# STORMWATER TECHNICAL DRAINAGE REPORT

# COMPASS & KEY INDUSTRIAL PARK

Project Location:

2616 N Raceway Rd, Brownsburg, IN 46234

Prepared for:

Compass and Key LLC

9129 Log Run Dr S, Indianapolis, IN 46234

KEVIN L. STEELY
REGISTERED
No.
PE12501224
STATE OF
INDIANA
PROFESSIONAL ENGINEER

Date:

February 21, 2026


TERRA SITE DEVELOPMENT

CONSULTING ENGINEERS & LAND SURVEYORS

CIVIL / SITE ENGINEERING
LAND SURVEYING
GEOTECHNICAL ENGINEERING
ENVIRONMENTAL CONSULTING
BROWNFIELDS REDEVELOPMENT
CONSTRUCTION MATERIALS TESTING (CMT) / INSPECTION

# Table of Contents

# PROJECT DESCRIPTION

The client intends to convert this vacant agricultural field into two similar 40,000± SF light industrial tenant spaces. The project will include on site underground detention and water quality units.

# EXISTING CONDITIONS

The site is located at 2616 N Raceway Rd, Brownsburg, in section 29, Town 16 north, Range 2 east, Lincoln Township, Hendricks county. The site is zoned I-2. See Location Map Appendix A.

## FEMA (FLOODPLAIN) INFORMATION

The site is Zone X on FEMA FIRM 18063C0187D, effective 9/25/2009 (FEMA, 2025). See Appendix B.

## WATERSHED DESCRIPTION

The site discharges to nearby Mario Creek, part of the Ristow Branch of Eagle Creek, with HUC 05120 2011 110 (Indiana Dept of Environmental Management, 2025).

## SOILS OVERVIEW

The predominant soil types and hydrologic soil groups (HSG) for the site are Crosby silt loam (C/D) and Treaty silty clay loam (B/D). See Appendix C (Web Soil Survey, 2025).

## STORMWATER RUNOFF

We used HydroCAD v10.20 to model the site using NRCS TR-20 times of concentration and curve number methodology. Rainfall depths were taken from NOAA Atlas 14 for the gauge nearest Brownsburg (NOAA Atlas 14, 2025). See Appendix D.

The existing site primarily sheet drains from northwest to southeast. There is a culvert (offsite) under Raceway where runoff reaches Mario Creek. The land has been used for row crop agriculture but is currently vacant. See the Exhibit in Appendix E.

The weighted Curve Numbers (CN) for each sub basin are provided below.

*Table 1 Weighted CN Existing Conditions*

| Sub basin | Area (ac) | CN | Description |
|---|---|---|---|
| **Total** | 7.230 | 82 | Row Crops, SR+CR, good, HSG C |

The time of concentration used is summarized in the table below.

*Table 2 Time of Concentration Existing Conditions*

| Sub Basin | Length (ft) | Slope (ft/ft) | Description | Tc (min) |
|---|---|---|---|---|
| **1s** | 100 | 0.0093 | Sheet flow, row crops | 15.2 |
| | 385 | 0.0128 | Shallow concentrated flow | 6.3 |
| | 485 | | Total | 21.5 |

The model yields the following results for the critical duration storm (24 hr). Detailed calculations are provided in Appendix F.

*Table 3 Existing Conditions Runoff*

| Sub basin | Frequency (yr) | Rainfall (in) | Runoff (cfs) | Vol (ac-ft) |
|---|---|---|---|---|
| **1s** | 2 | 2.98 | 10.39 | 0.821 |
| | 10 | 4.22 | 18.38 | 1.441 |
| | 100 | 6.18 | 31.66 | 2.502 |

# DEVELOPED CONDITIONS

The developed site is just below 65% impervious. The runoff is collected in storm sewer and conveyed to water quality units before entering underground detention onsite. A swale and culvert have been provided along the east property line in the existing drainage easement to convey runoff from the adjacent parcel north. The Developed Conditions Plan is provided in Appendix G.

*Table 4 Weighted CN Developed Conditions*

| Node | Area (ac) | CN | Description |
|---|---|---|---|
| **1S** | 2.564 | 80 | >75% grass cover, good, HSG D |
| | 4.662 | 98 | Impervious |
| **Total** | 7.226 | 92 | Weighted |

The developed times of concentration were determined following the NRCS TR-55 method in the table below.

*Table 5  Times of Concentration Developed Conditions*

| Node | Length (ft) | Slope (ft/ft) | Description | Tc (min) |
|---|---|---|---|---|
| **1S** | 60 | 0.02 | Sheet flow, landscape | 9.8 |
| | 125 | 0.02 | Sheet flow, pavement | 1.5 |
| | 950 | 0.0025 | Pipe flow | 6.1 |
| | | | Direct entry (Min allowed) | 12.6 |
| **Total** | 1,135 | | | 30.0 |

## ALLOWABLE RELEASE RATES

The allowable release rates provided in the Manual (Christopher B Burke engineering LLC, 2017) are calculated in the table below.

*Table 6 Allowable Release Rates*

| Frequency (yr) | Ordinance | Release Rate (cfs) |
|---|---|---|
| **2** | <=2 | 10.39 |
| **10** | 0.2 cfs/ac | 1.44 |

| | | |
|---|---|---|
| **100** | 0.4 cfs/ac | 2.89 |

## STORMWATER RUNOFF

See Appendix H for detailed calculations for the developed conditions for the critical duration storm (24 hr).

## STORMWATER DETENTION

To satisfy the Manual detention requirements, we provided underground detention in a modular stormwater storage system. See details in Appendix I. This is provided in two beds to avoid conflicts with other utilities. There is an equalizer pipe between them.

The outlet control structure (OCS) will consist of a 60" manhole with two orifices and a sharp-crested weir. The 18" outlet and 6" low flow orifice are at invert 832.50, as well as the detention system. The next 6" orifice is at invert 834.75 and the 5' long sharp-crested weir is at elevation 836.50. See Appendix J for OCS detail.

*Table 7 Peak Flow Results*

| Frequency | Allowable (cfs) | Actual (cfs) | Stage | Storage (ac-ft) |
|---|---|---|---|---|
| **2** | 10.39 | 1.05 | 833.98 | 0.783 |
| **10** | 1.44 | 1.42 | 834.87 | 1.253 |
| **100** | 2.89 | 2.81 | 836.22 | 1.919 |

## STORMWTAER QUALITY

We selected the AquaShield XCelerator XP system to provide 80% TSS removal. This system is listed on the City of Indianapolis SQU Selection Guide Version 2025 12 01. We have designed it offline and adjusted the inverts of the through and bypass pipes to direct the first one (1) inch runoff to the SQU. Calculations are in Appendix K.

*Table 8 SQU Sizing Table*

| SQU Str # | Treatment Q (cfs) | Allowable Q (cfs) | SQU Model |
|---|---|---|---|
| **420** | 1.33 | 1.41 | XP-4 |
| **304** | 0.59 | 0.85 | XP-3 |
| **117** | 1.19 | 1.41 | XP-4 |

Installation, Operation & Maintenance Instructions are provided in Appendix L.

## WATER QUALITY VOLUME

The water quality volume required to treat the runoff from the first one-inch of rainfall is calculated below. The impervious area is 64.52% for the developed condition.

$$WQv = \frac{P * Rv * A}{12} = \frac{1 * (0.05 + 0.009 * 64.52) * 7.226}{12} = 0.38\ ac\ ft$$

## STORM SEWER

The storm sewer was designed using the 10-yr storm frequency to size the pipes (NOAA Atlas 14, 2025). The model was then run with the 25-yr intensities to verify the HGL remains below grade. The HGL from both storms are shown on the construction plans. The minimum pipe size of 12" was used on site. Reinforced concrete pipe is recommended. A minimum pipe cover of 2.5' was used for design. See Appendix M.

### GRATE CAPACITY

We used the Neenah Catalog to determine weir perimeter and open area (orifice) parameters. Grate capacity calculations are in Appendix N.

*Table 9 Grate Capacity*

| Structure # | Area (ac) | Q (cfs) | Depth (ft) |
|---|---|---|---|
| **113** | 0.12 | 0.70 | 0.12 |
| **114** | 0.28 | 1.63 | 0.21 |
| **115** | 0.10 | 0.58 | 0.11 |
| **307** | 0.11 | 0.64 | 0.11 |
| **306** | 0.23 | 1.34 | 0.18 |
| **305** | 0.46 | 2.68 | 0.29 |
| **304** | 0.41 | 2.38 | 0.26 |
| **413** | 0.09 | 0.52 | 0.10 |
| **412** | 0.23 | 1.34 | 0.18 |
| **411** | 0.07 | 0.41 | 0.08 |
| **410** | 0.08 | 0.47 | 0.09 |
| **409** | 0.23 | 1.34 | 0.18 |
| **408** | 0.46 | 2.68 | 0.29 |
| **494** | 0.26 | 1.51 | 0.19 |
| **406** | 0.45 | 2.62 | 0.50 |
| **407** | 0.43 | 2.50 | 0.46 |
| **120** | 0.39 | 2.27 | 0.38 |
| **119** | 0.41 | 2.38 | 0.42 |
| **117** | 0.29 | 1.69 | 0.21 |
| **121** | 0.46 | 2.68 | 0.29 |

## CONCLUSION

The Design Professional certifying this drainage report acknowledges his/her professional responsibility to reasonably ensure that all work is correct, accurate and complies with the Hendricks County Stormwater Technical Standards Manual (latest edition) and all other applicable standards in place at the time his/her seal was affixed to said report.

# REFERENCES


Christopher B Burke engineering LLC. (2017). *Hendricks County Stormwater Technical Standards Manual.* Danville: Hendricks County.

FEMA. (2025, March 2). *Flood Map Service Center*. Retrieved from FEMA: https://msc.fema.gov/portal/home

Indiana Dept of Environmental Management. (2025, 3 17). *Indiana HUC Finder*. Retrieved from IDEM: https://www.in.gov/idem/cleanwater/resources/indiana-huc-finder/

*NOAA Atlas 14*. (2025, 10 13). Retrieved from NOAA National Weather Service: https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=in

*Web Soil Survey*. (2025, 10 12). Retrieved from USDA NRCS Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx


# APPENDIX

A. Location Map
B. FEMA FIRM
C. USDA Web Soil Survey
D. NOAA 14 Rainfall Depths
E. Existing Conditions Plan
F. Existing Conditions Calculations
G. Developed Conditions Plan
H. Developed Conditions Calculations
I. Modular Stormwater Storage System Details
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K. SQU Sizing Calculations
L. SQU O&M
M. Storm Sewer Calculations
N. Grate Capacity Calculations

# APPENDIX A

# LOCATION MAP


Marathon Petroleum Corporation
Enterprise Products
E County Rd 300 N
E County Rd 300 N
W 30th St
Hittle Landscaping, Inc
General Piping
Penn Tank Lines
N Raceway Rd
N Raceway Rd
N Raceway Rd
N Raceway Rd
Iglesia Pentecostes El Pozo de Jacob
Robey Glen Dr
Gammon Dr
Drewmatt Ln
Tansel Crk Dr
Bratton Ct

