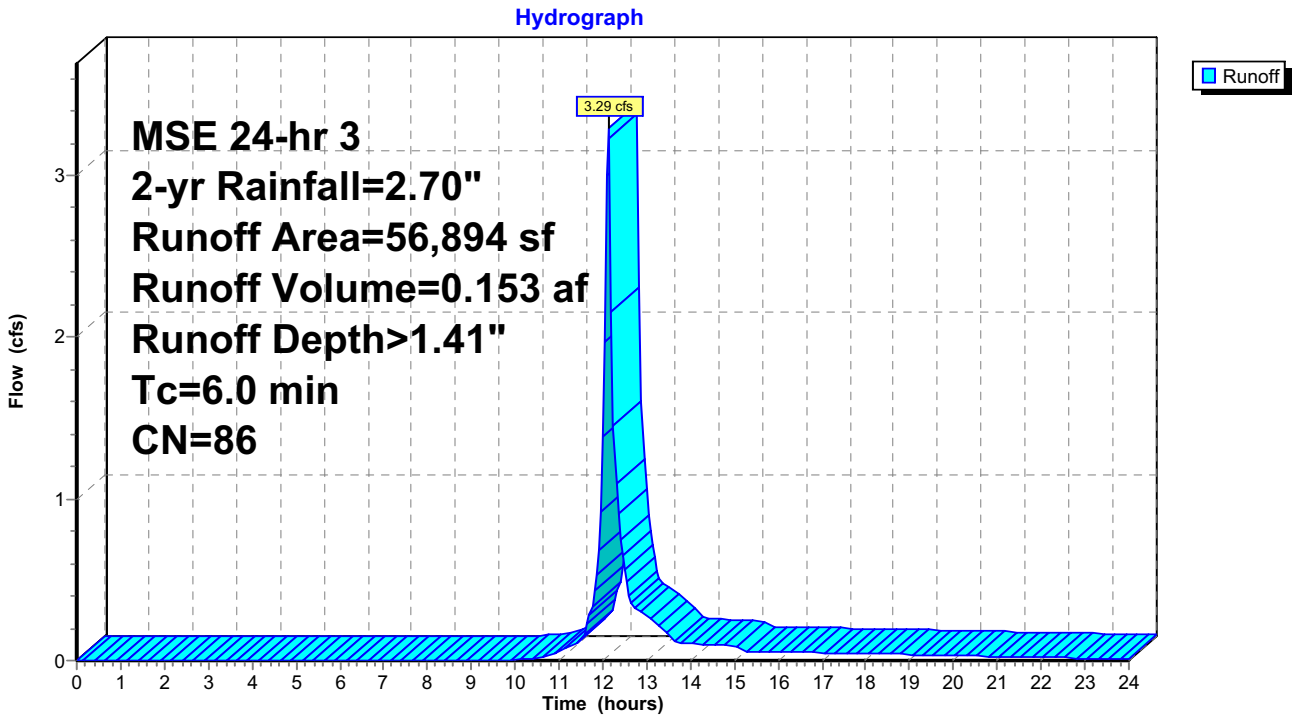
Runoff = 3.29 cfs @ 12.13 hrs, Volume= 0.153 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-yr Rainfall=2.70"

	Area (sf)	CN	Description
	38,233	80	>75% Grass cover, Good, HSG D
*	17,444	98	Paved parking
*	1,217	98	Sidewalk
	56,894	86	Weighted Average
	38,233		67.20% Pervious Area
	18,661		32.80% Impervious Area

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

Subcatchment 4S: P-2



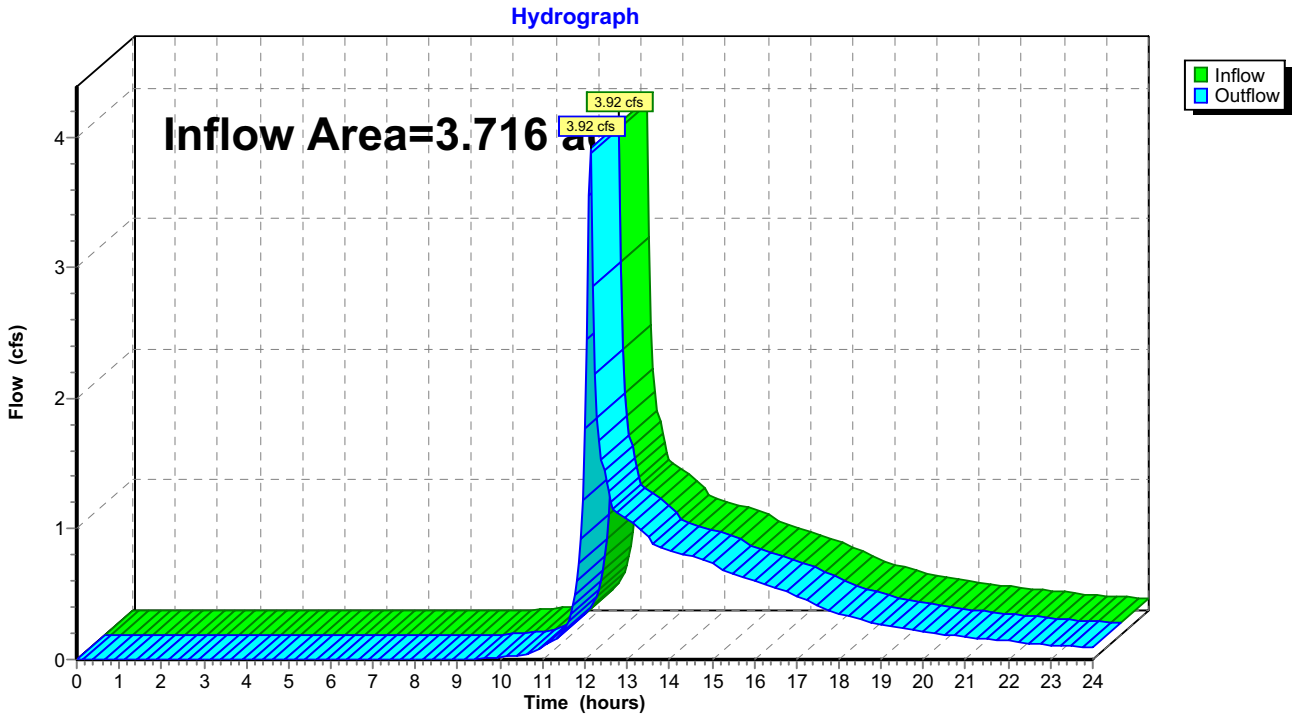
Summary for Reach 3R: Proposed Conditions

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.716 ac, 68.35% Impervious, Inflow Depth > 1.78" for 2-yr event
Inflow = 3.92 cfs @ 12.14 hrs, Volume= 0.550 af
Outflow = 3.92 cfs @ 12.14 hrs, Volume= 0.550 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3R: Proposed Conditions



Summary for Pond 2P: Wet Pond

Inflow Area = 2.410 ac, 87.63% Impervious, Inflow Depth > 2.26" for 2-yr event
Inflow = 8.86 cfs @ 12.13 hrs, Volume= 0.453 af
Outflow = 0.80 cfs @ 12.68 hrs, Volume= 0.397 af, Atten= 91%, Lag= 33.3 min
Primary = 0.80 cfs @ 12.68 hrs, Volume= 0.397 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 814.22' @ 12.68 hrs Surf.Area= 13,038 sf Storage= 11,986 cf

Plug-Flow detention time= 219.0 min calculated for 0.397 af (88% of inflow)
Center-of-Mass det. time= 172.2 min (941.1 - 768.9)

Volume	Invert	Avail.Storage	Storage Description
#1	813.25'	67,028 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

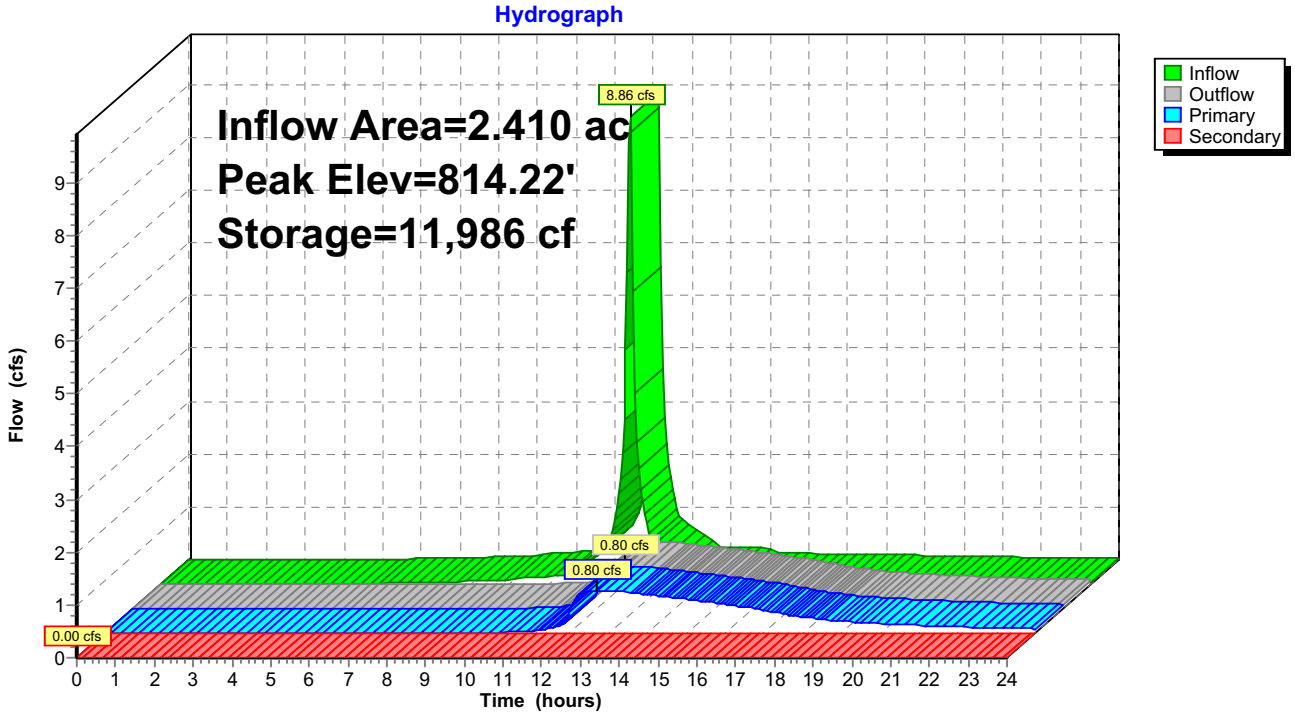
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
813.25	11,737	0	0
814.25	13,082	12,410	12,410
815.25	14,484	13,783	26,193
816.25	15,942	15,213	41,406
817.25	17,457	16,700	58,105
817.75	18,236	8,923	67,028