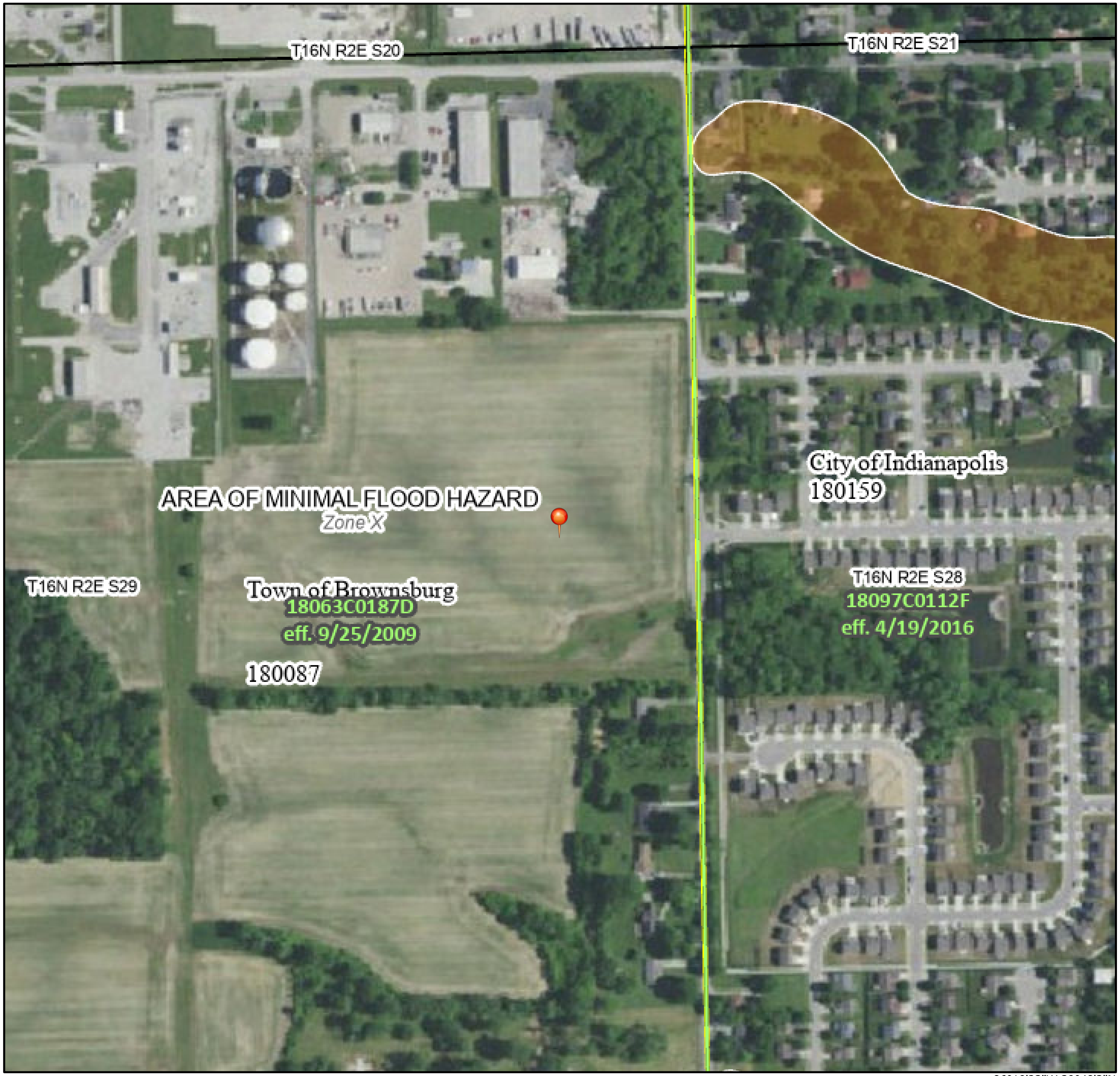
# APPENDIX B

# FEMA FIRM

# National Flood Hazard Layer FIRMette

FEMA

86°20'W 39°48'30"N




86°19'23"W 39°48'3"N

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

1:6,000

*Basemap Imagery Source: USGS National Map 2023*

## 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
- 8 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.

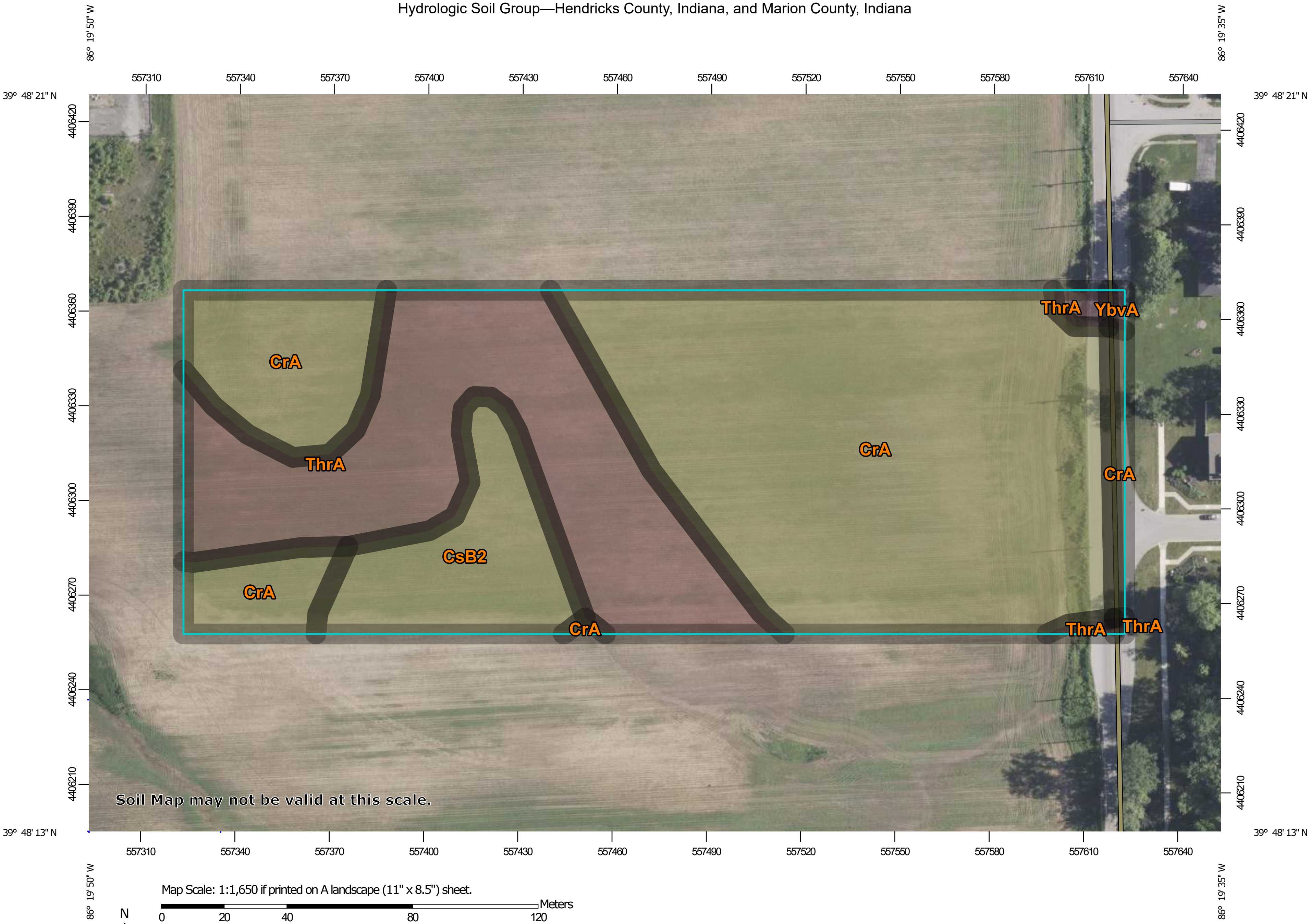
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/14/2025 at 5:56 PM 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.

# APPENDIX C

# USDA WEB SOIL SURVEY




Map Scale: 1:1,650 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| CrA | Crosby silt loam, fine-loamy subsoil, 0 to 2 percent slopes | C/D | 4.8 | 59.8% |
| CsB2 | Crosby-Miami silt loams, 2 to 4 percent slopes, eroded | C/D | 0.8 | 10.2% |
| ThrA | Treaty silty clay loam, 0 to 1 percent slopes | B/D | 2.3 | 28.6% |
| **Subtotals for Soil Survey Area** | | | **8.0** | **98.6%** |
| **Totals for Area of Interest** | | | **8.1** | **100.0%** |

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| CrA | Crosby silt loam, fine-loamy subsoil, 0 to 2 percent slopes | C/D | 0.1 | 1.2% |
| ThrA | Treaty silty clay loam, 0 to 1 percent slopes | B/D | 0.0 | 0.1% |
| YbvA | Brookston silty clay loam-Urban land complex, 0 to 2 percent slopes | B/D | 0.0 | 0.2% |
| **Subtotals for Soil Survey Area** | | | **0.1** | **1.4%** |
| **Totals for Area of Interest** | | | **8.1** | **100.0%** |

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# APPENDIX D

# NOAA 14 RAINFALL DEPTHS

NOAA Atlas 14, Volume 2, Version 3
Location name: Brownsburg, Indiana, USA*
Latitude: 39.8433°, Longitude: -86.398°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

## POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

# PF tabular

| PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Duration | Average recurrence interval (years) | | | | | | | | | |
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 0.387 (0.349-0.430) | 0.461 (0.416-0.511) | 0.554 (0.500-0.615) | 0.627 (0.562-0.694) | 0.723 (0.644-0.801) | 0.799 (0.706-0.887) | 0.874 (0.767-0.971) | 0.953 (0.826-1.06) | 1.06 (0.904-1.19) | 1.14 (0.959-1.29) |
| 10-min | 0.602 (0.543-0.668) | 0.720 (0.650-0.798) | 0.861 (0.776-0.955) | 0.968 (0.868-1.07) | 1.11 (0.985-1.22) | 1.21 (1.07-1.34) | 1.32 (1.15-1.46) | 1.42 (1.23-1.59) | 1.56 (1.33-1.75) | 1.66 (1.40-1.88) |
| 15-min | 0.738 (0.665-0.819) | 0.881 (0.795-0.976) | 1.06 (0.953-1.17) | 1.19 (1.07-1.32) | 1.37 (1.22-1.51) | 1.50 (1.32-1.66) | 1.64 (1.43-1.82) | 1.77 (1.53-1.98) | 1.94 (1.66-2.19) | 2.08 (1.74-2.35) |
| 30-min | 0.976 (0.880-1.08) | 1.18 (1.06-1.31) | 1.45 (1.30-1.61) | 1.65 (1.48-1.83) | 1.93 (1.72-2.14) | 2.14 (1.89-2.38) | 2.36 (2.07-2.62) | 2.58 (2.24-2.88) | 2.88 (2.46-3.24) | 3.11 (2.62-3.52) |
| 60-min | 1.19 (1.08-1.32) | 1.45 (1.30-1.60) | 1.82 (1.64-2.02) | 2.10 (1.89-2.33) | 2.50 (2.23-2.77) | 2.82 (2.50-3.13) | 3.16 (2.77-3.51) | 3.50 (3.04-3.91) | 3.99 (3.40-4.48) | 4.37 (3.67-4.95) |
| 2-hr | 1.40 (1.26-1.56) | 1.69 (1.52-1.89) | 2.14 (1.92-2.38) | 2.49 (2.23-2.77) | 3.00 (2.66-3.33) | 3.42 (3.00-3.80) | 3.86 (3.35-4.30) | 4.33 (3.70-4.82) | 5.00 (4.19-5.61) | 5.55 (4.57-6.28) |
| 3-hr | 1.48 (1.34-1.66) | 1.80 (1.62-2.00) | 2.27 (2.05-2.53) | 2.66 (2.39-2.96) | 3.22 (2.85-3.56) | 3.68 (3.24-4.08) | 4.18 (3.63-4.64) | 4.71 (4.03-5.26) | 5.48 (4.58-6.17) | 6.11 (5.02-6.93) |
| 6-hr | 1.76 (1.59-1.96) | 2.13 (1.93-2.38) | 2.70 (2.44-3.01) | 3.17 (2.84-3.52) | 3.85 (3.41-4.27) | 4.42 (3.87-4.90) | 5.04 (4.35-5.59) | 5.70 (4.84-6.35) | 6.68 (5.53-7.48) | 7.48 (6.06-8.44) |
| 12-hr | 2.09 (1.89-2.32) | 2.52 (2.28-2.79) | 3.14 (2.84-3.48) | 3.65 (3.29-4.04) | 4.37 (3.90-4.84) | 4.97 (4.40-5.50) | 5.61 (4.91-6.20) | 6.28 (5.42-6.98) | 7.24 (6.11-8.11) | 8.02 (6.65-9.04) |
| 24-hr | 2.48 (2.30-2.69) | 2.98 (2.76-3.23) | 3.67 (3.40-3.98) | 4.22 (3.89-4.57) | 4.96 (4.56-5.37) | 5.57 (5.09-6.02) | 6.18 (5.62-6.69) | 6.82 (6.16-7.40) | 7.71 (6.89-8.39) | 8.41 (7.45-9.18) |
| 2-day | 2.89 (2.69-3.12) | 3.47 (3.22-3.74) | 4.24 (3.94-4.58) | 4.85 (4.49-5.23) | 5.68 (5.24-6.11) | 6.33 (5.81-6.83) | 7.00 (6.40-7.56) | 7.69 (6.99-8.32) | 8.63 (7.76-9.38) | 9.37 (8.35-10.2) |
| 3-day | 3.09 (2.90-3.31) | 3.70 (3.46-3.96) | 4.50 (4.21-4.82) | 5.12 (4.78-5.48) | 5.97 (5.56-6.39) | 6.64 (6.16-7.11) | 7.33 (6.77-7.85) | 8.03 (7.38-8.61) | 8.98 (8.18-9.66) | 9.72 (8.80-10.5) |
| 4-day | 3.30 (3.10-3.50) | 3.93 (3.70-4.19) | 4.75 (4.47-5.06) | 5.39 (5.07-5.74) | 6.27 (5.88-6.67) | 6.96 (6.50-7.40) | 7.65 (7.14-8.14) | 8.36 (7.76-8.91) | 9.33 (8.61-9.95) | 10.1 (9.26-10.8) |
| 7-day | 3.89 (3.66-4.14) | 4.62 (4.35-4.93) | 5.55 (5.22-5.91) | 6.28 (5.90-6.69) | 7.28 (6.81-7.73) | 8.06 (7.52-8.56) | 8.85 (8.24-9.41) | 9.66 (8.96-10.3) | 10.7 (9.93-11.4) | 11.6 (10.7-12.4) |
| 10-day | 4.43 (4.17-4.72) | 5.25 (4.95-5.60) | 6.28 (5.91-6.69) | 7.08 (6.66-7.55) | 8.17 (7.67-8.70) | 9.03 (8.46-9.62) | 9.90 (9.24-10.5) | 10.8 (10.0-11.5) | 12.0 (11.1-12.8) | 12.9 (11.9-13.8) |
| 20-day | 6.05 (5.72-6.42) | 7.15 (6.75-7.58) | 8.42 (7.94-8.93) | 9.41 (8.87-9.98) | 10.7 (10.1-11.4) | 11.8 (11.0-12.5) | 12.8 (11.9-13.5) | 13.8 (12.9-14.6) | 15.1 (14.0-16.0) | 16.1 (14.9-17.1) |
| 30-day | 7.46 (7.06-7.89) | 8.78 (8.31-9.29) | 10.2 (9.65-10.8) | 11.3 (10.7-12.0) | 12.8 (12.0-13.5) | 13.8 (13.0-14.6) | 14.9 (14.0-15.8) | 16.0 (14.9-16.9) | 17.3 (16.1-18.3) | 18.3 (17.0-19.4) |
| 45-day | 9.43 (8.95-9.95) | 11.1 (10.5-11.7) | 12.7 (12.1-13.4) | 14.0 (13.3-14.8) | 15.6 (14.8-16.5) | 16.9 (15.9-17.8) | 18.1 (17.0-19.0) | 19.2 (18.0-20.2) | 20.6 (19.3-21.8) | 21.7 (20.3-22.9) |
| 60-day | 11.3 (10.7-11.9) | 13.2 (12.6-13.9) | 15.1 (14.4-15.9) | 16.6 (15.7-17.4) | 18.4 (17.5-19.4) | 19.8 (18.7-20.8) | 21.1 (19.9-22.2) | 22.3 (21.1-23.5) | 23.9 (22.5-25.2) | 25.0 (23.5-26.4) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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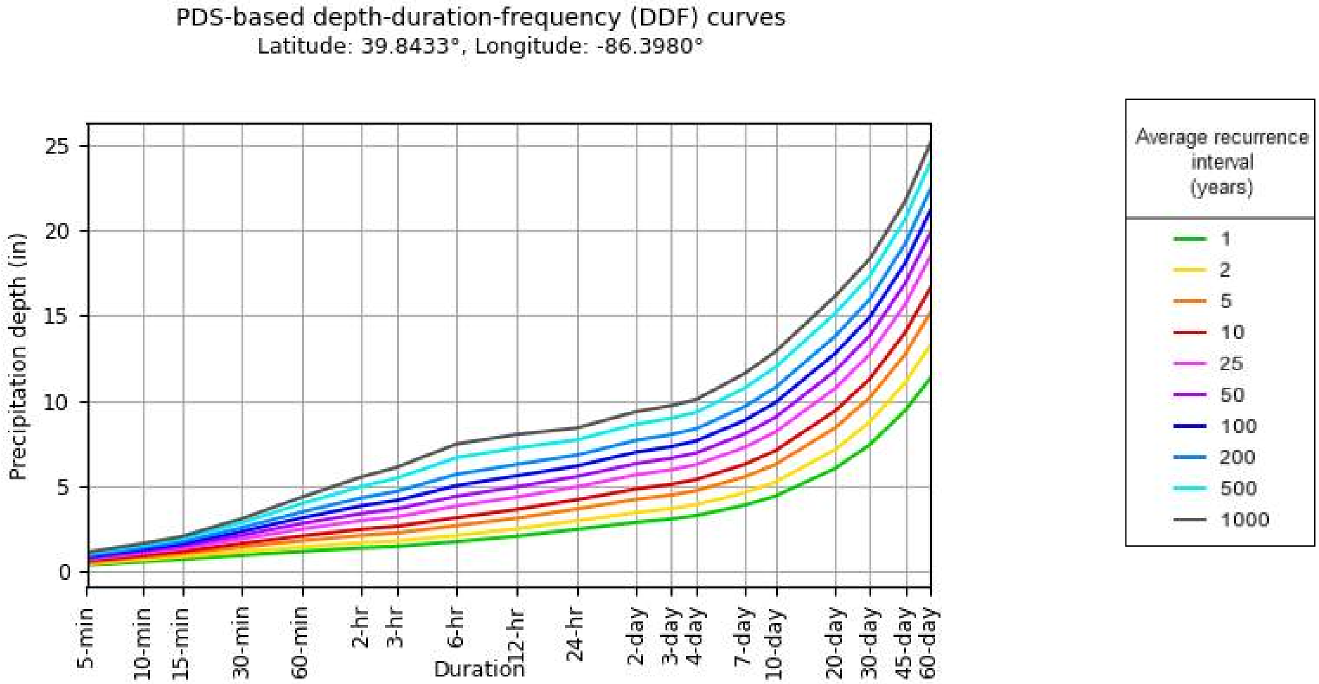
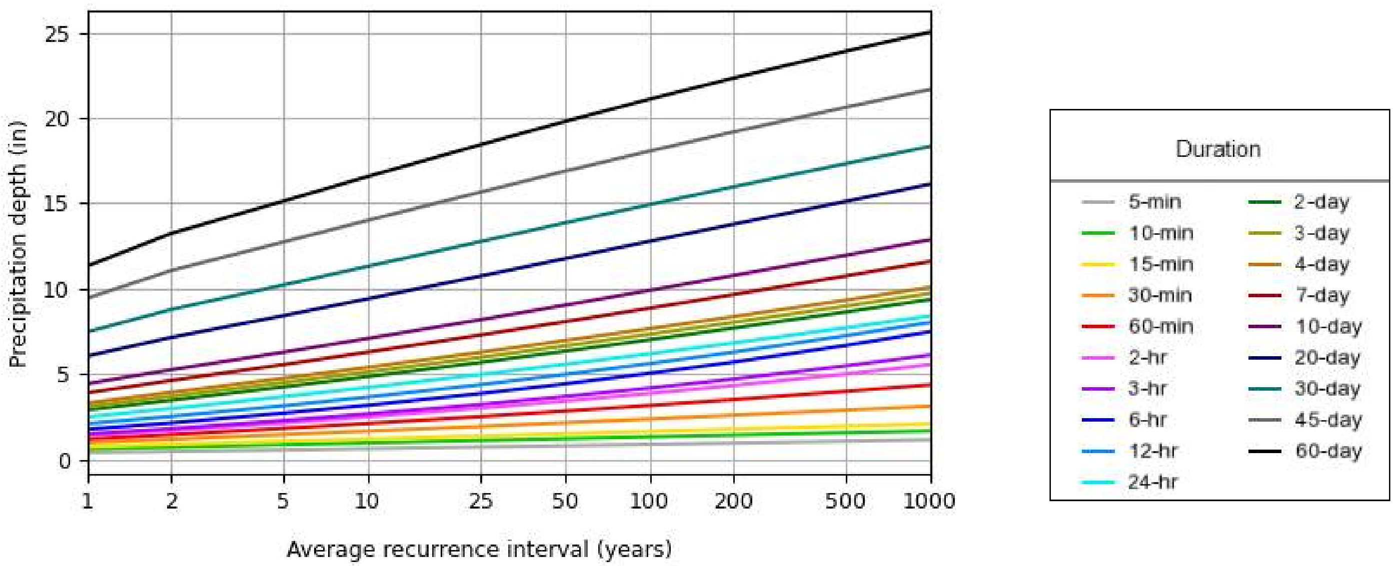
# PF graphical




NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Thu Jul 24 13:46:17 2025

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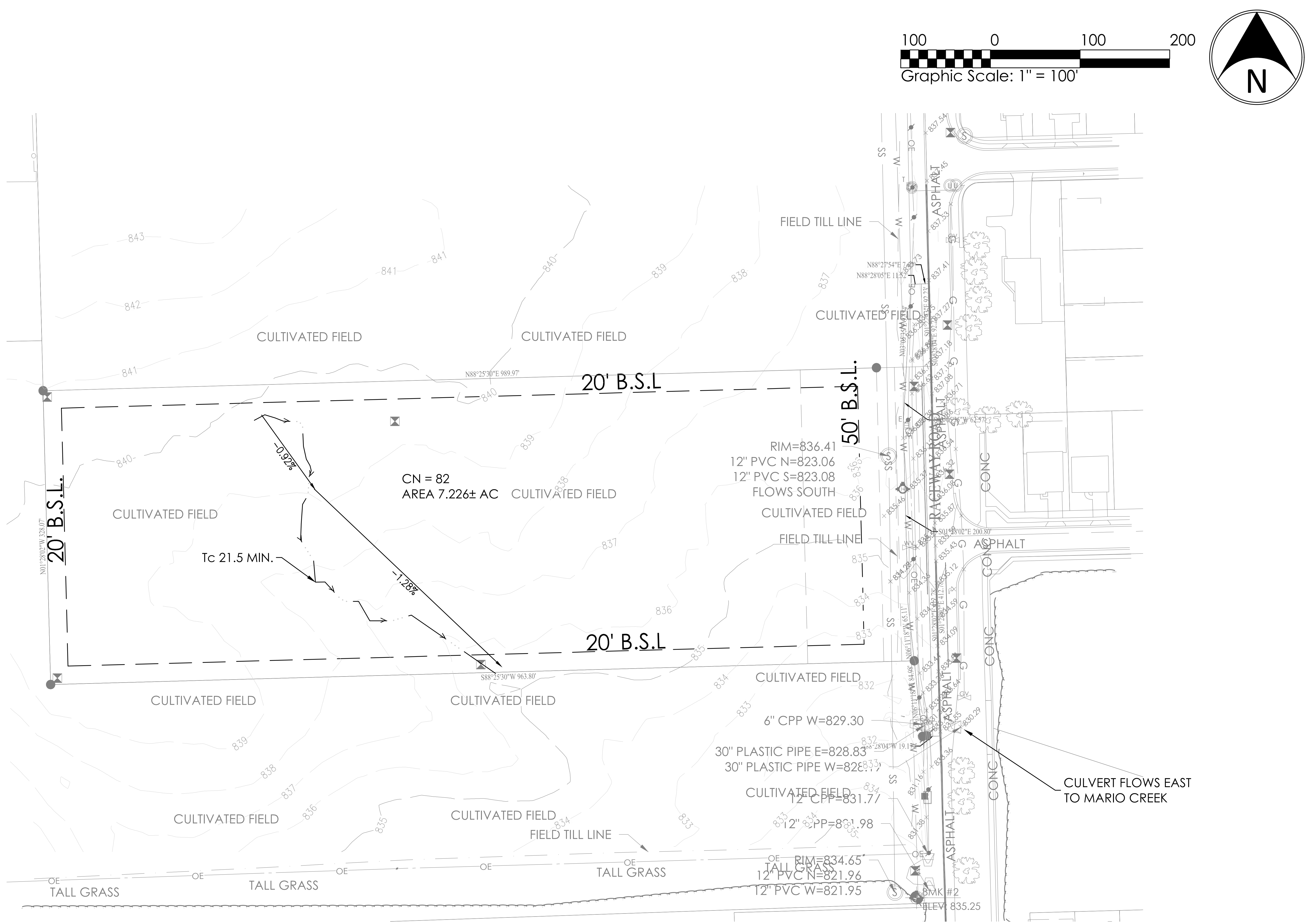
## Maps & aerials

**Small scale terrain**

# APPENDIX E

# EXISTING CONDITIONS PLAN




CIVIL ENGINEERS
LAND SURVEYORS
DEVELOPMENT CONSULTANTS
GEOTECHNICAL
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CONSTRUCTION MAT. TESTING

TERRA SITE DEVELOPMENT
16102 Spring Mill Road Westfield, Indiana 46074
P: 317.399.1216 F: 317.399.1216
www.TERRAsitedev.com

# COMPASS & KEY INDUSTRIAL PARK

2616 N RACEWAY RD, BROWNSBURG, IN 46234

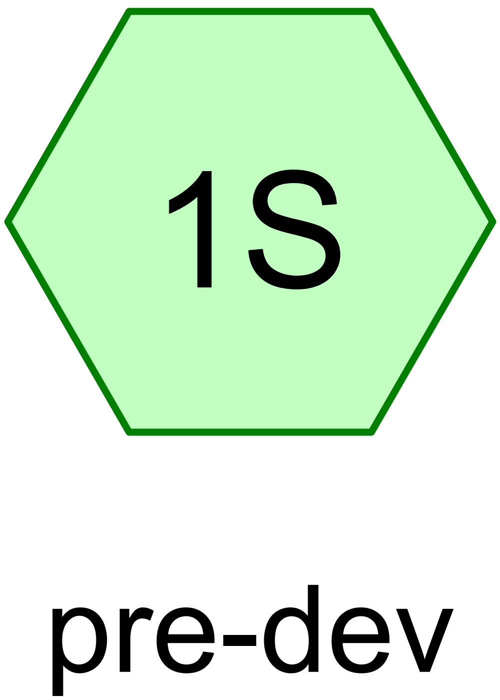
COMPASS AND KEY LLC
9129 LOG RUN DR S, INDIANAPOLIS, IN 46234

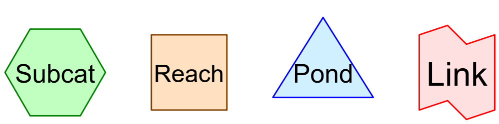
## EXISTING CONDITIONS PLAN

| DATE: 01-07-26 | CHECK: GEM |
|---|---|
| PROJECT NO. 2504018 | DRAWN: KLS |
| SHEET NO. C350 | |

# APPENDIX F

# EXISTING CONDITIONS CALCULATIONS




**Routing Diagram for CompassKeyIndustrial-pre**
Prepared by TERRA Site Development, Printed 12/29/2025

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C (1S) |
| **7.230** | **82** | **TOTAL AREA** |

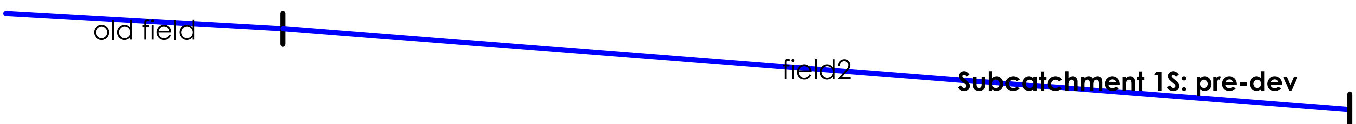
## Summary for Subcatchment 1S: pre-dev

Runoff = 2.06 cfs @ 12.17 hrs, Volume= 0.192 af, Depth= 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 01h002y Rainfall=1.45"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



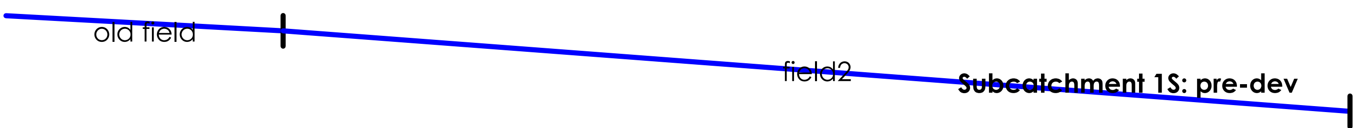
## Summary for Subcatchment 1S: pre-dev

Runoff = 5.25 cfs @ 12.16 hrs, Volume= 0.431 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 01h010y Rainfall=2.10"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



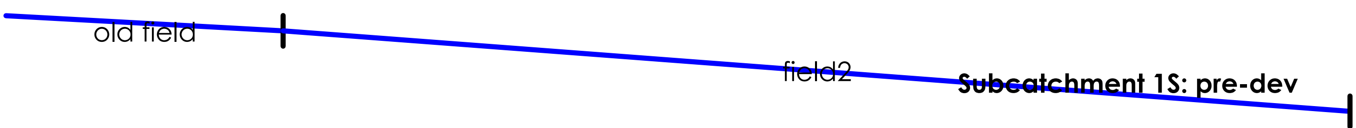
## Summary for Subcatchment 1S: pre-dev

Runoff = 11.51 cfs @ 12.15 hrs, Volume= 0.907 af, Depth= 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 01h100y Rainfall=3.16"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



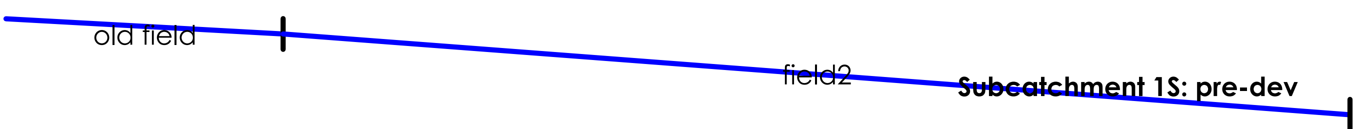
## Summary for Subcatchment 1S: pre-dev

Runoff = 3.69 cfs @ 12.16 hrs, Volume= 0.314 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 03h002y Rainfall=1.80"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



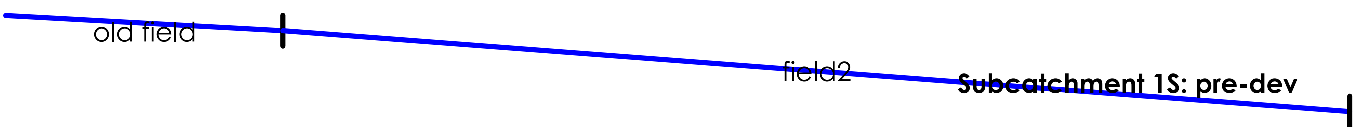
## Summary for Subcatchment 1S: pre-dev

Runoff = 8.44 cfs @ 12.15 hrs, Volume= 0.673 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 03h010y Rainfall=2.66"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



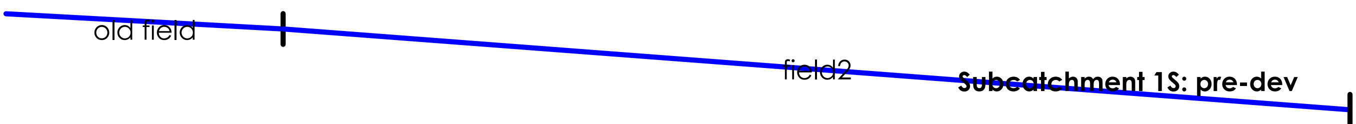
## Summary for Subcatchment 1S: pre-dev

Runoff = 18.12 cfs @ 12.15 hrs, Volume= 1.420 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 03h100y Rainfall=4.18"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



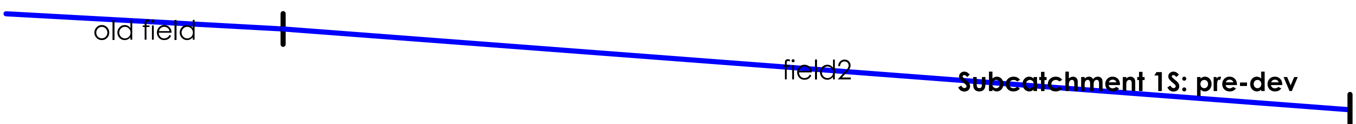
## Summary for Subcatchment 1S: pre-dev

Runoff = 5.41 cfs @ 12.16 hrs, Volume= 0.443 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 06h002y Rainfall=2.13"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



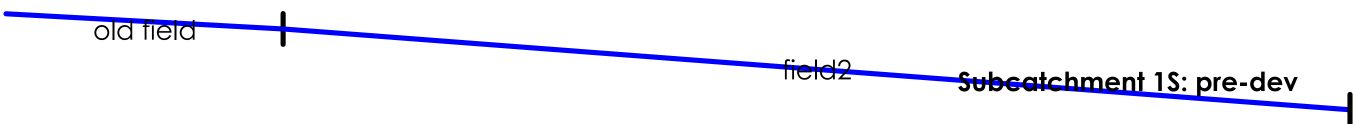
## Summary for Subcatchment 1S: pre-dev

Runoff = 11.57 cfs @ 12.15 hrs, Volume= 0.912 af, Depth= 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 06h010y Rainfall=3.17"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field** |
| | | | | | Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2** |
| | | | | | Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



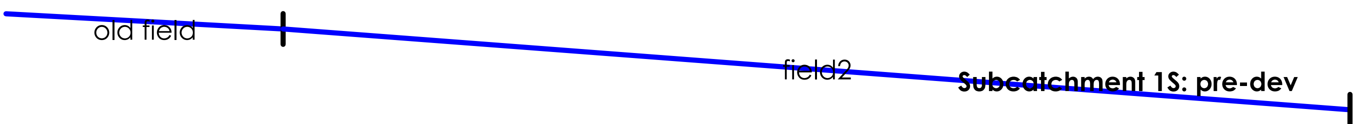
## Summary for Subcatchment 1S: pre-dev

Runoff = 23.89 cfs @ 12.14 hrs, Volume= 1.877 af, Depth= 3.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 06h100y Rainfall=5.04"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