Device	Routing	Invert	Outlet Devices
#1	Primary	813.25'	**12.0" Round Culvert** L= 111.4' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 813.25' / 813.00' S= 0.0022 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#2	Device 1	813.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	815.25'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	816.75'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.80 cfs @ 12.68 hrs HW=814.22' (Free Discharge)
└**1=Culvert** (Passes 0.80 cfs of 1.56 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.80 cfs @ 4.08 fps)
  └**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=813.25' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Wet Pond



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: P-1 Runoff Area=104,958 sf 87.63% Impervious Runoff Depth>3.35"
Tc=6.0 min CN=96 Runoff=12.82 cfs 0.673 af

Subcatchment4S: P-2 Runoff Area=56,894 sf 32.80% Impervious Runoff Depth>2.37"
Tc=6.0 min CN=86 Runoff=5.46 cfs 0.258 af

Reach 3R: Proposed Conditions Inflow=6.27 cfs 0.863 af
Outflow=6.27 cfs 0.863 af

Pond 2P: Wet Pond Peak Elev=814.66' Storage=17,923 cf Inflow=12.82 cfs 0.673 af
Primary=1.02 cfs 0.604 af Secondary=0.00 cfs 0.000 af Outflow=1.02 cfs 0.604 af

Total Runoff Area = 3.716 ac Runoff Volume = 0.931 af Average Runoff Depth = 3.01"
31.65% Pervious = 1.176 ac 68.35% Impervious = 2.540 ac

Summary for Subcatchment 1S: P-1

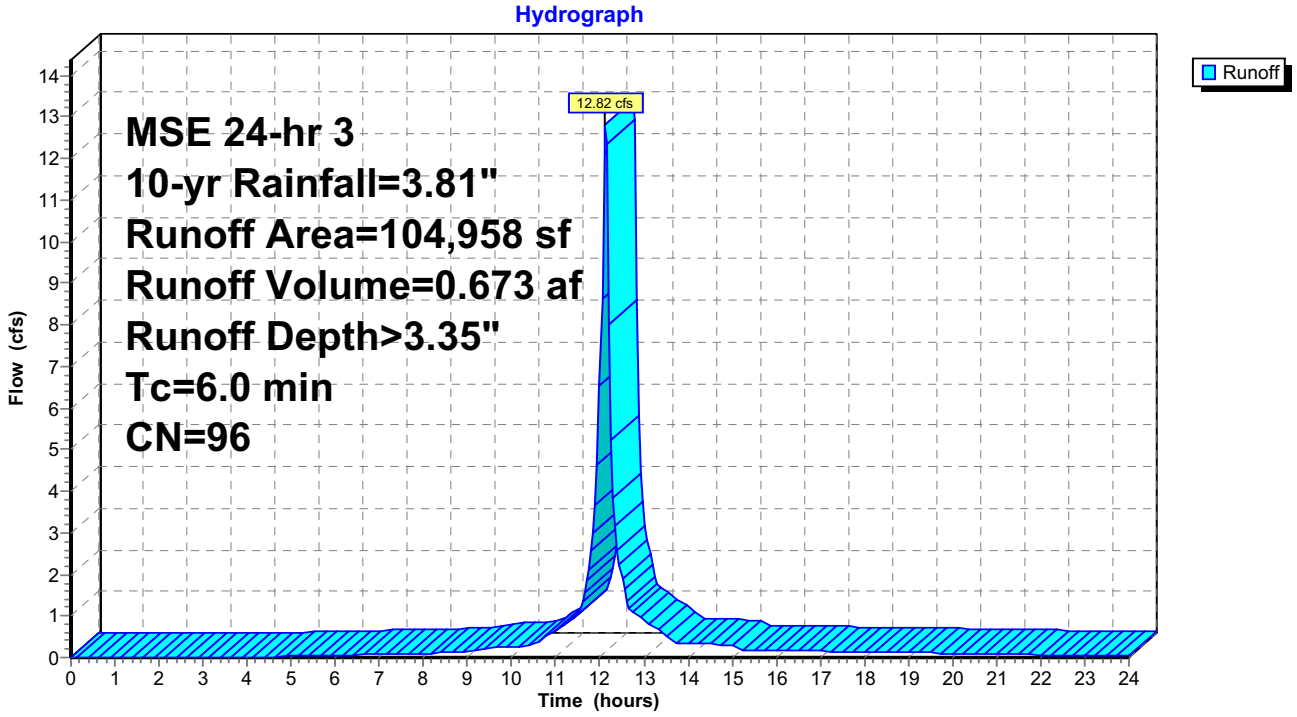
Runoff = 12.82 cfs @ 12.13 hrs, Volume= 0.673 af, Depth> 3.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yr Rainfall=3.81"

	Area (sf)	CN	Description
	12,988	80	>75% Grass cover, Good, HSG D
	11,122	98	Roofs, HSG D
	65,380	98	Paved parking, HSG D
	11,737	98	Water Surface, HSG D
*	3,731	98	Sidewalk, HSG D
	104,958	96	Weighted Average
	12,988		12.37% Pervious Area
	91,970		87.63% Impervious Area

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

Subcatchment 1S: P-1



Summary for Subcatchment 4S: P-2

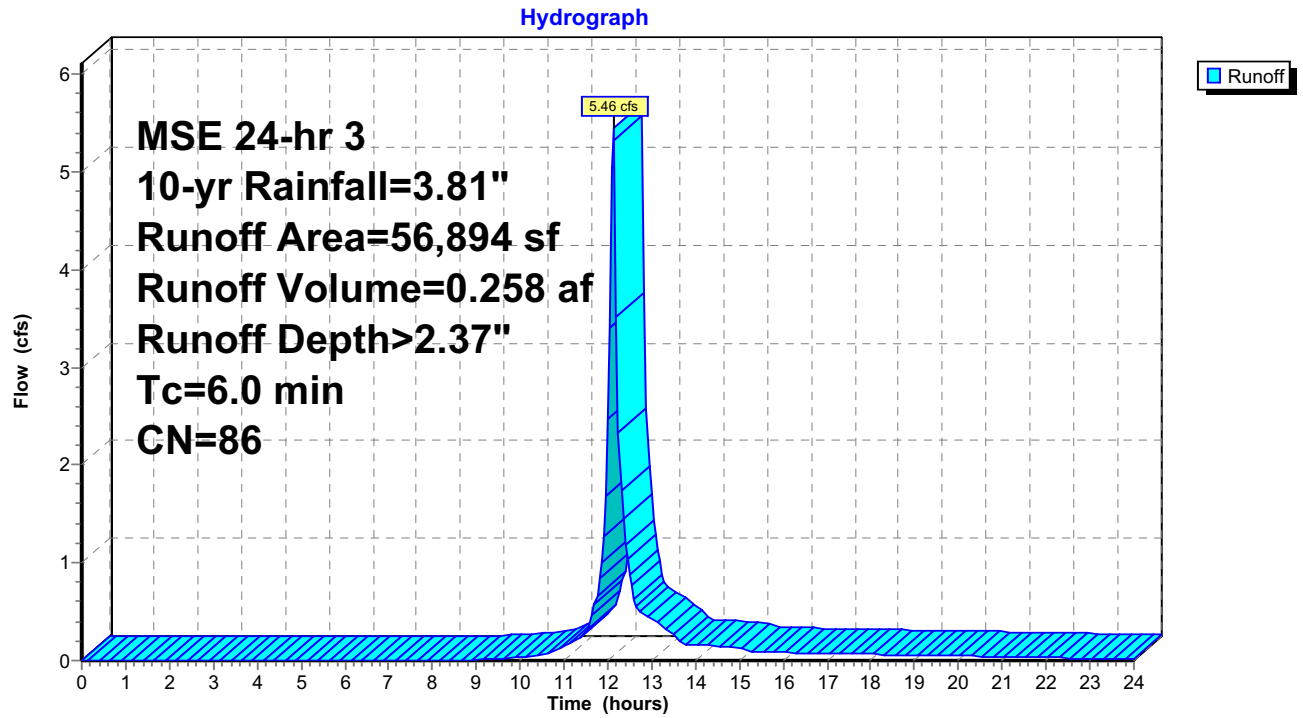
Runoff = 5.46 cfs @ 12.13 hrs, Volume= 0.258 af, Depth> 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yr Rainfall=3.81"

	Area (sf)	CN	Description
	38,233	80	>75% Grass cover, Good, HSG D
*	17,444	98	Paved parking
*	1,217	98	Sidewalk
	56,894	86	Weighted Average
	38,233		67.20% Pervious Area
	18,661		32.80% Impervious Area

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

Subcatchment 4S: P-2



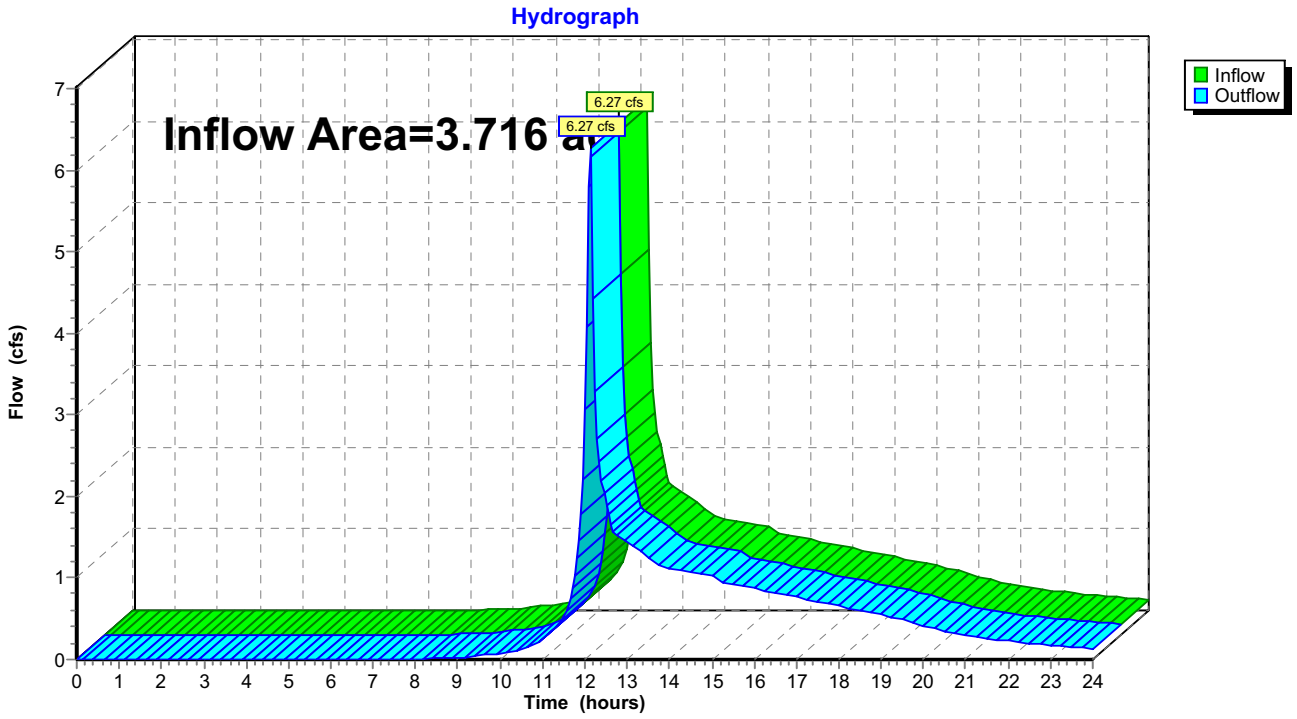
Summary for Reach 3R: Proposed Conditions

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.716 ac, 68.35% Impervious, Inflow Depth > 2.79" for 10-yr event
Inflow = 6.27 cfs @ 12.13 hrs, Volume= 0.863 af
Outflow = 6.27 cfs @ 12.13 hrs, Volume= 0.863 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3R: Proposed Conditions



Summary for Pond 2P: Wet Pond

Inflow Area = 2.410 ac, 87.63% Impervious, Inflow Depth > 3.35" for 10-yr event
Inflow = 12.82 cfs @ 12.13 hrs, Volume= 0.673 af
Outflow = 1.02 cfs @ 12.83 hrs, Volume= 0.604 af, Atten= 92%, Lag= 41.9 min
Primary = 1.02 cfs @ 12.83 hrs, Volume= 0.604 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 814.66' @ 12.83 hrs Surf.Area= 13,660 sf Storage= 17,923 cf

Plug-Flow detention time= 236.2 min calculated for 0.604 af (90% of inflow)
Center-of-Mass det. time= 194.7 min (956.3 - 761.6)

Volume	Invert	Avail.Storage	Storage Description
#1	813.25'	67,028 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

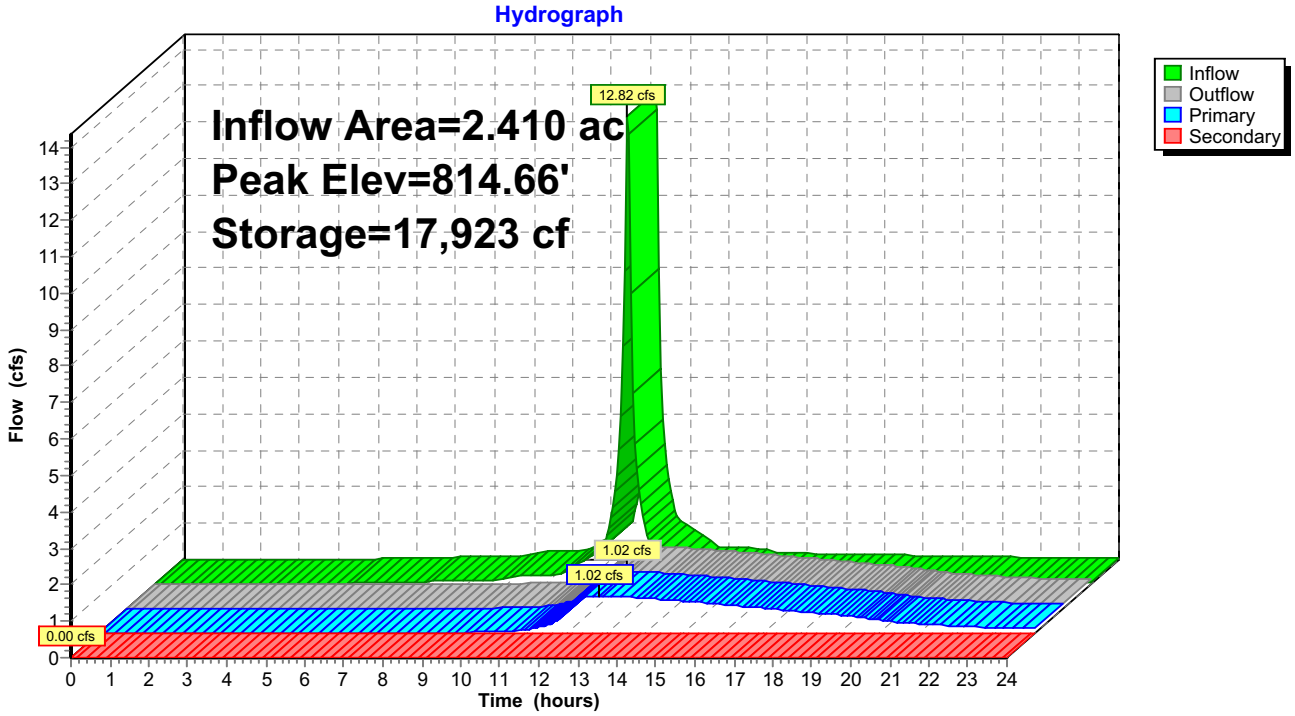
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
813.25	11,737	0	0
814.25	13,082	12,410	12,410
815.25	14,484	13,783	26,193
816.25	15,942	15,213	41,406
817.25	17,457	16,700	58,105
817.75	18,236	8,923	67,028

Device	Routing	Invert	Outlet Devices
#1	Primary	813.25'	**12.0" Round Culvert** L= 111.4' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 813.25' / 813.00' S= 0.0022 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#2	Device 1	813.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	815.25'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	816.75'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=1.02 cfs @ 12.83 hrs HW=814.66' (Free Discharge)
└**1=Culvert** (Passes 1.02 cfs of 2.12 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.02 cfs @ 5.19 fps)
  └**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=813.25' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Wet Pond



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: P-1 Runoff Area=104,958 sf 87.63% Impervious Runoff Depth>5.71"
Tc=6.0 min CN=96 Runoff=21.19 cfs 1.146 af

Subcatchment4S: P-2 Runoff Area=56,894 sf 32.80% Impervious Runoff Depth>4.58"
Tc=6.0 min CN=86 Runoff=10.17 cfs 0.498 af

Reach 3R: Proposed Conditions Inflow=11.27 cfs 1.544 af
Outflow=11.27 cfs 1.544 af

Pond 2P: Wet Pond Peak Elev=815.44' Storage=28,947 cf Inflow=21.19 cfs 1.146 af
Primary=2.92 cfs 1.045 af Secondary=0.00 cfs 0.000 af Outflow=2.92 cfs 1.045 af

Total Runoff Area = 3.716 ac Runoff Volume = 1.644 af Average Runoff Depth = 5.31"
31.65% Pervious = 1.176 ac 68.35% Impervious = 2.540 ac

Summary for Subcatchment 1S: P-1

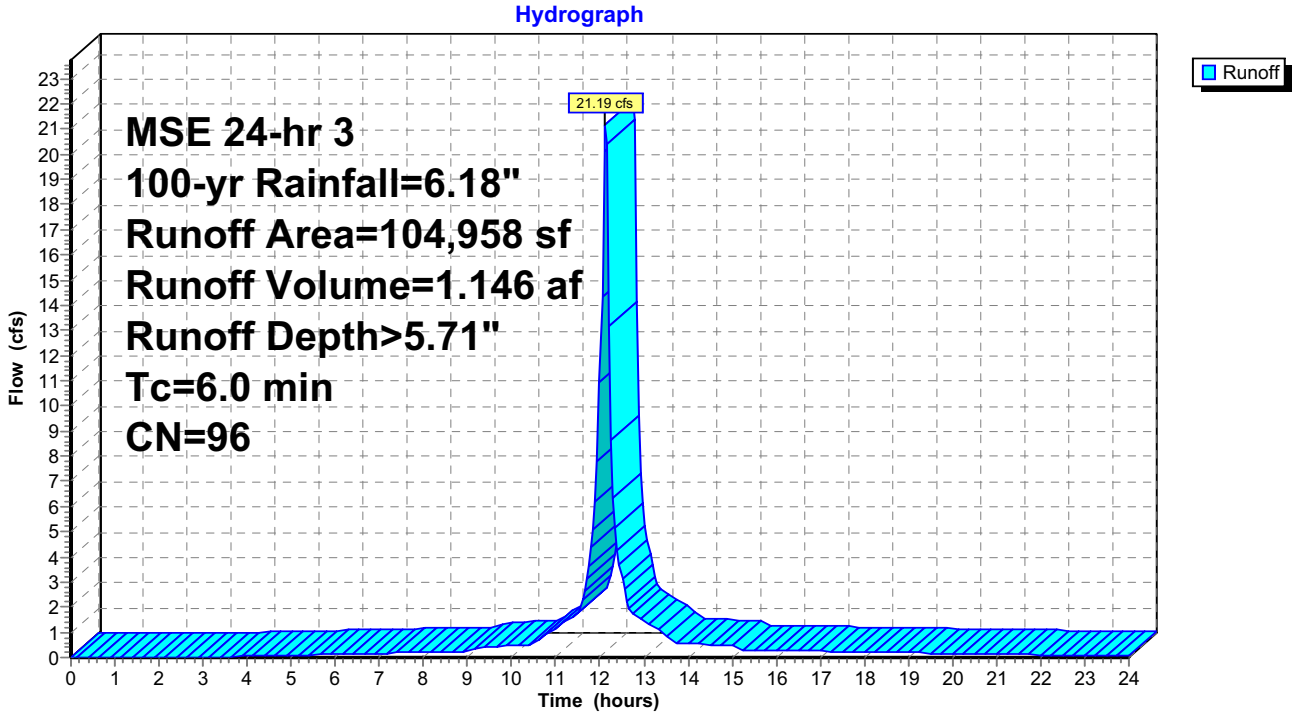
Runoff = 21.19 cfs @ 12.13 hrs, Volume= 1.146 af, Depth> 5.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-yr Rainfall=6.18"