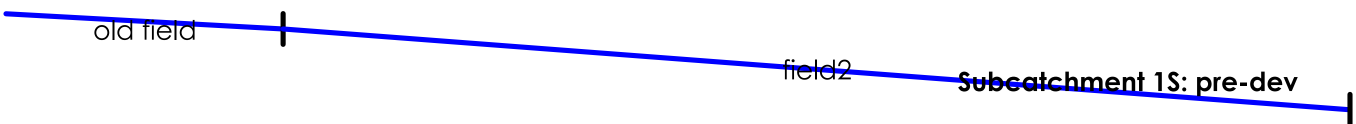
## Summary for Subcatchment 1S: pre-dev

Runoff = 7.62 cfs @ 12.15 hrs, Volume= 0.610 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 12h002y Rainfall=2.52"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



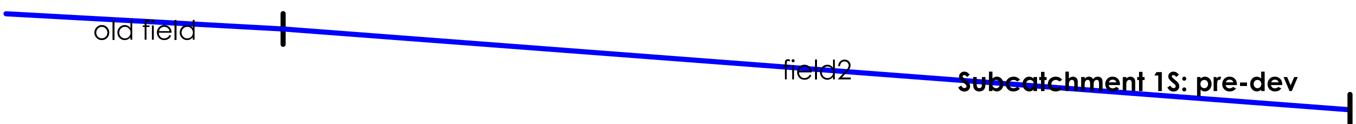
## Summary for Subcatchment 1S: pre-dev

Runoff = 14.64 cfs @ 12.15 hrs, Volume= 1.149 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 12h010y Rainfall=3.65"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



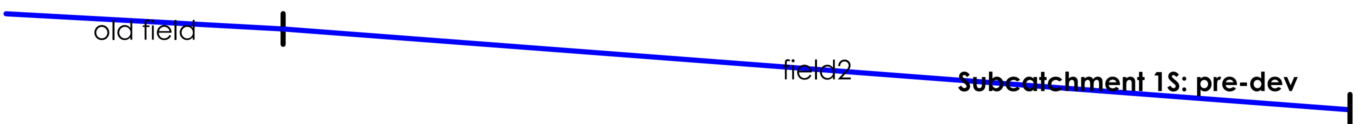
## Summary for Subcatchment 1S: pre-dev

Runoff = 27.77 cfs @ 12.14 hrs, Volume= 2.187 af, Depth= 3.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 12h100y Rainfall=5.61"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field** Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2** Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



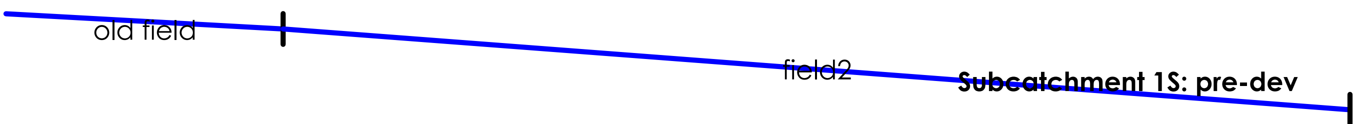
## Summary for Subcatchment 1S: pre-dev

Runoff = 10.39 cfs @ 12.15 hrs, Volume= 0.821 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 24h002y Rainfall=2.98"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



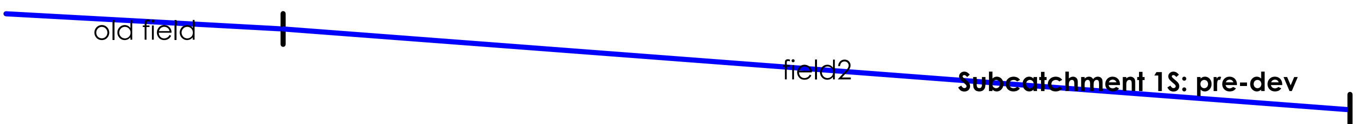
## Summary for Subcatchment 1S: pre-dev

Runoff = 18.38 cfs @ 12.14 hrs, Volume= 1.441 af, Depth= 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 24h010y Rainfall=4.22"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



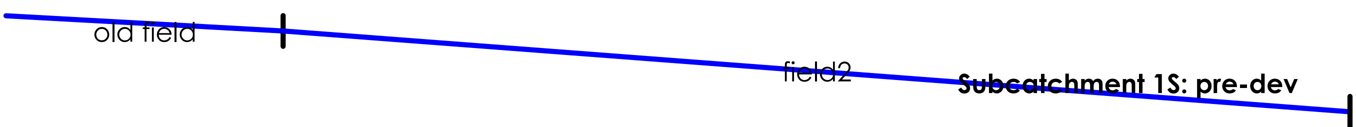
## Summary for Subcatchment 1S: pre-dev

Runoff = 31.66 cfs @ 12.14 hrs, Volume= 2.502 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 24h100y Rainfall=6.18"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



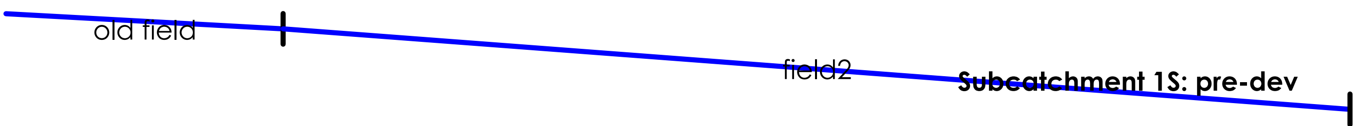
## Summary for Subcatchment 1S: pre-dev

Runoff = 1.02 cfs @ 12.19 hrs, Volume= 0.113 af, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 030m002y Rainfall=1.18"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



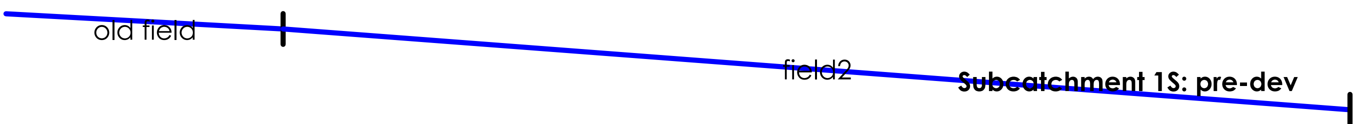
## Summary for Subcatchment 1S: pre-dev

Runoff = 2.96 cfs @ 12.17 hrs, Volume= 0.259 af, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 030m010y Rainfall=1.65"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |



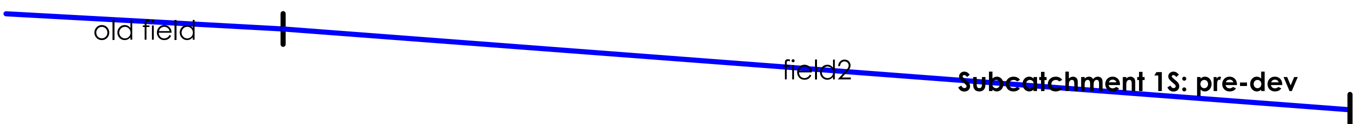
## Summary for Subcatchment 1S: pre-dev

Runoff = 6.69 cfs @ 12.16 hrs, Volume= 0.540 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 030m100y Rainfall=2.36"

| Area (ac) | CN | Description |
|---|---|---|
| 7.230 | 82 | Row crops, SR + CR, Good, HSG C |
| 7.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.2 | 100 | 0.0093 | 0.11 | | **Sheet Flow, old field**<br>Cultivated: Residue>20% n= 0.170 P2= 2.98" |
| 6.3 | 385 | 0.0128 | 1.02 | | **Shallow Concentrated Flow, field2**<br>Cultivated Straight Rows Kv= 9.0 fps |
| 21.5 | 485 | Total | | | |

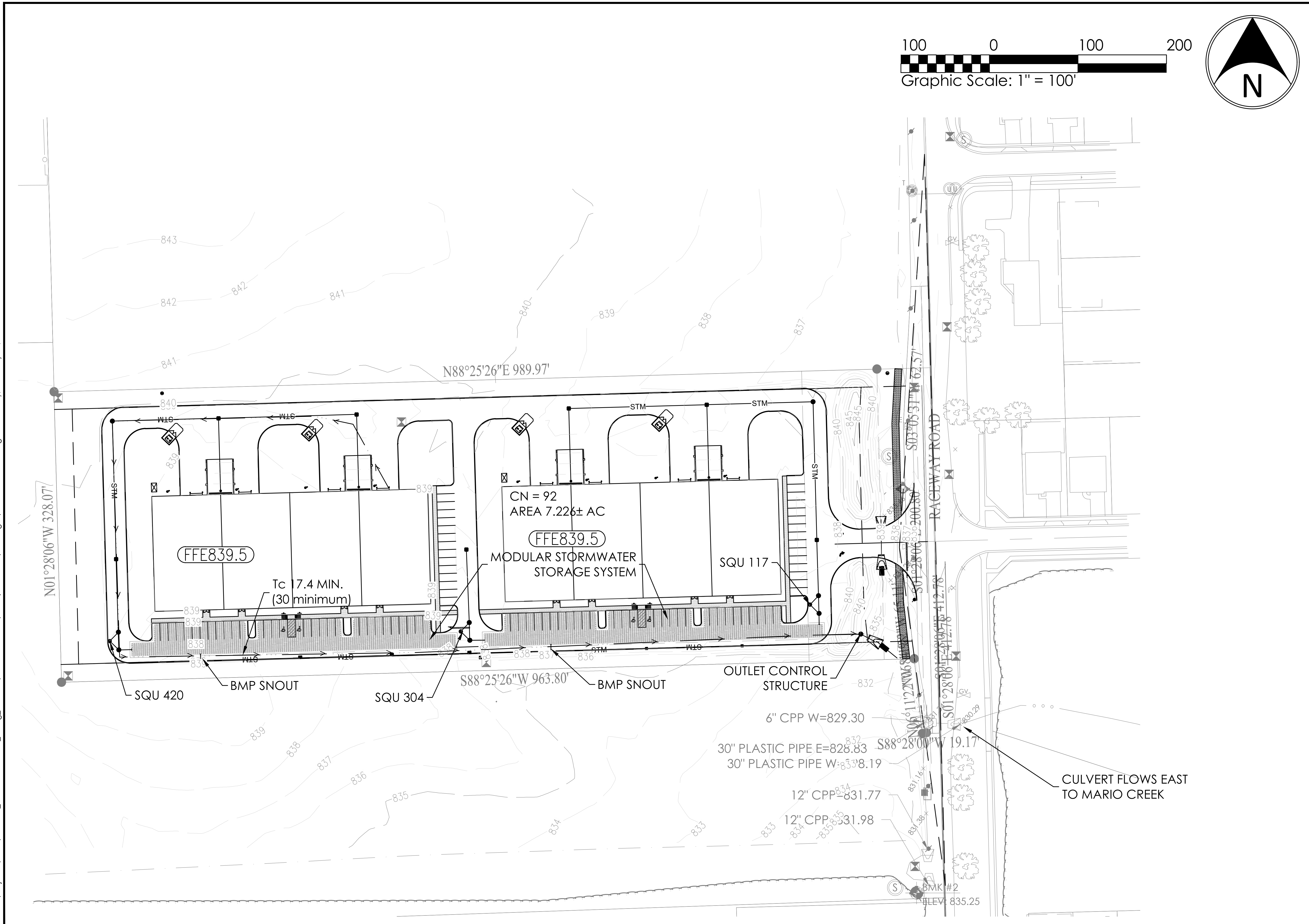


## Events for Subcatchment 1S: pre-dev

| Event | Rainfall (inches) | Runoff (cfs) | Volume (acre-feet) | Depth (inches) |
|---|---|---|---|---|
| 01h002y | 1.45 | 2.06 | 0.192 | 0.32 |
| 01h010y | 2.10 | 5.25 | 0.431 | 0.72 |
| 01h100y | 3.16 | 11.51 | 0.907 | 1.51 |
| 03h002y | 1.80 | 3.69 | 0.314 | 0.52 |
| 03h010y | 2.66 | 8.44 | 0.673 | 1.12 |
| 03h100y | 4.18 | 18.12 | 1.420 | 2.36 |
| 06h002y | 2.13 | 5.41 | 0.443 | 0.74 |
| 06h010y | 3.17 | 11.57 | 0.912 | 1.51 |
| 06h100y | 5.04 | 23.89 | 1.877 | 3.11 |
| 12h002y | 2.52 | 7.62 | 0.610 | 1.01 |
| 12h010y | 3.65 | 14.64 | 1.149 | 1.91 |
| 12h100y | 5.61 | 27.77 | 2.187 | 3.63 |
| 24h002y | 2.98 | 10.39 | 0.821 | 1.36 |
| 24h010y | 4.22 | 18.38 | 1.441 | 2.39 |
| 24h100y | **6.18** | **31.66** | **2.502** | **4.15** |
| 030m002y | 1.18 | 1.02 | 0.113 | 0.19 |
| 030m010y | 1.65 | 2.96 | 0.259 | 0.43 |
| 030m100y | 2.36 | 6.69 | 0.540 | 0.90 |

# APPENDIX G

# DEVELOPED CONDITIONS PLAN




Y:\Projects\2025\2504018_Macias Industrial_Bburg_Macias\05 Civil Macias\CAD\02-sheets\drainage\T2504018-C351.dwg Saturday, February 21, 2026 7:51:43 AM

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www.TERRAsitedev.com

# COMPASS & KEY INDUSTRIAL PARK
2616 N RACEWAY RD, BROWNSBURG, IN 46234

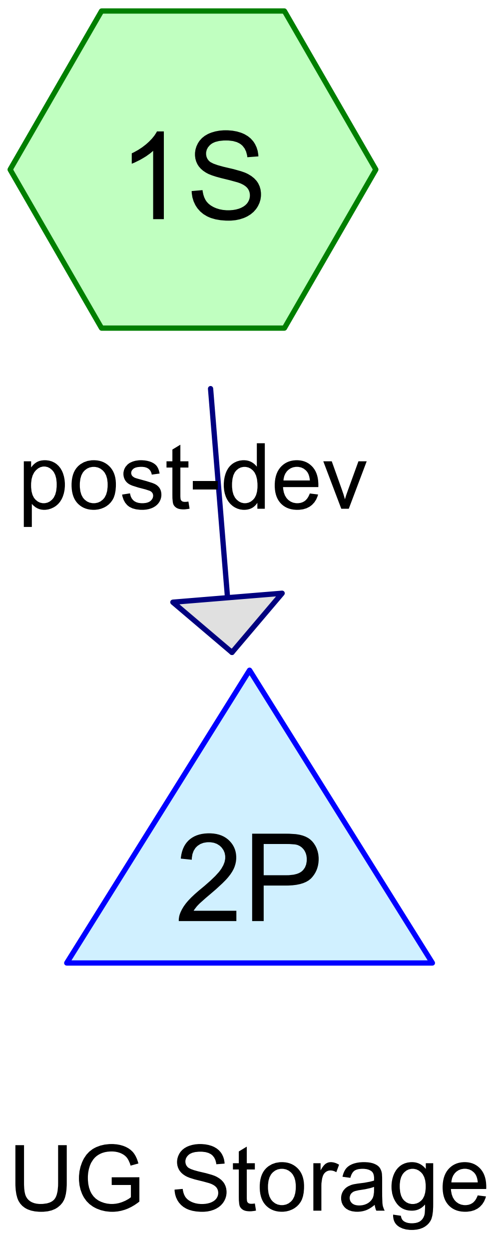
COMPASS AND KEY LLC
9129 LOG RUN DR S, INDIANAPOLIS, IN 46234

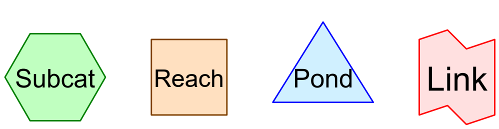
## DEVELOPED CONDITIONS PLAN

| DATE: 02-19-26 | CHECK: KLS |
|---|---|
| PROJECT NO. 2504018 | DRAWN: KLS |
| SHEET NO. C351 | |

# APPENDIX H

# DEVELOPED CONDITIONS CALCULATIONS




**Routing Diagram for CompassKeyIndustrial-post_rtank**
Prepared by TERRA Site Development, Printed 2/17/2026
HydroCAD® 10.20-7a s/n 09102 © 2025 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 2.564 | 80 | >75% Grass cover, Good, HSG D (1S) |
| 4.662 | 98 | Unconnected roofs, HSG C (1S) |
| **7.226** | **92** | **TOTAL AREA** |