	Area (sf)	CN	Description
	12,988	80	>75% Grass cover, Good, HSG D
	11,122	98	Roofs, HSG D
	65,380	98	Paved parking, HSG D
	11,737	98	Water Surface, HSG D
*	3,731	98	Sidewalk, HSG D
	104,958	96	Weighted Average
	12,988		12.37% Pervious Area
	91,970		87.63% Impervious Area

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

Subcatchment 1S: P-1



Summary for Subcatchment 4S: P-2

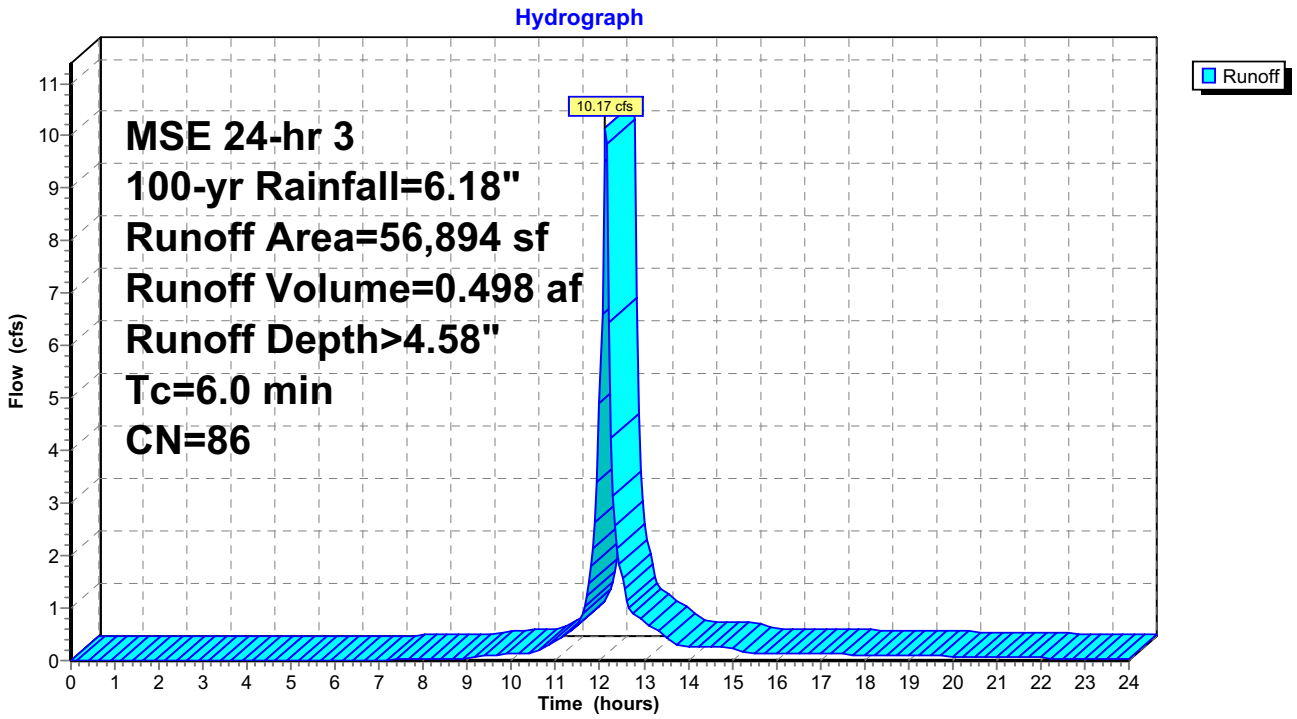
Runoff = 10.17 cfs @ 12.13 hrs, Volume= 0.498 af, Depth> 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-yr Rainfall=6.18"

	Area (sf)	CN	Description
	38,233	80	>75% Grass cover, Good, HSG D
*	17,444	98	Paved parking
*	1,217	98	Sidewalk
	56,894	86	Weighted Average
	38,233		67.20% Pervious Area
	18,661		32.80% Impervious Area

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

Subcatchment 4S: P-2



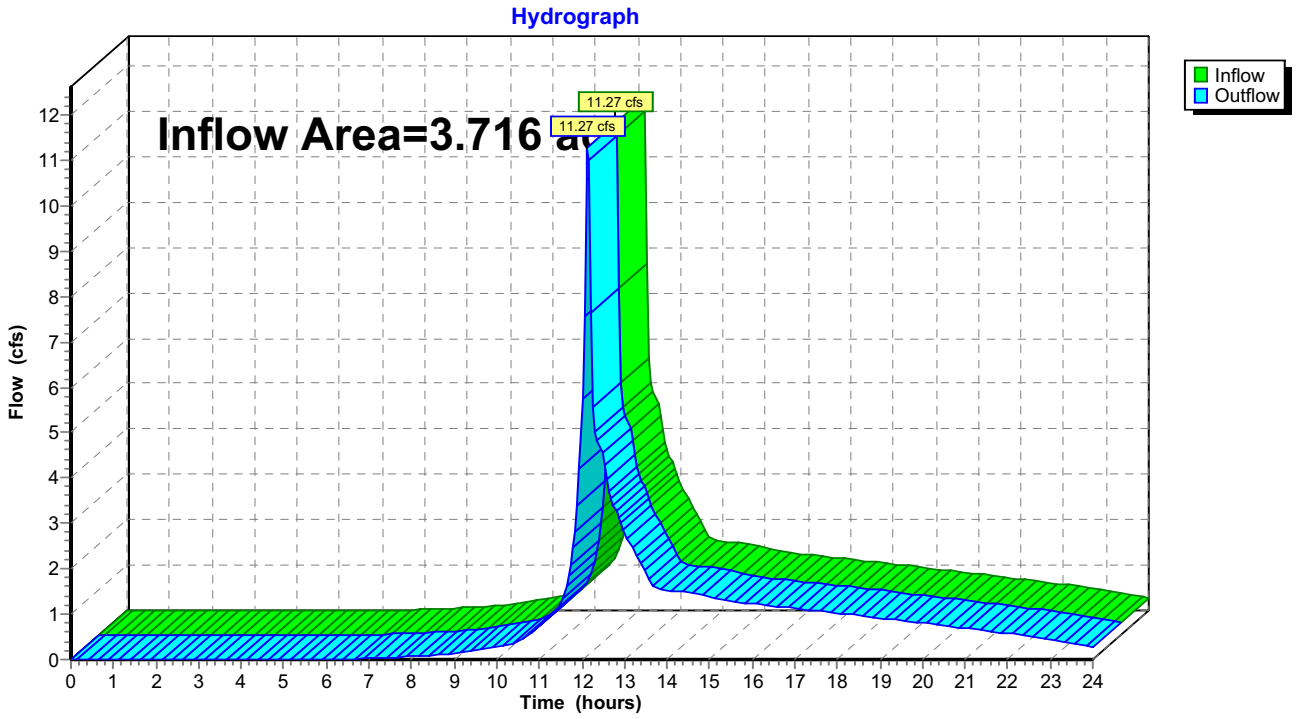
Summary for Reach 3R: Proposed Conditions

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.716 ac, 68.35% Impervious, Inflow Depth > 4.99" for 100-yr event
Inflow = 11.27 cfs @ 12.13 hrs, Volume= 1.544 af
Outflow = 11.27 cfs @ 12.13 hrs, Volume= 1.544 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3R: Proposed Conditions



Summary for Pond 2P: Wet Pond

Inflow Area = 2.410 ac, 87.63% Impervious, Inflow Depth > 5.71" for 100-yr event
Inflow = 21.19 cfs @ 12.13 hrs, Volume= 1.146 af
Outflow = 2.92 cfs @ 12.52 hrs, Volume= 1.045 af, Atten= 86%, Lag= 23.8 min
Primary = 2.92 cfs @ 12.52 hrs, Volume= 1.045 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 815.44' @ 12.52 hrs Surf.Area= 14,759 sf Storage= 28,947 cf

Plug-Flow detention time= 243.5 min calculated for 1.045 af (91% of inflow)
Center-of-Mass det. time= 205.6 min (958.2 - 752.6)

Volume	Invert	Avail.Storage	Storage Description
#1	813.25'	67,028 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

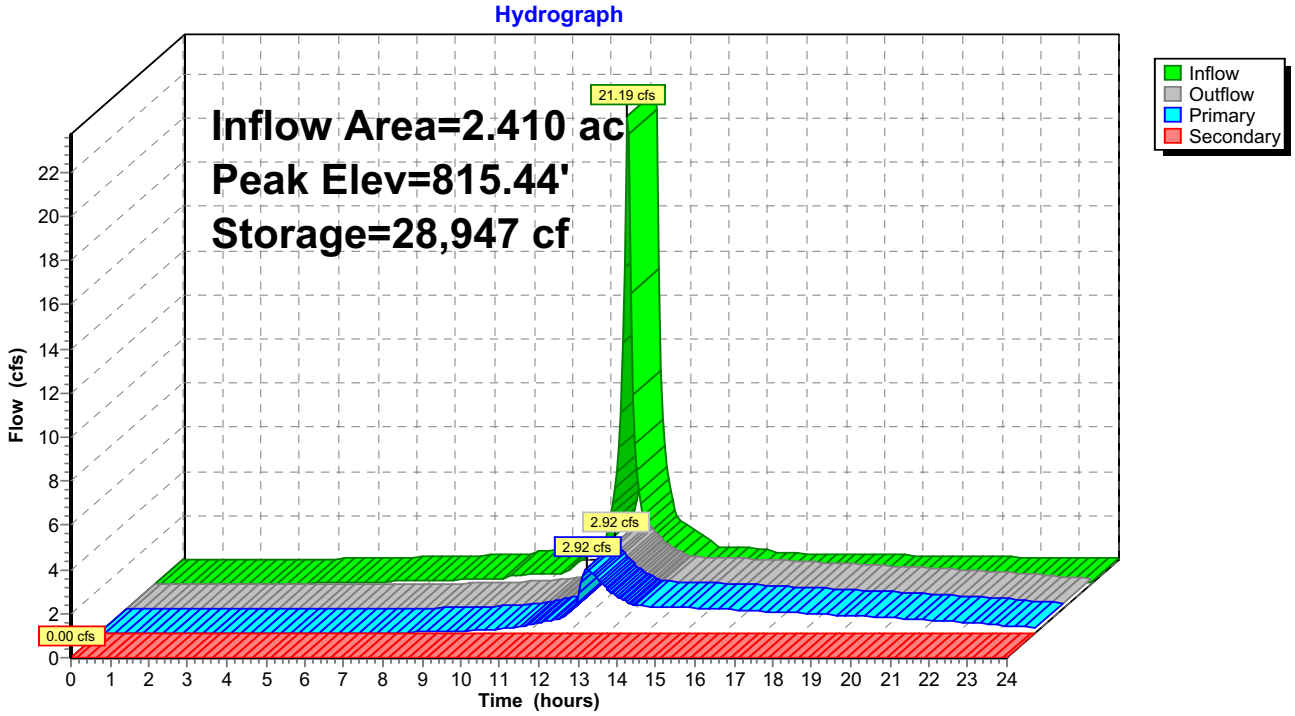
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
813.25	11,737	0	0
814.25	13,082	12,410	12,410
815.25	14,484	13,783	26,193
816.25	15,942	15,213	41,406
817.25	17,457	16,700	58,105
817.75	18,236	8,923	67,028

Device	Routing	Invert	Outlet Devices
#1	Primary	813.25'	**12.0" Round Culvert** L= 111.4' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 813.25' / 813.00' S= 0.0022 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 0.79 sf
#2	Device 1	813.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	815.25'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	816.75'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=2.90 cfs @ 12.52 hrs HW=815.44' (Free Discharge)
└**1=Culvert** (Passes 2.90 cfs of 3.12 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.32 cfs @ 6.70 fps)
  └**3=Sharp-Crested Rectangular Weir** (Weir Controls 1.58 cfs @ 1.42 fps)

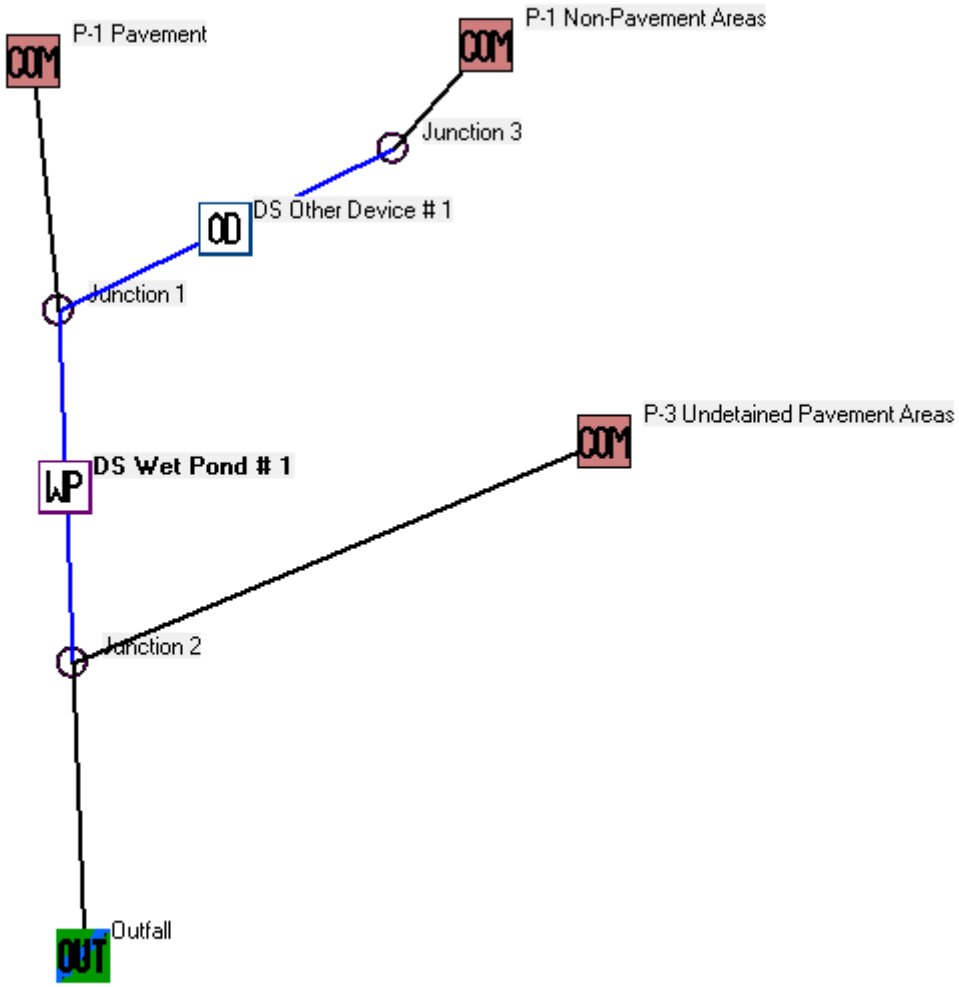
Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=813.25' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Wet Pond



Appendix D – Water Quality Calculations

WinSLAMM Model



Data file name: P:\3190495\Eng Data\Hydrology\3190495_KT 970 WinSLAMM.mdb
WinSLAMM Version 10.4.1
Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Milwaukee WI 1969.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO03.ppdx
Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP Source Area PSD Files.csv
Cost Data file name:
If Other Device Pollutant Load Reduction Values = 1, Off-site Pollutant Loads are Removed from Pollutant Load % Reduction calculations
Seed for random number generator: -42
Study period starting date: 01/05/69 Study period ending date: 12/31/69
Start of Winter Season: 12/02 End of Winter Season: 03/12
Date: 04-23-2020 Time: 15:06:56
Site information:

LU# 1 - Commercial: P-1 Pavement Total area (ac): 1.501
13 - Paved Parking 1: 1.501 ac. Connected PSD File: C:\WinSLAMM Files\NURP.cpz

LU# 2 - Commercial: P-3 Undetained Pavement Areas Total area (ac): 0.400
13 - Paved Parking 1: 0.400 ac. Connected PSD File: C:\WinSLAMM Files\NURP.cpz

LU# 3 - Commercial: P-1 Non-Pavement Areas Total area (ac): 0.908
1 - Roofs 1: 0.255 ac. Flat Connected PSD File: C:\WinSLAMM Files\NURP.cpz
31 - Sidewalks 1: 0.086 ac. Connected PSD File: C:\WinSLAMM Files\NURP.cpz
45 - Large Landscaped Areas 1: 0.298 ac. Normal Clayey Low Density PSD File: C:\WinSLAMM Files\NURP.cpz
70 - Water Body Areas: 0.269 ac. PSD File:

Control Practice 1: Wet Detention Pond CP# 1 (DS) - DS Wet Pond # 1
Particle Size Distribution file name: Not needed - calculated by program
Initial stage elevation (ft): 5
Peak to Average Flow Ratio: 3.8
Maximum flow allowed into pond (cfs): No maximum value entered
Outlet Characteristics:
Outlet type: Sharp Crested Weir
1. Sharp crested weir length (ft): 6
2. Sharp crested weir height from invert: 2.5
3. Sharp crested weir invert elevation above datum (ft): 7
Outlet type: Orifice 1
1. Orifice diameter (ft): 0.5
2. Number of orifices: 1
3. Invert elevation above datum (ft): 5
Outlet type: Broad Crested Weir
1. Weir crest length (ft): 10
2. Weir crest width (ft): 5
3. Height from datum to bottom of weir opening: 8.5
Pond stage and surface area

Entry Number	Stage (ft)	Pond Area (acres)	Natural Seepage (in/hr)	Other Outflow (cfs)
0	0.00	0.0000	0.00	0.00
1	0.01	0.1115	0.00	0.00
2	1.00	0.1267	0.00	0.00
3	2.00	0.1425	0.00	0.00
4	3.00	0.1589	0.00	0.00
5	4.00	0.1759	0.00	0.00
6	5.00	0.2694	0.00	0.00
7	6.00	0.3003	0.00	0.00
8	7.00	0.3325	0.00	0.00
9	8.00	0.3660	0.00	0.00
10	9.00	0.4008	0.00	0.00
11	9.50	0.4186	0.00	0.00