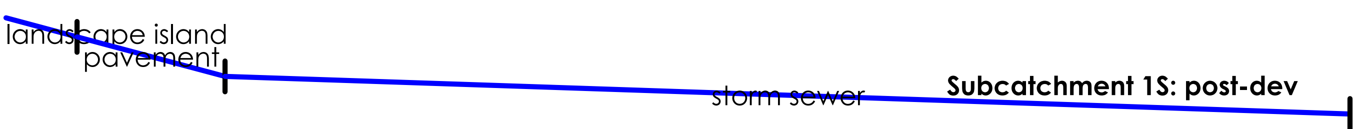
## Summary for Subcatchment 1S: post-dev

Runoff = 13.29 cfs @ 12.24 hrs, Volume= 1.290 af, Depth= 2.14"
Routed to Pond 2P : UG Storage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
Type II 24-hr 24h002y Rainfall=2.98"

| Area (ac) | CN | Description |
|---|---|---|
| 2.564 | 80 | >75% Grass cover, Good, HSG D |
| 4.662 | 98 | Unconnected roofs, HSG C |
| 7.226 | 92 | Weighted Average |
| 2.564 | | 35.48% Pervious Area |
| 4.662 | | 64.52% Impervious Area |
| 4.662 | | 100.00% Unconnected |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.8 | 60 | 0.0200 | 0.10 | | **Sheet Flow, landscape island**<br>Grass: Dense n= 0.240 P2= 2.98" |
| 1.5 | 125 | 0.0200 | 1.39 | | **Sheet Flow, pavement**<br>Smooth surfaces n= 0.011 P2= 2.98" |
| 6.1 | 950 | 0.0025 | 2.58 | 4.55 | **Pipe Channel, storm sewer**<br>18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'<br>n= 0.015 Concrete sewer w/manholes & inlets |
| 12.6 | | | | | **Direct Entry, min allowable** |
| 30.0 | 1,135 | Total | | | |



## Summary for Pond 2P: UG Storage

Inflow Area = 7.226 ac, 64.52% Impervious, Inflow Depth = 2.14" for 24h002y event
Inflow = 13.29 cfs @ 12.24 hrs, Volume= 1.290 af
Outflow = 1.05 cfs @ 13.79 hrs, Volume= 1.197 af, Atten= 92%, Lag= 93.1 min
Primary = 1.05 cfs @ 13.79 hrs, Volume= 1.197 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
Peak Elev= 833.98' @ 13.79 hrs Surf.Area= 0.600 ac Storage= 0.783 af

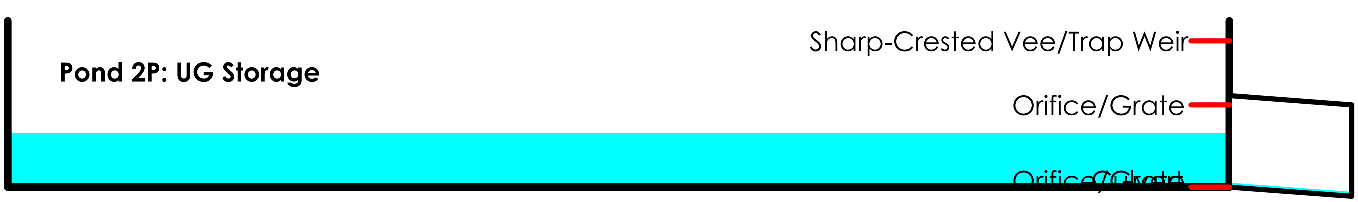
Plug-Flow detention time= 429.5 min calculated for 1.197 af (93% of inflow)
Center-of-Mass det. time= 390.0 min ( 1,209.5 - 819.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 832.50' | 0.182 af | **36.81'W x 379.33'L x 4.54'H Field A**<br>1.456 af Overall - 1.002 af Embedded = 0.455 af x 40.0% Voids |
| #2A | 832.50' | 0.952 af | **Ferguson R-Tank HD 2.5** x 4000 Inside #1<br>Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf<br>Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf<br>4000 Chambers in 25 Rows |
| #3B | 832.50' | 0.162 af | **34.18'W x 355.87'L x 4.54'H Field B**<br>1.269 af Overall - 0.864 af Embedded = 0.405 af x 40.0% Voids |
| #4B | 832.50' | 0.821 af | **Ferguson R-Tank HD 2.5** x 3450 Inside #3<br>Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf<br>Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf<br>3450 Chambers in 23 Rows |
| | | 2.116 af | Total Available Storage |

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 832.50' | **30.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500<br>Inlet / Outlet Invert= 832.50' / 832.25' S= 0.0066 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 4.91 sf |
| #2 | Device 1 | 832.50' | **6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 834.75' | **6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 1 | 836.50' | **5.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28) |

**Primary OutFlow** Max=1.05 cfs @ 13.79 hrs HW=833.98' (Free Discharge)
└**1=Culvert** (Passes 1.05 cfs of 9.82 cfs potential flow)
 ├**2=Orifice/Grate** (Orifice Controls 1.05 cfs @ 5.34 fps)
 ├**3=Orifice/Grate** ( Controls 0.00 cfs)
 └**4=Sharp-Crested Vee/Trap Weir** ( Controls 0.00 cfs)



## Pond 2P: UG Storage - Chamber Wizard Field A

**Chamber Model = Ferguson R-Tank HD 2.5 (Ferguson R-Tank HD)**
Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf
Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf

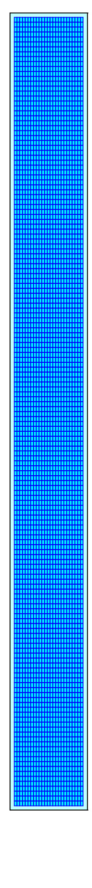
160 Chambers/Row x 2.35' Long = 375.33' Row Length +24.0" End Stone x 2 = 379.33' Base Length
25 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 36.81' Base Width
42.5" Chamber Height + 12.0" Stone Cover = 4.54' Field Height

4,000 Chambers x 10.4 cf = 41,450.4 cf Chamber Storage
4,000 Chambers x 10.9 cf = 43,632.0 cf Displacement

63,435.7 cf Field - 43,632.0 cf Chambers = 19,803.8 cf Stone x 40.0% Voids = 7,921.5 cf Stone Storage

Chamber Storage + Stone Storage = 49,371.9 cf = 1.133 af
Overall Storage Efficiency = 77.8%
Overall System Size = 379.33' x 36.81' x 4.54'

4,000 Chambers
2,349.5 cy Field
733.5 cy Stone



## Pond 2P: UG Storage - Chamber Wizard Field B

**Chamber Model = Ferguson R-Tank HD 2.5 (Ferguson R-Tank HD)**
Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf
Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf

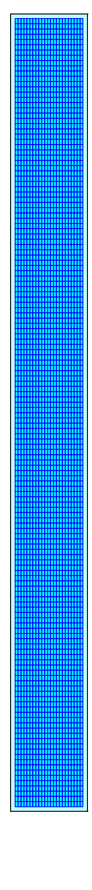
150 Chambers/Row x 2.35' Long = 351.87' Row Length +24.0" End Stone x 2 = 355.87' Base Length
23 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 34.18' Base Width
42.5" Chamber Height + 12.0" Stone Cover = 4.54' Field Height

3,450 Chambers x 10.4 cf = 35,751.0 cf Chamber Storage
3,450 Chambers x 10.9 cf = 37,632.6 cf Displacement

55,269.2 cf Field - 37,632.6 cf Chambers = 17,636.6 cf Stone x 40.0% Voids = 7,054.6 cf Stone Storage

Chamber Storage + Stone Storage = 42,805.6 cf = 0.983 af
Overall Storage Efficiency = 77.4%
Overall System Size = 355.87' x 34.18' x 4.54'

3,450 Chambers
2,047.0 cy Field
653.2 cy Stone



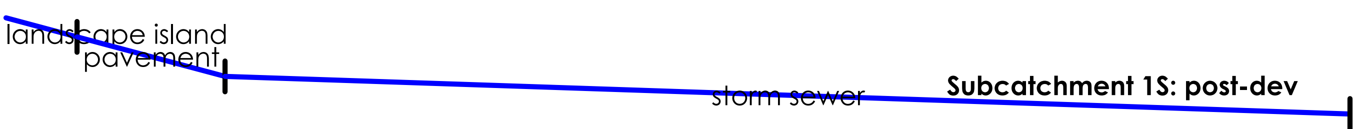
## Summary for Subcatchment 1S: post-dev

Runoff = 20.31 cfs @ 12.23 hrs, Volume= 2.005 af, Depth= 3.33"
Routed to Pond 2P : UG Storage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
Type II 24-hr 24h010y Rainfall=4.22"

| Area (ac) | CN | Description |
|---|---|---|
| 2.564 | 80 | >75% Grass cover, Good, HSG D |
| 4.662 | 98 | Unconnected roofs, HSG C |
| 7.226 | 92 | Weighted Average |
| 2.564 | | 35.48% Pervious Area |
| 4.662 | | 64.52% Impervious Area |
| 4.662 | | 100.00% Unconnected |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.8 | 60 | 0.0200 | 0.10 | | **Sheet Flow, landscape island**<br>Grass: Dense n= 0.240 P2= 2.98" |
| 1.5 | 125 | 0.0200 | 1.39 | | **Sheet Flow, pavement**<br>Smooth surfaces n= 0.011 P2= 2.98" |
| 6.1 | 950 | 0.0025 | 2.58 | 4.55 | **Pipe Channel, storm sewer**<br>18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'<br>n= 0.015 Concrete sewer w/manholes & inlets |
| 12.6 | | | | | **Direct Entry, min allowable** |
| 30.0 | 1,135 | Total | | | |



## Summary for Pond 2P: UG Storage

Inflow Area = 7.226 ac, 64.52% Impervious, Inflow Depth = 3.33" for 24h010y event
Inflow = 20.31 cfs @ 12.23 hrs, Volume= 2.005 af
Outflow = 1.42 cfs @ 13.95 hrs, Volume= 1.857 af, Atten= 93%, Lag= 102.7 min
Primary = 1.42 cfs @ 13.95 hrs, Volume= 1.857 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
Peak Elev= 834.87' @ 13.95 hrs Surf.Area= 0.600 ac Storage= 1.253 af

Plug-Flow detention time= 491.2 min calculated for 1.855 af (93% of inflow)
Center-of-Mass det. time= 451.2 min ( 1,258.4 - 807.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 832.50' | 0.182 af | **36.81'W x 379.33'L x 4.54'H Field A** |
| | | | 1.456 af Overall - 1.002 af Embedded = 0.455 af x 40.0% Voids |
| #2A | 832.50' | 0.952 af | **Ferguson R-Tank HD 2.5** x 4000 Inside #1 |
| | | | Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf |
| | | | Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf |
| | | | 4000 Chambers in 25 Rows |
| #3B | 832.50' | 0.162 af | **34.18'W x 355.87'L x 4.54'H Field B** |
| | | | 1.269 af Overall - 0.864 af Embedded = 0.405 af x 40.0% Voids |
| #4B | 832.50' | 0.821 af | **Ferguson R-Tank HD 2.5** x 3450 Inside #3 |
| | | | Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf |
| | | | Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf |
| | | | 3450 Chambers in 23 Rows |
| | | 2.116 af | Total Available Storage |

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 832.50' | **30.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500 |
| | | | Inlet / Outlet Invert= 832.50' / 832.25' S= 0.0066 '/' Cc= 0.900 |
| | | | n= 0.012 Concrete pipe, finished, Flow Area= 4.91 sf |
| #2 | Device 1 | 832.50' | **6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 834.75' | **6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 1 | 836.50' | **5.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28) |

**Primary OutFlow** Max=1.42 cfs @ 13.95 hrs HW=834.87' (Free Discharge)
└**1=Culvert** (Passes 1.42 cfs of 20.82 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.38 cfs @ 7.01 fps)
  ├**3=Orifice/Grate** (Orifice Controls 0.04 cfs @ 1.16 fps)
  └**4=Sharp-Crested Vee/Trap Weir** ( Controls 0.00 cfs)

## Pond 2P: UG Storage - Chamber Wizard Field A

**Chamber Model = Ferguson R-Tank HD 2.5 (Ferguson R-Tank HD)**
Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf
Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf

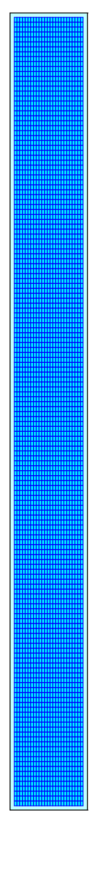
160 Chambers/Row x 2.35' Long = 375.33' Row Length +24.0" End Stone x 2 = 379.33' Base Length
25 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 36.81' Base Width
42.5" Chamber Height + 12.0" Stone Cover = 4.54' Field Height

4,000 Chambers x 10.4 cf = 41,450.4 cf Chamber Storage
4,000 Chambers x 10.9 cf = 43,632.0 cf Displacement

63,435.7 cf Field - 43,632.0 cf Chambers = 19,803.8 cf Stone x 40.0% Voids = 7,921.5 cf Stone Storage

Chamber Storage + Stone Storage = 49,371.9 cf = 1.133 af
Overall Storage Efficiency = 77.8%
Overall System Size = 379.33' x 36.81' x 4.54'

4,000 Chambers
2,349.5 cy Field
733.5 cy Stone



## Pond 2P: UG Storage - Chamber Wizard Field B

**Chamber Model = Ferguson R-Tank HD 2.5 (Ferguson R-Tank HD)**
Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf
Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf

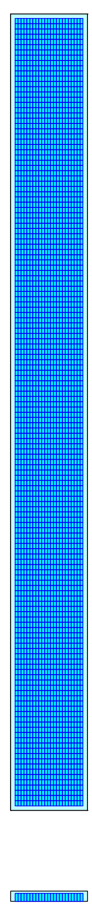
150 Chambers/Row x 2.35' Long = 351.87' Row Length +24.0" End Stone x 2 = 355.87' Base Length
23 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 34.18' Base Width
42.5" Chamber Height + 12.0" Stone Cover = 4.54' Field Height

3,450 Chambers x 10.4 cf = 35,751.0 cf Chamber Storage
3,450 Chambers x 10.9 cf = 37,632.6 cf Displacement

55,269.2 cf Field - 37,632.6 cf Chambers = 17,636.6 cf Stone x 40.0% Voids = 7,054.6 cf Stone Storage

Chamber Storage + Stone Storage = 42,805.6 cf = 0.983 af
Overall Storage Efficiency = 77.4%
Overall System Size = 355.87' x 34.18' x 4.54'

3,450 Chambers
2,047.0 cy Field
653.2 cy Stone



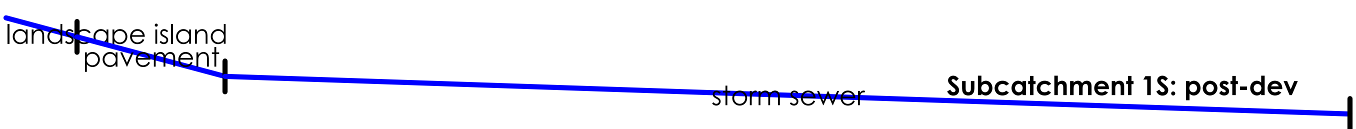
## Summary for Subcatchment 1S: post-dev