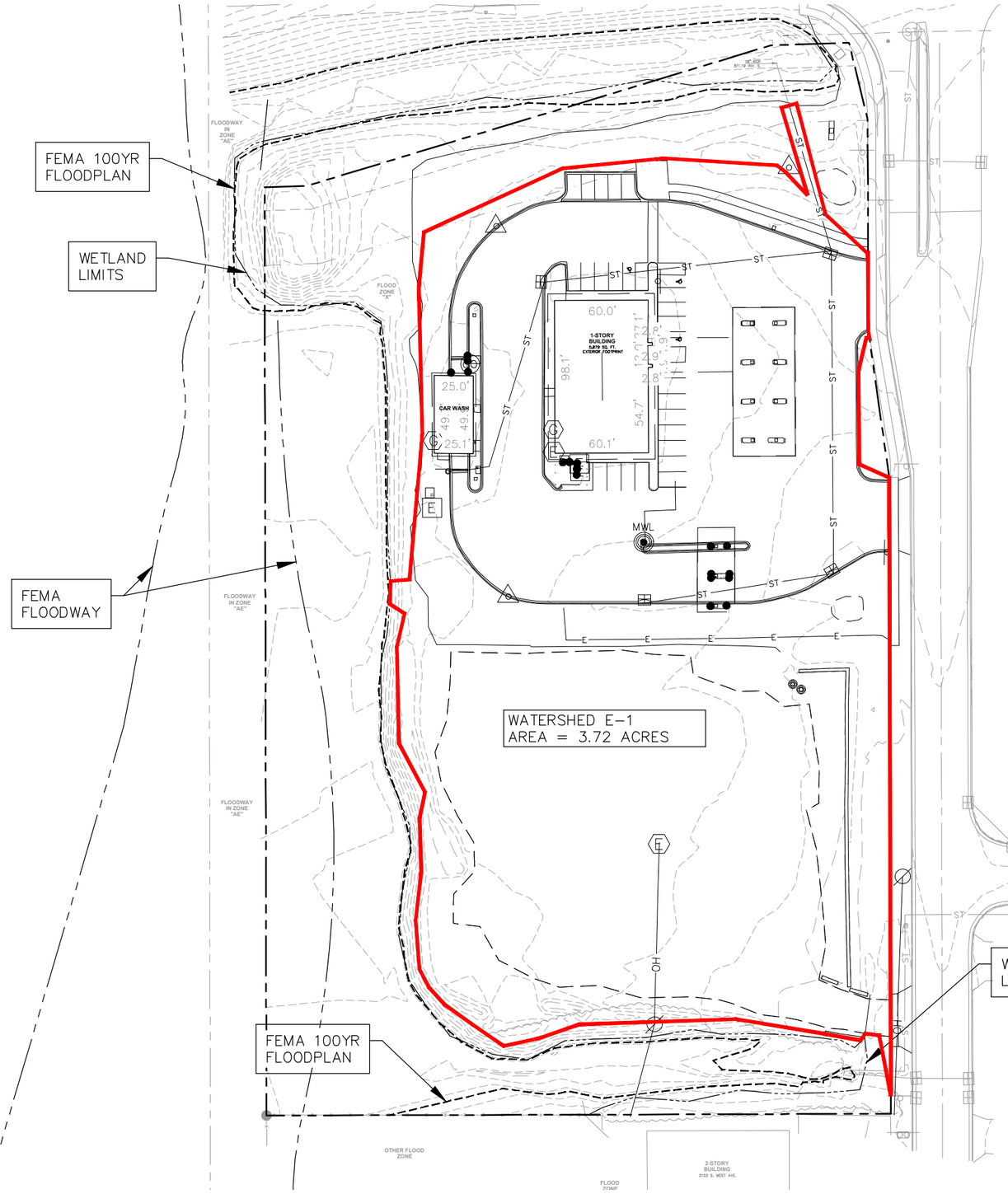
Control Practice 2: Other Device CP# 1 (DS) - DS Other Device # 1
Fraction of drainage area served by device (ac) = 1.00
Particulate Concentration reduction fraction = 1.00
Filterable Concentration reduction fraction = 0.00
Runoff volume reduction fraction = 0

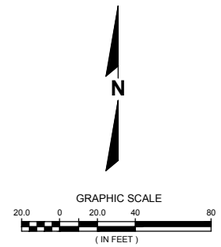
SLAMM for Windows Version 10.4.1

Data file name: P:\3190495\Eng Data\Hydrology\3190495_KT 970 WinSLAMM.mdb
WinSLAMM Version 10.4.1
Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Milwaukee WI 1969.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO03.ppdx
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP Source Area PSD Files.csv
Cost Data file name:
If Other Device Pollutant Load Reduction Values = 1, Off-site Pollutant Loads are Removed from Pollutant Load % Reduction calculations
Seed for random number generator: -42
Study period starting date: 01/05/69 Study period ending date: 12/31/69
Start of Winter Season: 12/02 End of Winter Season: 03/12
Model Run Start Date: 01/05/69 Model Run End Date: 12/31/69
Date of run: 04-23-2020 Time of run: 15:05:29
Total Area Modeled (acres): 2.809
Years in Model Run: 0.99

	Runoff Volume (cu ft)	Percent Runoff Volume Reduction	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total of all Land Uses without Controls:	209830	-	93.03	1219	-
Outfall Total with Controls:	210025	-0.09%	31.52	413.3	66.10%
Annualized Total After Outfall Controls:	212942			419.0	

Appendix E – Hydrology Exhibits and BMP Details





DESCRIPTION	DATE

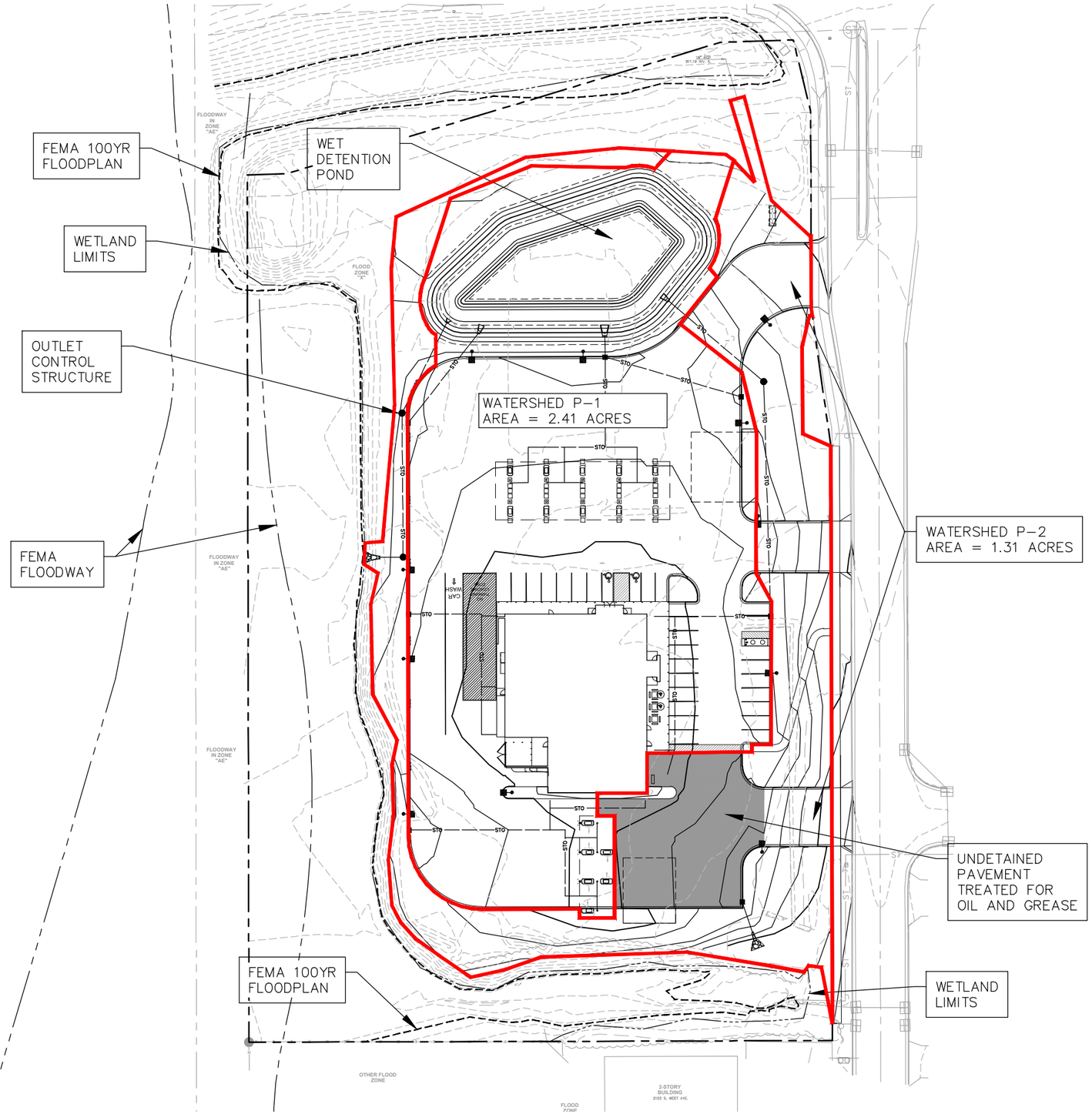
raSmith
CREATIVITY BEYOND ENGINEERING
16745 W. Bluemound Road
Brookfield, WI 53005-5938
(262) 781-1000
rasmith.com
Brookfield, WI | Milwaukee, WI | Appleton, WI | Madison, WI | Cedarburg, WI
Mount Pleasant, WI | Naperville, IL | Irvine, CA

KWIK TRIP #970
WAUKESHA, WI

EXISTING HYDROLOGY EXHIBIT

Know what's **below.**
Call before you dig.

DATE:	04/23/2020
SCALE:	1" = 80'
JOB NO.	3190495
PROJECT MANAGER:	ROBERT J HARLEY, P.E.
DESIGNED BY:	CBW
CHECKED BY:	RJH
SHEET NUMBER	HX100



N

GRAPHIC SCALE

20.0 0 20.0 40 80

(IN FEET)

DATE	DESCRIPTION

raSmith
CREATIVITY BEYOND ENGINEERING
16745 W. Bluemound Road
Brookfield, WI 53005-5938
(262) 781-1000
rasmith.com

Brookfield, WI | Milwaukee, WI | Appleton, WI | Madison, WI | Cedarburg, WI
Mount Pleasant, WI | Naperville, IL | Irvine, CA

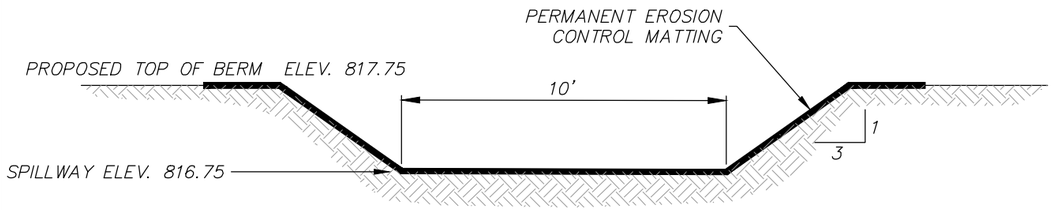
KWIK TRIP #970
WAUKESHA, WI

PROPOSED HYDROLOGY EXHIBIT

811 Know what's **below.** **Call** before you dig.

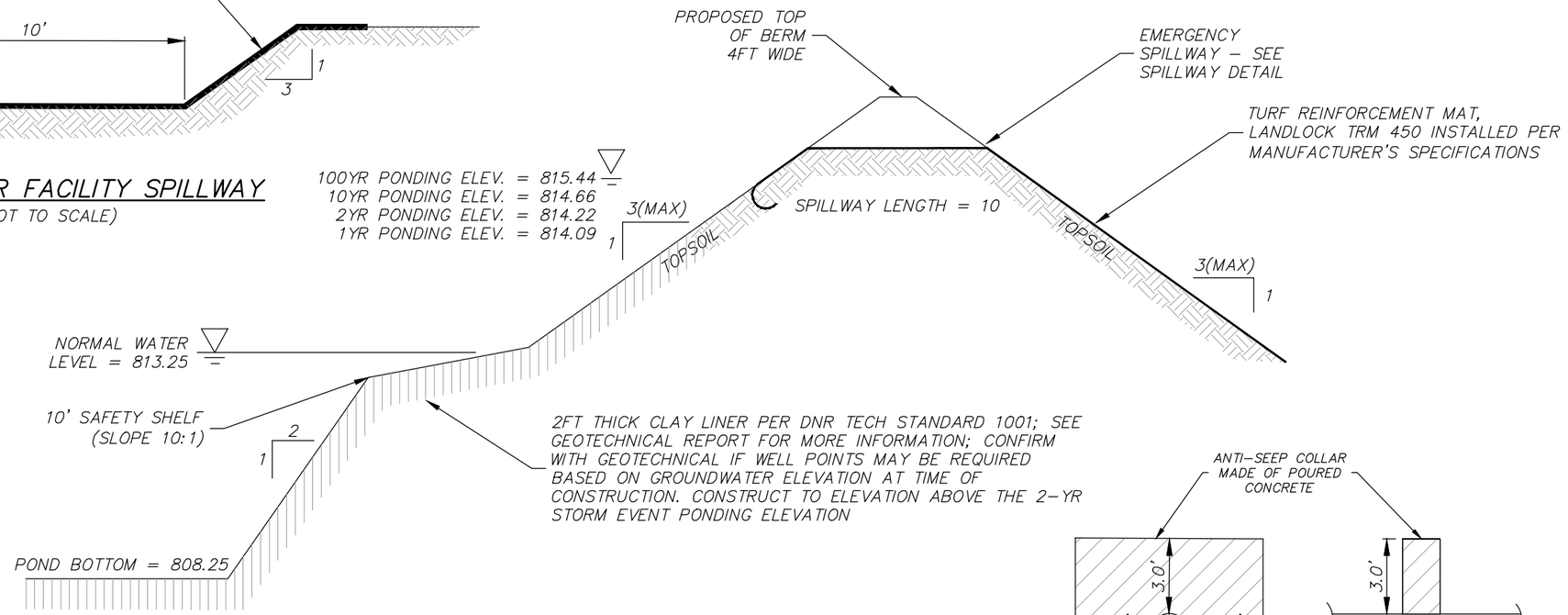
DATE: 04/23/2020
SCALE: 1" = 80'
JOB NO. 3190495
PROJECT MANAGER: ROBERT J HARLEY, P.E.
DESIGNED BY: CBW
CHECKED BY: RJH

SHEET NUMBER
HX101



STORM WATER FACILITY SPILLWAY

(NOT TO SCALE)

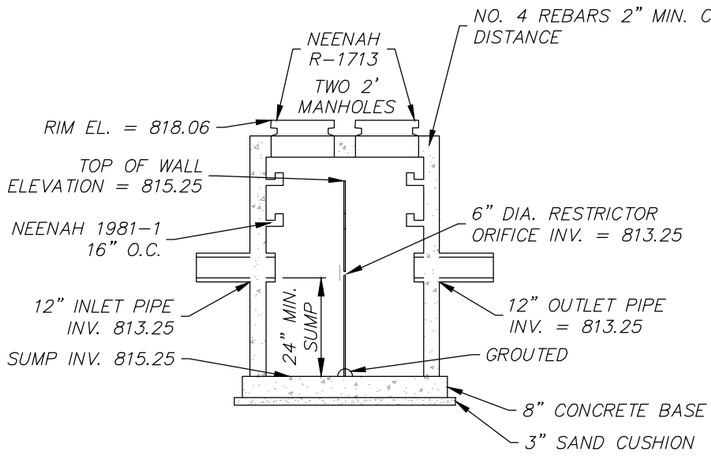


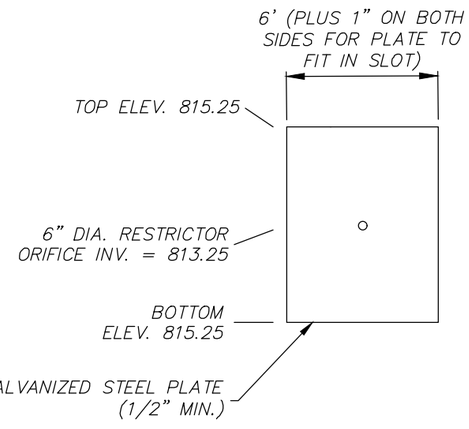
TYPICAL POND CROSS SECTION W/ OUTLET STRUCTURE

(SECTION W/OUTLET)

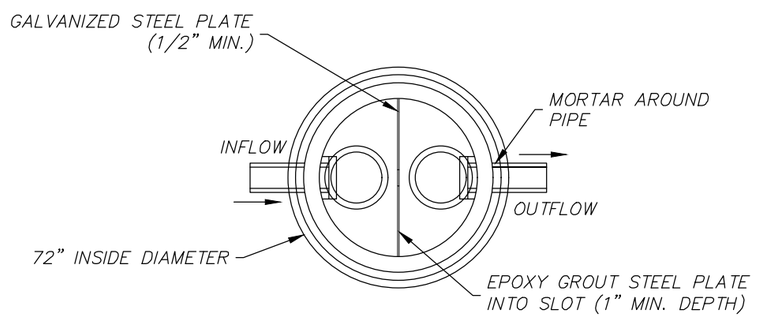
ANTI-SEEP COLLAR

TO BE INSTALLED ON OUTLET PIPE LEADING TO THE OUTLET CONTROL STRUCTURE.





STEEL PLATE DETAIL



NOTES:

1. STRUCTURE SHALL BE CONSTRUCTED CONFORMING TO THE REQUIREMENTS OF ASTM C-478.
2. REINFORCING STEEL NOT SHOWN

OUTLET CONTROL STRUCTURE POND – MH 400

DESCRIPTION

DATE

raSmith
CREATIVITY BEYOND ENGINEERING
16745 W. Bluemound Road
Brookfield, WI 53005-5938
(262) 781-1000
rasmith.com
Brookfield, WI | Milwaukee, WI | Appleton, WI | Madison, WI | Cedarburg, WI
Mount Pleasant, WI | Naperville, IL | Irvine, CA

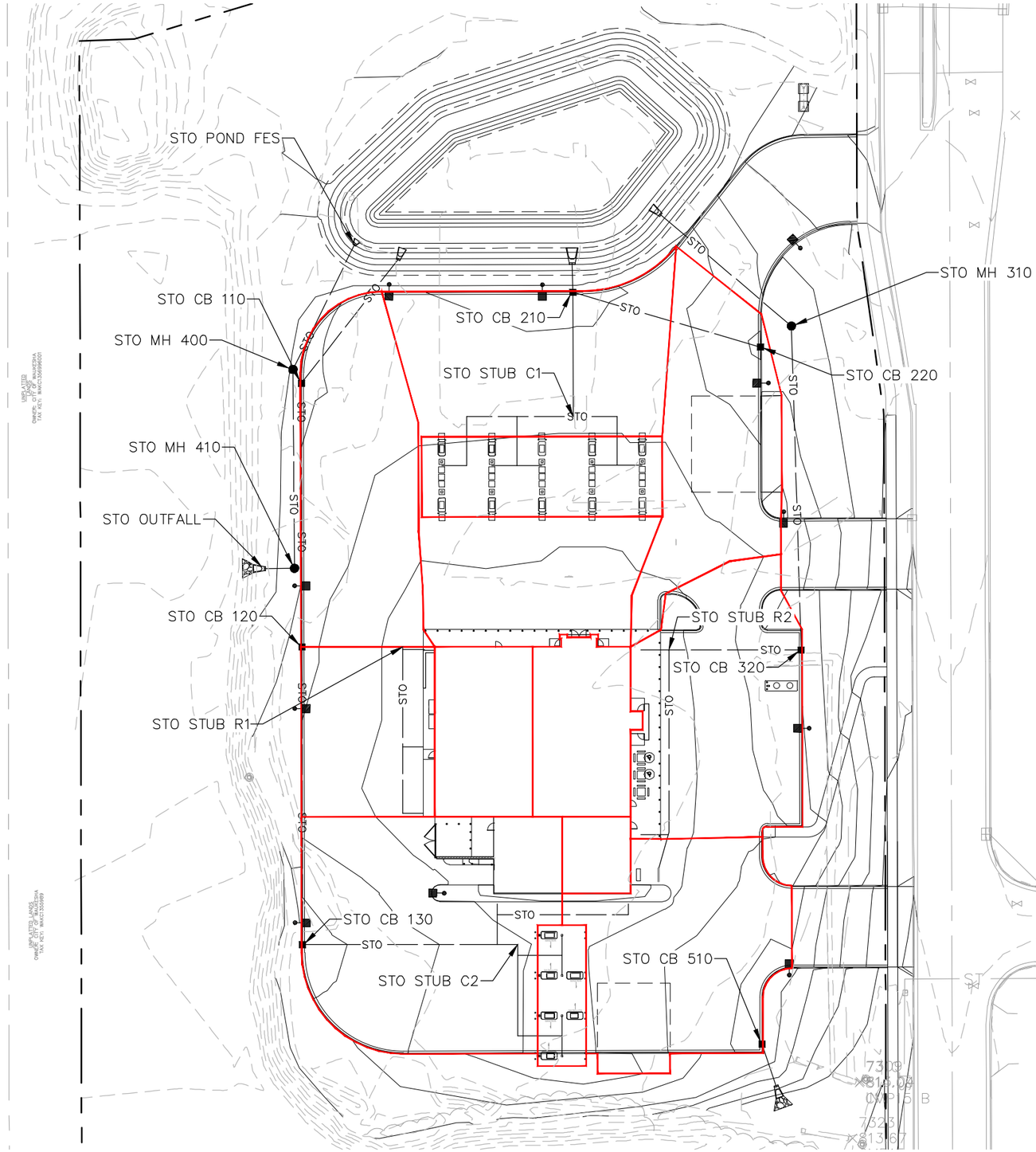
KWIK TRIP #970
WAUKESHA, WI

WET DETENTION POND DETAIL

DATE: 02/13/2020
SCALE: N.T.S.
JOB NO. 3190495
PROJECT MANAGER: ROBERT J HARLEY, P.E.
DESIGNED BY: CBW
CHECKED BY: RJH

SHEET NUMBER
HX300

Appendix F – Storm Sewer Design



N

GRAPHIC SCALE
15.0 0 15.0 30 60
(IN FEET)