Runoff = 31.32 cfs @ 12.23 hrs, Volume= 3.159 af, Depth= 5.25"
Routed to Pond 2P : UG Storage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
Type II 24-hr 24h100y Rainfall=6.18"

| Area (ac) | CN | Description |
|---|---|---|
| 2.564 | 80 | >75% Grass cover, Good, HSG D |
| 4.662 | 98 | Unconnected roofs, HSG C |
| 7.226 | 92 | Weighted Average |
| 2.564 | | 35.48% Pervious Area |
| 4.662 | | 64.52% Impervious Area |
| 4.662 | | 100.00% Unconnected |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.8 | 60 | 0.0200 | 0.10 | | **Sheet Flow, landscape island**<br>Grass: Dense n= 0.240 P2= 2.98" |
| 1.5 | 125 | 0.0200 | 1.39 | | **Sheet Flow, pavement**<br>Smooth surfaces n= 0.011 P2= 2.98" |
| 6.1 | 950 | 0.0025 | 2.58 | 4.55 | **Pipe Channel, storm sewer**<br>18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'<br>n= 0.015 Concrete sewer w/manholes & inlets |
| 12.6 | | | | | **Direct Entry, min allowable** |
| 30.0 | 1,135 | Total | | | |



## Summary for Pond 2P: UG Storage

Inflow Area = 7.226 ac, 64.52% Impervious, Inflow Depth = 5.25" for 24h100y event
Inflow = 31.32 cfs @ 12.23 hrs, Volume= 3.159 af
Outflow = 2.81 cfs @ 13.49 hrs, Volume= 2.921 af, Atten= 91%, Lag= 75.8 min
Primary = 2.81 cfs @ 13.49 hrs, Volume= 2.921 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.04 hrs
Peak Elev= 836.22' @ 13.49 hrs Surf.Area= 0.600 ac Storage= 1.919 af

Plug-Flow detention time= 462.5 min calculated for 2.921 af (92% of inflow)
Center-of-Mass det. time= 421.0 min ( 1,216.1 - 795.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 832.50' | 0.182 af | **36.81'W x 379.33'L x 4.54'H Field A**<br>1.456 af Overall - 1.002 af Embedded = 0.455 af x 40.0% Voids |
| #2A | 832.50' | 0.952 af | **Ferguson R-Tank HD 2.5** x 4000 Inside #1<br>Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf<br>Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf<br>4000 Chambers in 25 Rows |
| #3B | 832.50' | 0.162 af | **34.18'W x 355.87'L x 4.54'H Field B**<br>1.269 af Overall - 0.864 af Embedded = 0.405 af x 40.0% Voids |
| #4B | 832.50' | 0.821 af | **Ferguson R-Tank HD 2.5** x 3450 Inside #3<br>Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf<br>Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf<br>3450 Chambers in 23 Rows |
| | | 2.116 af | Total Available Storage |

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 832.50' | **30.0" Round Culvert** L= 38.0' RCP, sq.cut end projecting, Ke= 0.500<br>Inlet / Outlet Invert= 832.50' / 832.25' S= 0.0066 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 4.91 sf |
| #2 | Device 1 | 832.50' | **6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 834.75' | **6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #4 | Device 1 | 836.50' | **5.0' long x 1.00' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28) |

**Primary OutFlow** Max=2.81 cfs @ 13.49 hrs HW=836.22' (Free Discharge)
└─**1=Culvert** (Passes 2.81 cfs of 35.64 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.76 cfs @ 8.97 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 1.05 cfs @ 5.33 fps)
  └─**4=Sharp-Crested Vee/Trap Weir** ( Controls 0.00 cfs)

## Pond 2P: UG Storage - Chamber Wizard Field A

**Chamber Model = Ferguson R-Tank HD 2.5 (Ferguson R-Tank HD)**
Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf
Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf

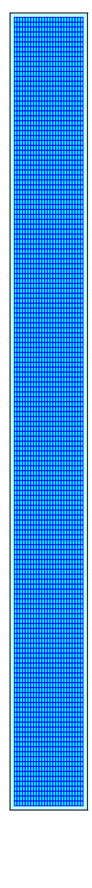
160 Chambers/Row x 2.35' Long = 375.33' Row Length +24.0" End Stone x 2 = 379.33' Base Length
25 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 36.81' Base Width
42.5" Chamber Height + 12.0" Stone Cover = 4.54' Field Height

4,000 Chambers x 10.4 cf = 41,450.4 cf Chamber Storage
4,000 Chambers x 10.9 cf = 43,632.0 cf Displacement

63,435.7 cf Field - 43,632.0 cf Chambers = 19,803.8 cf Stone x 40.0% Voids = 7,921.5 cf Stone Storage

Chamber Storage + Stone Storage = 49,371.9 cf = 1.133 af
Overall Storage Efficiency = 77.8%
Overall System Size = 379.33' x 36.81' x 4.54'

4,000 Chambers
2,349.5 cy Field
733.5 cy Stone



## Pond 2P: UG Storage - Chamber Wizard Field B

**Chamber Model = Ferguson R-Tank HD 2.5 (Ferguson R-Tank HD)**
Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf
Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf

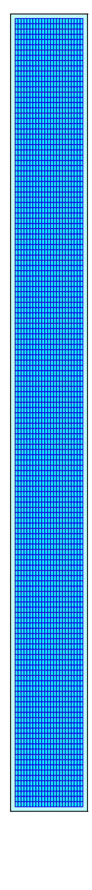
150 Chambers/Row x 2.35' Long = 351.87' Row Length +24.0" End Stone x 2 = 355.87' Base Length
23 Rows x 15.7" Wide + 24.0" Side Stone x 2 = 34.18' Base Width
42.5" Chamber Height + 12.0" Stone Cover = 4.54' Field Height

3,450 Chambers x 10.4 cf = 35,751.0 cf Chamber Storage
3,450 Chambers x 10.9 cf = 37,632.6 cf Displacement

55,269.2 cf Field - 37,632.6 cf Chambers = 17,636.6 cf Stone x 40.0% Voids = 7,054.6 cf Stone Storage

Chamber Storage + Stone Storage = 42,805.6 cf = 0.983 af
Overall Storage Efficiency = 77.4%
Overall System Size = 355.87' x 34.18' x 4.54'

3,450 Chambers
2,047.0 cy Field
653.2 cy Stone

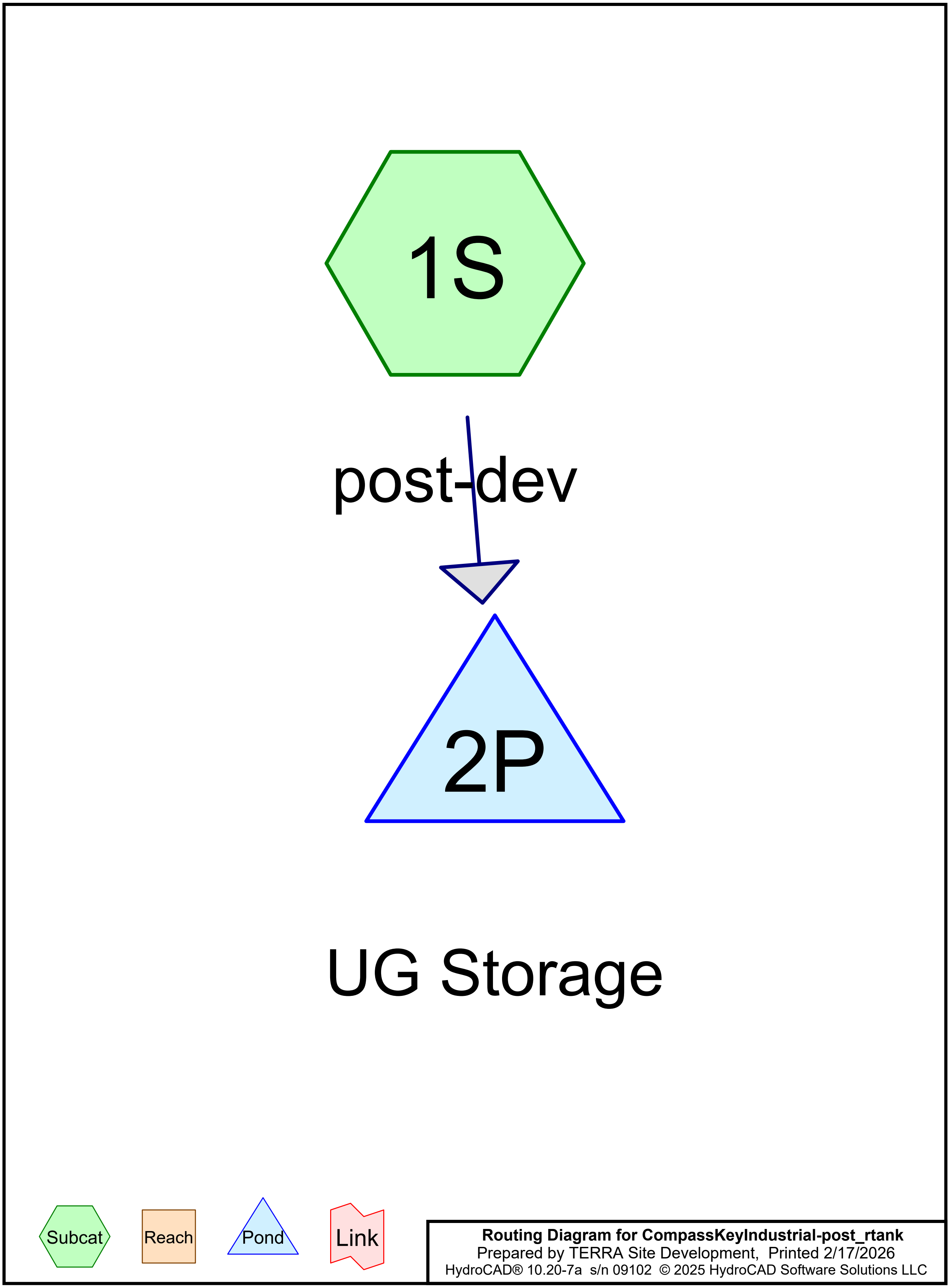


## Events for Subcatchment 1S: post-dev

| Event | Rainfall (inches) | Runoff (cfs) | Volume (acre-feet) | Depth (inches) |
|---|---|---|---|---|
| 24h002y | 2.98 | 13.29 | 1.290 | 2.14 |
| 24h010y | 4.22 | 20.31 | 2.005 | 3.33 |
| 24h100y | **6.18** | **31.32** | **3.159** | **5.25** |

## Events for Pond 2P: UG Storage

| Event | Inflow (cfs) | Primary (cfs) | Elevation (feet) | Storage (acre-feet) |
|---|---|---|---|---|
| 24h002y | 13.29 | 1.05 | 833.98 | 0.783 |
| 24h010y | 20.31 | 1.42 | 834.87 | 1.253 |
| 24h100y | **31.32** | **2.81** | **836.22** | **1.919** |




**Routing Diagram for CompassKeyIndustrial-post_rtank**
Prepared by TERRA Site Development, Printed 2/17/2026
HydroCAD® 10.20-7a s/n 09102 © 2025 HydroCAD Software Solutions LLC

## Events for Subcatchment 1S: post-dev

| Event | Rainfall (inches) | Runoff (cfs) | Volume (acre-feet) | Depth (inches) |
|---|---|---|---|---|
| 01h002y | 1.45 | 4.74 | 0.457 | 0.76 |
| 01h010y | 2.10 | 8.31 | 0.799 | 1.33 |
| 01h100y | 3.16 | 14.31 | 1.393 | 2.31 |
| 03h002y | 1.80 | 6.64 | 0.638 | 1.06 |
| 03h010y | 2.66 | 11.47 | 1.109 | 1.84 |
| 03h100y | 4.18 | 20.09 | 1.982 | 3.29 |
| 06h002y | 2.13 | 8.48 | 0.815 | 1.35 |
| 06h010y | 3.17 | 14.36 | 1.398 | 2.32 |
| 06h100y | 5.04 | 24.94 | 2.486 | 4.13 |
| 12h002y | 2.52 | 10.68 | 1.031 | 1.71 |
| 12h010y | 3.65 | 17.09 | 1.674 | 2.78 |
| 12h100y | 5.61 | 28.13 | 2.822 | 4.69 |
| 24h002y | 2.98 | 13.29 | 1.290 | 2.14 |
| 24h010y | 4.22 | 20.31 | 2.005 | 3.33 |
| 24h100y | **6.18** | **31.32** | **3.159** | **5.25** |
| 030m002y | 1.18 | 3.33 | 0.325 | 0.54 |
| 030m010y | 1.65 | 5.82 | 0.559 | 0.93 |
| 030m100y | 2.36 | 9.77 | 0.942 | 1.56 |

## Events for Pond 2P: UG Storage

| Event | Inflow (cfs) | Primary (cfs) | Elevation (feet) | Storage (acre-feet) |
|---|---|---|---|---|
| 01h002y | 4.74 | 0.46 | 832.98 | 0.256 |
| 01h010y | 8.31 | 0.75 | 833.38 | 0.466 |
| 01h100y | 14.31 | 1.10 | 834.11 | 0.851 |
| 03h002y | 6.64 | 0.63 | 833.19 | 0.365 |
| 03h010y | 11.47 | 0.95 | 833.76 | 0.665 |
| 03h100y | 20.09 | 1.39 | 834.84 | 1.239 |
| 06h002y | 8.48 | 0.76 | 833.40 | 0.476 |
| 06h010y | 14.36 | 1.10 | 834.11 | 0.854 |
| 06h100y | 24.94 | 2.11 | 835.38 | 1.524 |
| 12h002y | 10.68 | 0.90 | 833.66 | 0.614 |
| 12h010y | 17.09 | 1.24 | 834.46 | 1.036 |
| 12h100y | 28.13 | 2.45 | 835.75 | 1.720 |
| 24h002y | 13.29 | 1.05 | 833.98 | 0.783 |
| 24h010y | 20.31 | 1.42 | 834.87 | 1.253 |
| 24h100y | **31.32** | **2.81** | **836.22** | **1.919** |
| 030m002y | 3.33 | 0.29 | 832.84 | 0.182 |
| 030m010y | 5.82 | 0.56 | 833.10 | 0.316 |
| 030m100y | 9.77 | 0.85 | 833.55 | 0.557 |