DESCRIPTION	DATE

raSmith
CREATIVITY BEYOND ENGINEERING

16745 W. Bluemound Road
Brookfield, WI 53005-5938
(262) 781-1000
rasmith.com

Brookfield, WI | Milwaukee, WI | Appleton, WI | Madison, WI | Cedarburg, WI
Mount Pleasant, WI | Naperville, IL | Irvine, CA

KWIK TRIP #970
WAUKESHA, WI

STORM SEWER CATCHMENT AREAS

Know what's **below.**
Call before you dig.

DATE: 04/27/2020
SCALE: 1" = 60'
JOB NO. 3190495
PROJECT MANAGER: ROBERT J HARLEY, P.E.
DESIGNED BY: CBW
CHECKED BY: RJH

SHEET NUMBER
HX200

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	78.479	0.22	0.80	0.90	0.20	0.72	6.0	12.2	4.9	3.50	5.81	3.44	18	0.31	813.35	813.59	814.19	814.43	815.14	817.77	110-Pond
2	1	131.030	0.13	0.58	0.90	0.12	0.52	6.0	11.0	5.1	2.67	5.73	2.47	18	0.30	813.59	813.98	814.61	814.76	817.77	818.73	120-110
3	2	147.970	0.32	0.36	0.90	0.29	0.32	6.0	10.1	5.3	1.73	1.94	2.34	12	0.30	813.98	814.42	814.95	815.26	818.73	818.40	130-120
4	3	106.954	0.04	0.04	0.90	0.04	0.04	6.0	6.0	6.7	0.24	2.37	1.32	10	1.00	814.42	815.49	815.40	815.70	818.40	820.01	C2-130
5	2	53.677	0.09	0.09	0.90	0.08	0.08	6.0	6.0	6.7	0.54	3.35	1.88	10	1.99	813.98	815.05	814.95	815.37	818.73	820.45	R1-120

Project File: New.stm

Number of lines: 5

Run Date: 2/12/2020

NOTES:Intensity = 33.54 / (Inlet time + 4.60) ^ 0.68; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	78.479	0.22	0.80	0.90	0.20	0.72	6.0	10.2	7.8	5.59	5.81	4.33	18	0.31	813.35	813.59	814.26	814.79	815.14	817.77	110-Pond
2	1	131.030	0.13	0.58	0.90	0.12	0.52	6.0	9.4	8.1	4.22	5.73	2.62	18	0.30	813.59	813.98	815.00	815.17	817.77	818.73	120-110
3	2	147.970	0.32	0.36	0.90	0.29	0.32	6.0	8.7	8.4	2.71	1.94	3.45	12	0.30	813.98	814.42	815.36	816.21	818.73	818.40	130-120
4	3	106.954	0.04	0.04	0.90	0.04	0.04	6.0	6.0	9.9	0.36	2.37	0.65	10	1.00	814.42	815.49	816.49	816.51	818.40	820.01	C2-130
5	2	53.677	0.09	0.09	0.90	0.08	0.08	6.0	6.0	9.9	0.80	3.35	2.30	10	1.99	813.98	815.05	815.36	815.45	818.73	820.45	R1-120

Project File: New.stm

Number of lines: 5

Run Date: 2/12/2020

NOTES:Intensity = 34.00 / (Inlet time + 2.20) ^ 0.59; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	14.607	0.39	0.70	0.90	0.35	0.63	6.0	7.1	6.2	3.93	6.73	3.95	18	0.41	813.35	813.41	814.17	814.24	815.14	817.65	210-Pond
2	1	61.742	0.11	0.11	0.90	0.10	0.10	6.0	6.0	6.7	0.66	1.68	2.42	10	0.50	814.08	814.39	814.58	814.75	817.65	818.85	C1-210
3	1	97.202	0.20	0.20	0.90	0.18	0.18	6.0	6.0	6.7	1.20	2.26	1.58	12	0.40	813.41	813.80	814.58	814.68	817.65	816.80	220-210

Project File: New.stm | Number of lines: 3 | Run Date: 2/12/2020

NOTES:Intensity = 33.54 / (Inlet time + 4.60) ^ 0.68; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	14.607	0.39	0.70	0.90	0.35	0.63	6.0	6.7	9.4	5.93	6.73	4.80	18	0.41	813.35	813.41	814.29	814.46	815.14	817.65	210-Pond
2	1	61.742	0.11	0.11	0.90	0.10	0.10	6.0	6.0	9.9	0.98	1.68	2.05	10	0.50	814.08	814.39	814.91	815.00	817.65	818.85	C1-210
3	1	97.202	0.20	0.20	0.90	0.18	0.18	6.0	6.0	9.9	1.78	2.26	2.27	12	0.40	813.41	813.80	814.91	815.15	817.65	816.80	220-210

Project File: New.stm

Number of lines: 3

Run Date: 2/12/2020

NOTES:Intensity = 34.00 / (Inlet time + 2.20) ^ 0.59; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	85.848	0.00	0.34	0.90	0.00	0.31	6.0	8.1	5.9	1.80	2.24	3.17	12	0.40	813.25	813.59	813.93	814.27	815.04	817.14	310-Pond
2	1	161.030	0.24	0.34	0.90	0.22	0.31	6.0	7.0	6.3	1.91	2.25	3.06	12	0.40	813.59	814.23	814.39	814.93	817.14	818.29	320-310
3	2	65.790	0.10	0.10	0.90	0.09	0.09	6.0	6.0	6.7	0.60	2.36	3.24	10	0.99	814.90	815.55	815.19	815.89	818.29	820.26	R2-320

Project File: New.stm

Number of lines: 3

Run Date: 4/27/2020

NOTES:Intensity = 33.54 / (Inlet time + 4.60) ^ 0.68; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	85.848	0.00	0.34	0.90	0.00	0.31	6.0	7.4	9.0	2.76	2.24	4.07	12	0.40	813.25	813.59	813.96	814.71	815.04	817.14	310-Pond
2	1	161.030	0.24	0.34	0.90	0.22	0.31	6.0	6.7	9.4	2.89	2.25	3.68	12	0.40	813.59	814.23	814.86	815.92	817.14	818.29	320-310
3	2	65.790	0.10	0.10	0.90	0.09	0.09	6.0	6.0	9.9	0.89	2.36	1.66	10	0.99	814.90	815.55	816.24	816.32	818.29	820.26	R2-320

Project File: New.stm

Number of lines: 3

Run Date: 4/27/2020

NOTES:Intensity = 34.00 / (Inlet time + 2.20) ^ 0.59; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	14.877	0.00	0.00	0.00	0.00	0.00	0.0	3.3	0.0	1.02	1.60	2.16	12	0.20	813.10	813.13	813.68	813.71	814.13	818.71	410-OUT
2	1	98.804	0.00	0.00	0.00	0.00	0.00	0.0	2.0	0.0	1.02	1.24	1.76	12	0.12	813.13	813.25	813.82	813.94	818.71	818.06	400-410
3	2	69.268	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.02	0.00	1.19	18	0.00	813.25	813.25	813.97	814.00	818.06	814.50	POND-400

Project File: New.stm | Number of lines: 3 | Run Date: 4/27/2020

NOTES:Intensity = 33.54 / (Inlet time + 4.60) ^ 0.68; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	14.877	0.00	0.00	0.00	0.00	0.00	0.0	1.1	0.0	2.92	1.60	4.29	12	0.20	813.10	813.13	813.83	814.06	814.13	818.71	410-OUT
2	1	98.804	0.00	0.00	0.00	0.00	0.00	0.0	0.7	0.0	2.92	1.24	3.72	12	0.12	813.13	813.25	814.29	814.95	818.71	818.06	400-410
3	2	69.268	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.92	0.00	1.65	18	0.00	813.25	813.25	815.06	815.12	818.06	814.50	POND-400

Project File: New.stm | Number of lines: 3 | Run Date: 4/27/2020

NOTES:Intensity = 34.00 / (Inlet time + 2.20) ^ 0.59; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	22.437	0.23	0.23	0.90	0.21	0.21	6.0	6.0	6.7	1.38	2.26	3.02	12	0.40	814.50	814.59	815.06	815.15	813.83	817.55	510-OUT

Project File: New.stm

Number of lines: 1

Run Date: 4/27/2020

NOTES:Intensity = 33.54 / (Inlet time + 4.60) ^ 0.68; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	22.437	0.23	0.23	0.90	0.21	0.21	6.0	6.0	9.9	2.05	2.26	3.70	12	0.40	814.50	814.59	815.11	815.32	813.83	817.55	510-OUT

Project File: New.stm | Number of lines: 1 | Run Date: 4/27/2020

NOTES:Intensity = 34.00 / (Inlet time + 2.20) ^ 0.59; Return period =Yrs. 100 ; c = cir e = ellip b = box