# APPENDIX I
# MODULAR STORMWATER STORAGE SYSTEM DETAILS

## GENERAL NOTES & DISCLAIMERS

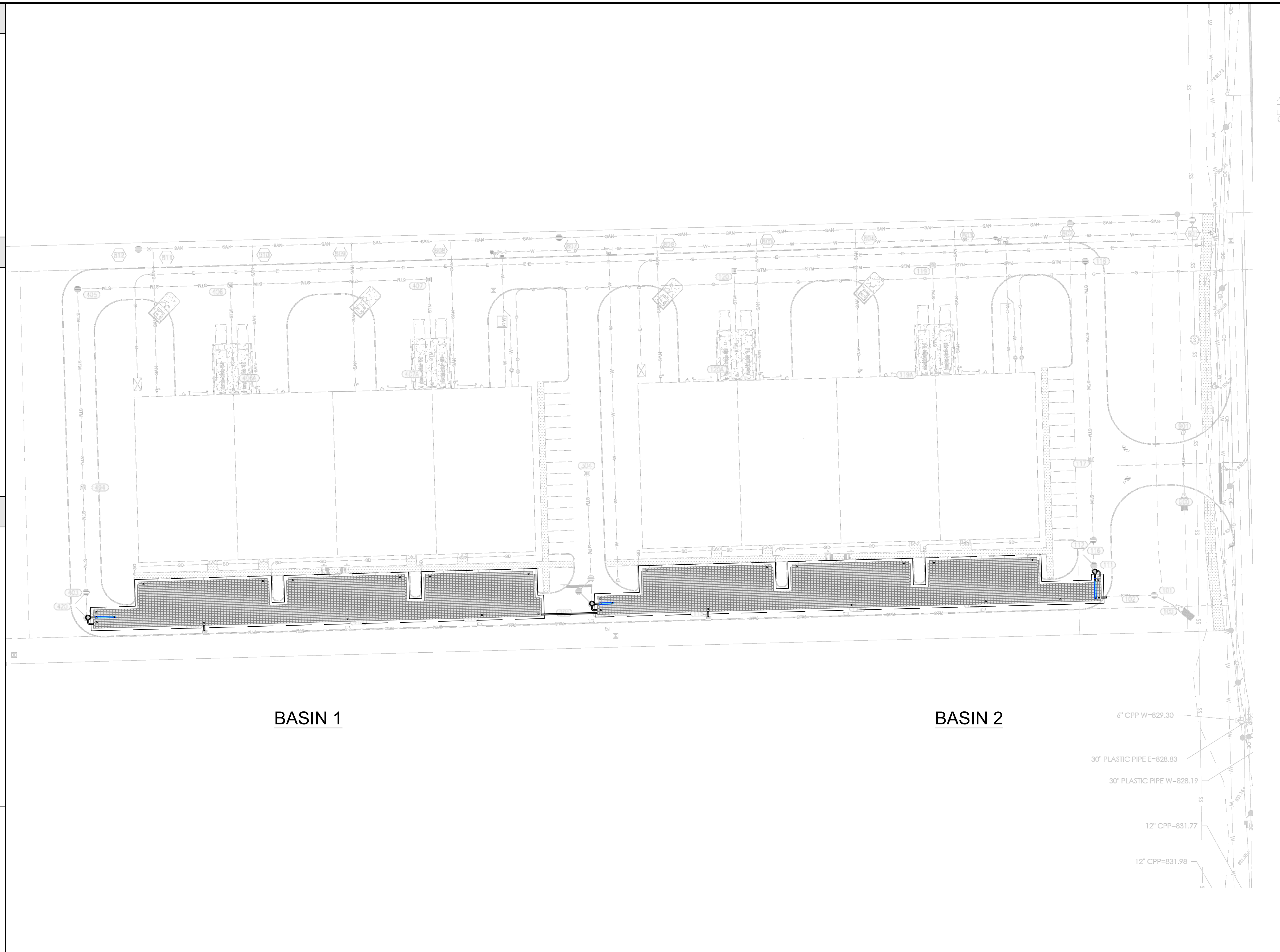
1. MATERIAL SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY
2. CONSULTANT DRAWINGS ARE BEING RELIED UPON AS BEING ACCURATE IN DEPICTING SITE CONDITIONS, THAT THEY SATISFY ANY LOCAL BUILDING CODE REQUIREMENTS, AND THAT THEY ACCURATELY DEPICT SUBSURFACE CONDITIONS.
3. FERGUSON SUPPLIES THE PRODUCTS ONLY AND TAKES NO RESPONSIBILITY FOR INSTALLATION AND HAS NO ROLE IN THE INSTALLATION OF THE PRODUCTS.
4. R-TANK SYSTEMS ARE NOT DESIGNED TO SUPPORT LOADS FROM BUILDINGS, RETAINING WALLS, ETC. THEREFORE, THE ENGINEER OF RECORD MUST COORDINATED WITH THE PROPER DISCIPLINES TO ENSURE NO STRUCTURAL LOADS ARE IMPARTED UPON THE SYSTEM AND ANY INFILTRATION FROM THE SYSTEM HAS BEEN ACCOUNTED FOR IN FOUNDATION DESIGN.

## MATERIAL HANDLING

1. PROTECT R-TANK AND OTHER MATERIALS FROM DAMAGE DURING DELIVERY AND OFFLOADING. HANDLING IS TO BE PERFORMED WITH EQUIPMENT APPROPRIATE TO THE MATERIALS AND SITE CONDITIONS.
2. STORAGE OF MATERIALS SHOULD BE ON SMOOTH SURFACES, FREE FROM DIRT, MUD AND DEBRIS, AND AWAY FROM ANY OPEN FLAME, WELDING OPERATIONS, OR OTHER POTENTIAL HEAT SOURCES.
3. UV SENSITIVE MATERIALS AND R-TANK UNITS SHOULD BE STORED UNDER A TARP TO PROTECT FROM SUNLIGHT WHEN TIME FROM DELIVERY TO INSTALLATION EXCEEDS TWO WEEKS.
4. WHEN HANDLING AND INSTALLING PRODUCT IN COLD WEATHER:
   A. WHEN THE AIR TEMPERATURE IS 40° F OR BELOW, CARE MUST BE TAKEN WHEN HANDLING PLASTICS TO ENSURE NO CRACKING. DO NOT USE FROZEN MATERIALS OR MATERIALS MIXED OR COATED WITH ICE OR FROST.
   B. DO NOT BUILD ON FROZEN GROUND OR WET, SATURATED OR MUDDY SUBGRADE.

## INSTALLATION NOTES

1. R-TANK INSTALLATION SHALL NOT BEGIN, UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-INSTALLATION CONFERENCE PER THE R-TANK SPECIFICATION.
2. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
3. BACKFILL, GEOTEXTILE, AND/OR LINER SHALL BE IN ACCORDANCE WITH THE R-TANK SPECIFICATIONS. QUANTITIES ARE APPROXIMATIONS BASED ON DIMENSIONS SHOWN.
4. THE USE OF CONSTRUCTION EQUIPMENT IS LIMITED, REFER TO THE CONSTRUCTION EQUIPMENT COVER DETAIL INCLUDE WITHIN THIS PLAN SET.
5. FERGUSON RECOMMENDS, PRIOR TO SITE STABILIZATION, ALL UPSTREAM INLETS BE PROTECTED FROM ACTIVE CONSTRUCTION SITE RUNOFF TO PREVENT DEBRIS AND SEDIMENT FROM ENTERING THE SYSTEM.
6. PRE-TREATMENT DEVICES ARE RECOMMENDED UP-STREAM OF ALL INFLOW CONNECTIONS. LEAF GUARDS SHOULD BE INSTALLED ON ANY DOWNSPOUT CONNECTIONS. CONTRACTOR AND ENGINEER ARE RESPONSIBLE ON ENSURING THE LAST UP-STREAM STRUCTURE IS ADEQUATE TO CONTAIN THE NECESSARY TREATMENT DEVICE.
7. CONTACT YOUR LOCAL FERGUSON REPRESENTATIVE WITH ANY QUESTIONS.




| DATE | INITIALS | DESCRIPTIONS |
|---|---|---|
| 2/16/2026 | CRH | INCREASE VOLUME AND CHANGE TANK TYPE |
| 2/19/2026 | CRH | REVISE PIPE CONNECTIONS AND TREATMENT ROWS |
| | | |
| | | |
| | | |
| | | |

DISTRIBUTED BY:

FERGUSON WATERWORKS

**R-Tank**

MODULAR STORMWATER STORAGE SYSTEM

0 80' 160'

SYSTEM OVERLAY
COMPASS & KEY INDUSTRIAL
BROWNSBURG, IN

DRAWN BY: CRH

DATE: 11/17/2025

SHEET NO.: 1 of 7

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO FERGUSON WATERWORKS BY THE DESIGN ENGINEER, CONTRACTOR, OR OTHER PROJECT REPRESENTATIVE. THE ENGINEER OF RECORD SHALL REVIEW AND APPROVED THAT THE DEPICTED LAYOUT AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE REGULATIONS AND PROJECT SPECIFIC REQUIREMENTS.

## R-TANK QUANTITIES

| | | |
|---|---|---|
| BASIN | 1 | 2 |
| TRAFFIC RATING | HS-20 | HS-20 |
| # OF HD DOUBLE+MINI R-TANKS | 3579 | 3785 |
| # OF HD DOUBLE+MINI ACCESS MODULES | 7 | 12 |

## R-TANK VOLUMES

| | | |
|---|---|---|
| TOTAL SYSTEM STORAGE | 44,773 CF | 47,585 CF |
| R-TANK STORAGE VOLUME | 37,166 CF | 39,353 CF |
| STONE STORAGE VOLUME (40% VOID RATIO) | 7,608 CF | 8,232 CF |
| STONE BED FOOTPRINT | 12,797 SF | 13,648 SF |
| STONE QUANTITY | 823 CY | 889 CY |

## R-TANK ELEVATIONS

| DESCRIPTION | ELEVATION | |
|---|---|---|
| BASE INV. | 832.25 | 832.25 |
| TANK INV. | 832.50 | 832.50 |
| TOP OF TANK | 836.04 | 836.04 |
| GEOGRID | 837.04 | 836.79 |
| MIN. ALLOW. FINAL GRADE | 837.71 | 837.29 |
| MAX. ALLOW. FINAL GRADE | 843.03 | 846.03 |

## LEGEND

R-TANK HD DOUBLE+MINI UNITS

R-TANK HD DOUBLE+MINI ACCESS UNITS

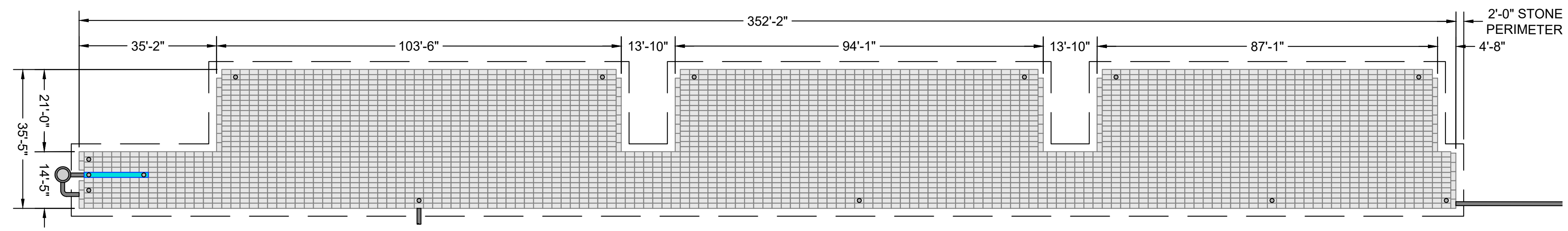
INSPECTION PORT

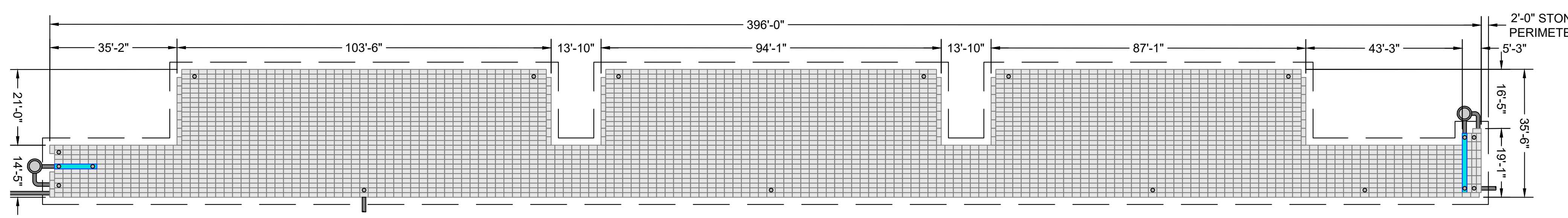
12" PIPE CONNECTION

EXCAVATION PERIMETER

PERIMETER BACKFILL

## BASIN 1




## BASIN 2

| DATE | INITIALS | DESCRIPTIONS |
|---|---|---|
| 2/16/2026 | CRH | INCREASE VOLUME AND CHANGE TANK TYPE |
| 2/19/2026 | CRH | REVISE PIPE CONNECTIONS AND TREATMENT ROWS |
| | | |
| | | |
| | | |
| | | |

R TANK

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FERGUSON WATERWORKS

**R-Tank**

MODULAR STORMWATER STORAGE SYSTEM

0 40' 80'

SYSTEM LAYOUT
COMPASS & KEY INDUSTRIAL
BROWNSBURG, IN

DRAWN BY: CRH

DATE: 11/17/2025

SHEET NO.: 2 of 7

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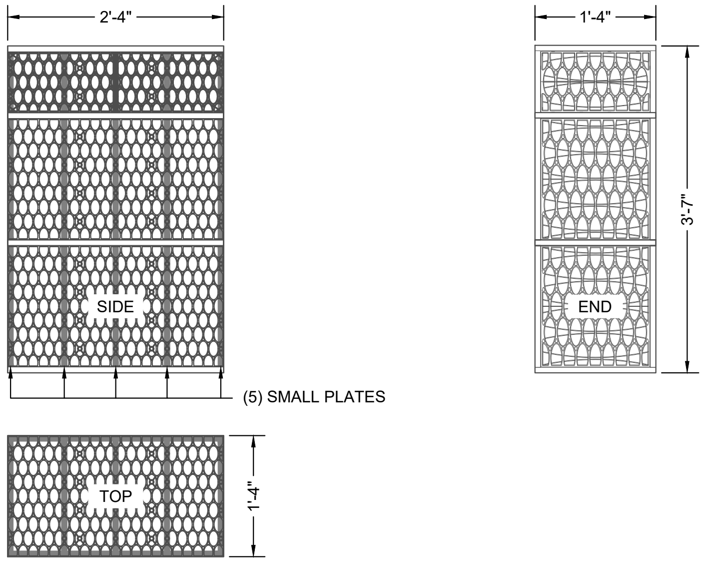
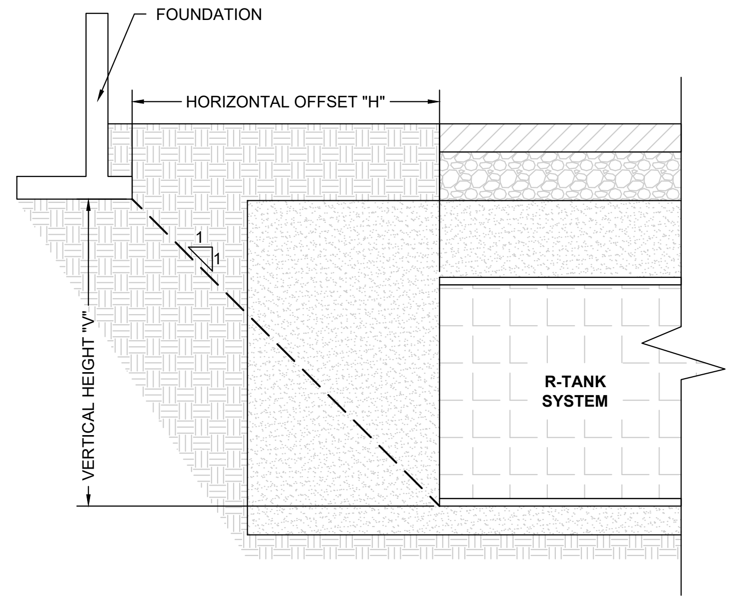



## MODULE DATA

| | |
|---|---|
| **GEOMETRY:**<br>LENGTH = 28.15 IN. (715 MM)<br>WIDTH = 15.75 IN. (400 MM)<br>HEIGHT = 42.52 IN. (1080 MM)<br>TANK VOLUME = 10.91 CF<br>STORAGE VOLUME = 10.36 CF<br>VOID INTERNAL VOLUME: 95%<br>VOID SURFACE AREA: 90% | **LOAD RATING:**<br>HS20/HS25 - SEE SPEC FOR COVER REQUIREMENTS<br><br>**MATERIAL:**<br>100% RECYCLED POLYPROPYLENE |

**DOUBLE + MINI R-TANK[HD] - MODULE DETAIL**



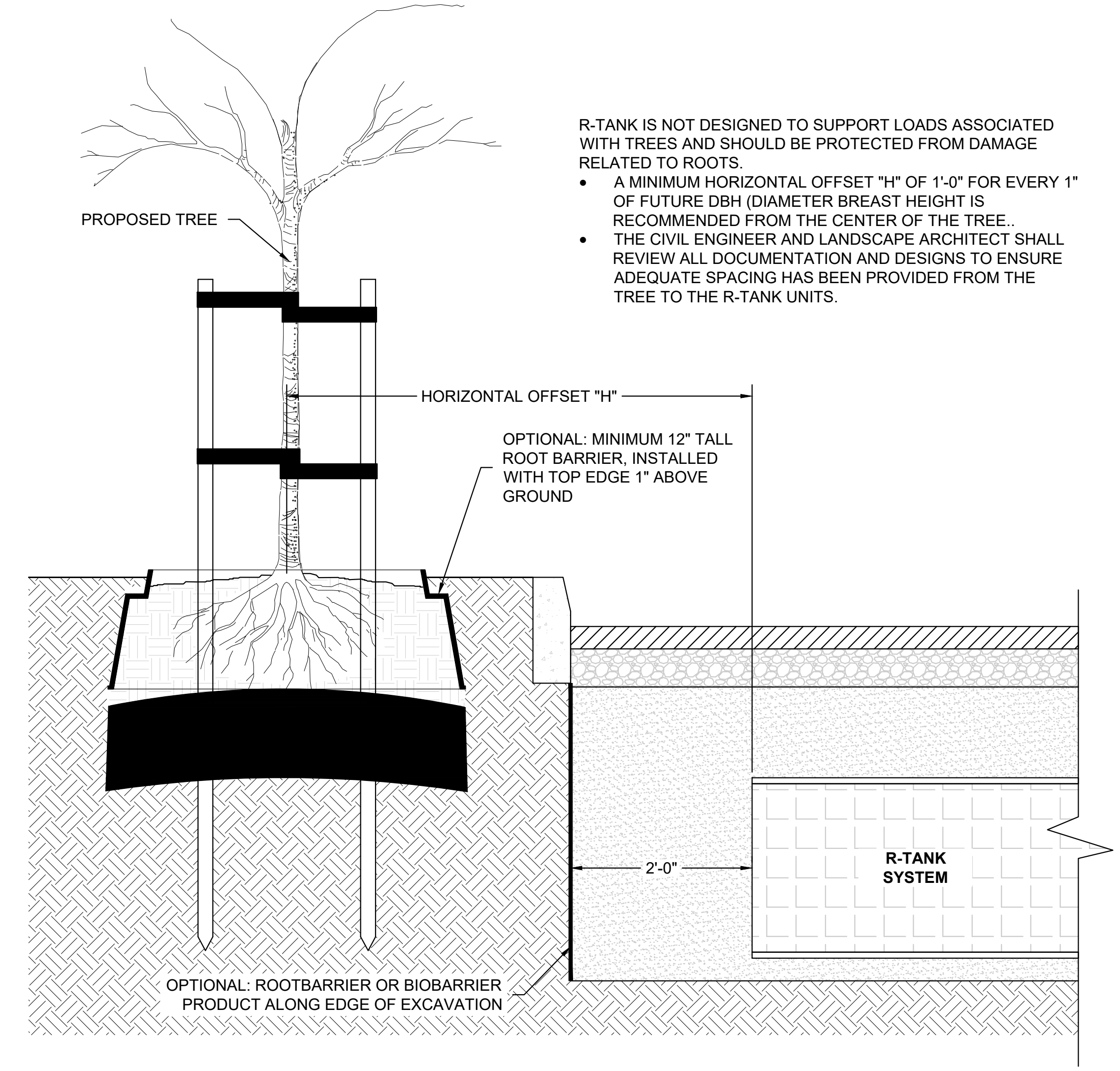

R-TANK IS NOT DESIGNED TO SUPPORT STRUCTURAL LOADS ASSOCIATED WITH BUILDINGS, RETAINING WALLS OR OTHER STRUCTURES.

- THE CIVIL ENGINEER AND STRUCTURAL ENGINEER SHALL REVIEW ALL DOCUMENTATION AND DESIGNS TO ENSURE NO STRUCTURAL LOADS ARE APPLIED BY THE STRUCTURE ON THE R-TANK UNITS. IT IS RECOMMENDED THAT ALL R-TANK UNITS BE INSTALLED ABOVE THE ELEVATION OF ANY SUBSURFACE STRUCTURAL ELEMENTS SUCH AS FOOTERS. IF THIS CANNOT BE ACHIEVED, IT RECOMMENDED THAT A MINIMUM 1:1 ZONE OF INFLUENCE, SITE SPECIFIC SOILS MAY REQUIRE GREATER SEPARATION DISTANCE, BE MAINTAINED BETWEEN THE STRUCTURAL ELEMENT AND THE UNITS.
- THE STRUCTURAL ENGINEER AND GEOTECHNICAL ENGINEER SHALL REVIEW ALL DOCUMENTATION AND DESIGNS TO ENSURE PROPER STABILITY OF STRUCTURAL ELEMENTS DURING SATURATED SOIL CONDITIONS POTENTIALLY CAUSED BY THE PROXIMITY OF INFILTRATION FACILITIES TO THE STRUCTURAL ELEMENTS.

**R-TANK - MINIMUM OFFSET DETAIL**

R-TANK IS NOT DESIGNED TO SUPPORT LOADS ASSOCIATED WITH TREES AND SHOULD BE PROTECTED FROM DAMAGE RELATED TO ROOTS.

- A MINIMUM HORIZONTAL OFFSET "H" OF 1'-0" FOR EVERY 1" OF FUTURE DBH (DIAMETER BREAST HEIGHT IS RECOMMENDED FROM THE CENTER OF THE TREE..
- THE CIVIL ENGINEER AND LANDSCAPE ARCHITECT SHALL REVIEW ALL DOCUMENTATION AND DESIGNS TO ENSURE ADEQUATE SPACING HAS BEEN PROVIDED FROM THE TREE TO THE R-TANK UNITS.




**R-TANK - TREE OFFSET DETAIL**

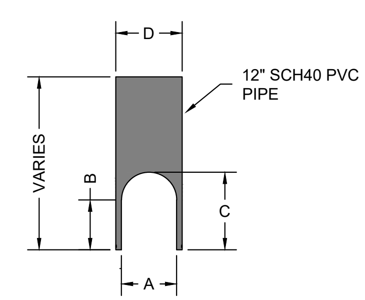
NOTES

1. THE INSPECTION PORT IS USED IN THE ACCESS MODULE TO INSPECT THE LEVEL OF SEDIMENT ACCUMULATION AND PERFORM ROUTINE MAINTENANCE.
2. MINIMUM REQUIRED MAINTENANCE INCLUDES A QUARTERLY INSPECTION DURING THE FIRST YEAR OF OPERATION AND A YEARLY INSPECTION THEREAFTER. FLUSH AS NEEDED.
3. R-TANK MAY BE USED IN TRAFFIC APPLICATIONS. SEE TRAFFIC LOADING DETAIL FOR MINIMUM & MAXIMUM COVER REQUIREMENTS.
4. IF INSPECTION PORT IS LOCATED IN A NON-TRAFFIC AREA, A PLASTIC CAP CAN BE USED IN LIEU OF A FRAME AND COVER WITH CONCRETE COLLAR.

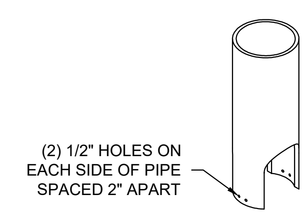
R-TANK INSPECTION PORT DIMENSIONS

| UNIT TYPE | DOGHOUSE BOTTOM WIDTH ("A") | DOGHOUSE VERTICAL LENGTH ("B")* | DOGHOUSE OPENING HEIGHT ("C") | PORT DIAMETER ("D") |
|---|---|---|---|---|
| HD | 10" | 9" | 14" | 12" |
| SD | 10" | 3" | 8" | 12" |
| UD | 8" | 7" | 12" | 10" |
| XD | 10" | VARIES** | VARIES** | 12" |

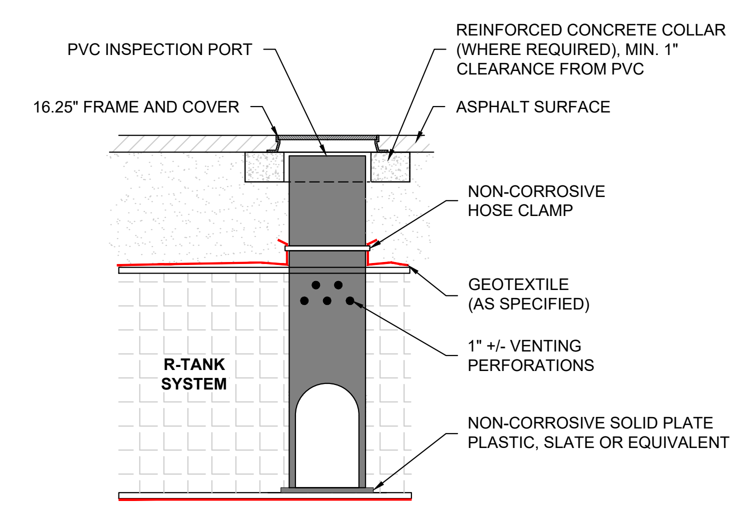
* PORTS ARE SUPPLIED WITH A STANDARD DOGHOUSE LENGTH OF 9". THE OPENING LENGTH SHALL BE REDUCED IN THE FIELD TO CORRESPOND WITH THE SPECIFIED PRODUCT TYPE.
** VERTICAL HEIGHTS VARY BASED ON THE STACKING HEIGHT OF THE XD SYSTEM. THE TOP OF ANY OPENING SHOULD NOT EXCEED THE TOP OF THE STACK HEIGHT.




FRONT VIEW OF INSPECTION PORT




ISOMETRIC PORT




**R-TANK TYPICAL VEHICULAR LOAD RATED INSPECTION PORT**

| DATE | INITIALS | DESCRIPTIONS |
|---|---|---|
| 2/16/2026 | CRH | INCREASE VOLUME AND CHANGE TANK TYPE |
| 2/19/2026 | CRH | REVISE PIPE CONNECTIONS AND TREATMENT ROWS |
| | | |
| | | |
| | | |

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**R-Tank**

MODULAR STORMWATER STORAGE SYSTEM

SYSTEM DETAILS
COMPASS & KEY INDUSTRIAL
BROWNSBURG, IN

DRAWN BY
CRH

DATE
11/17/2025

SHEET NO.
3 of 7

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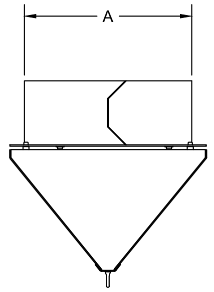
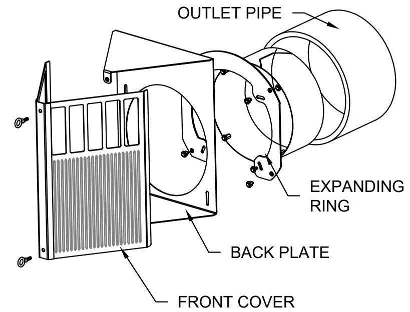
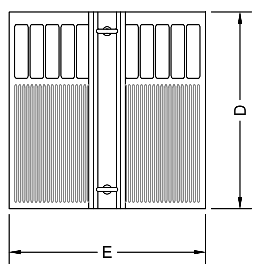


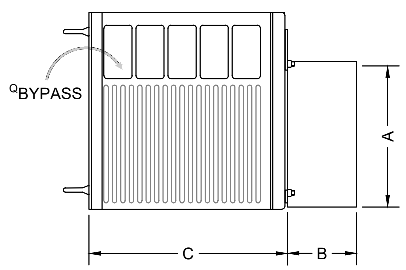

PLAN VIEW




REFERENCE VIEW




FRONT VIEW




SIDE VIEW

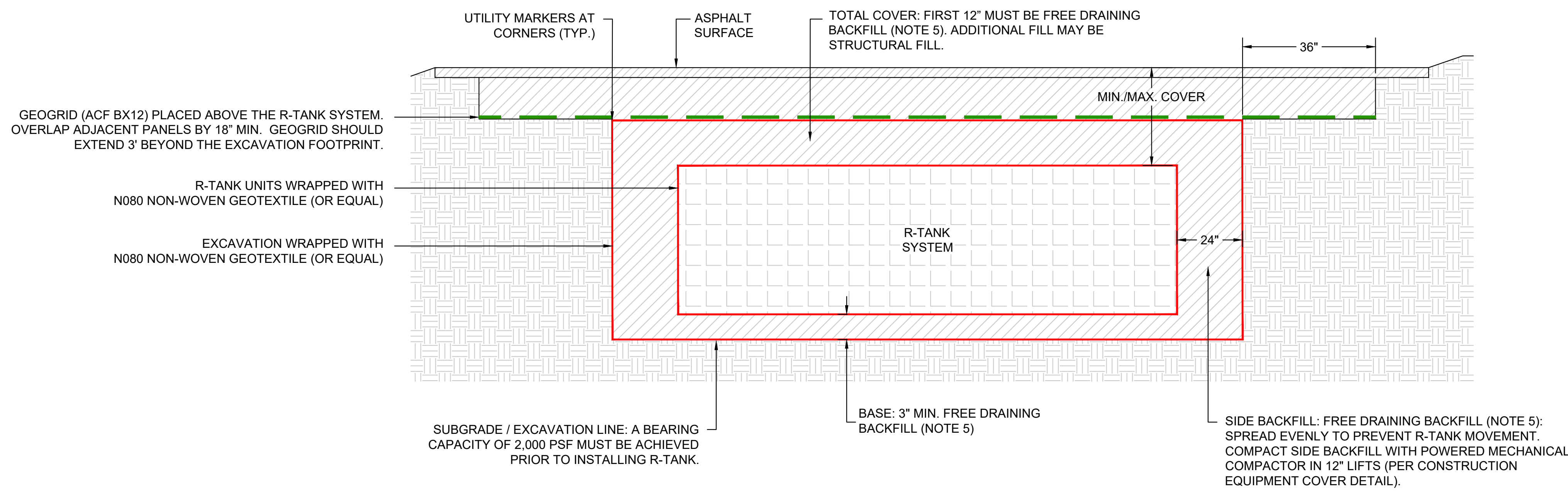
| PART NUMBER | NOMINAL PIPE DIA. | EXPANDING COLLAR DIA. (A) | | STUB LENGTH (B) | CPS DEPTH (C) | CPS HEIGHT (D) | CPS WIDTH (E) |
|---|---|---|---|---|---|---|---|
| | | MIN. | MAX. | | | | |
| SCA6-1 | 6" | 5.63" | 6.50" | 6.00" | 10.00" | 10.13" | 10.13" |
| SCA8-1 | 8" | 7.50" | 8.50" | 6.00" | 13.00" | 11.88" | 11.38" |
| SCA10-1 | 10" | 9.50" | 10.50" | 8.00" | 13.50" | 13.50" | 13.25" |
| SCA12-1 | 12" | 11.38" | 12.63" | 8.00" | 15.50" | 15.38" | 15.38" |
| SCA15-1 | 15" | 14.25" | 15.50" | 8.00" | 15.50" | 21.38" | 18.38" |
| SCA18-1 | 18" | 17.38" | 18.63" | 8.00" | 15.75" | 28.00" | 21.38" |
| SCA24-1 | 24" | 23.25" | 24.50" | 12.00" | 17.00" | 40.00" | 28.38" |

**STORMRING CPS PRETREATMENT DETAIL**

| R-TANK UNIT LOAD RATING | | | | | |
|---|---|---|---|---|---|
| UNIT TYPE | COMPRESSION STRENGTH | NON-VEHICULAR MIN. COVER* | HS-20 MIN. COVER* | HS-25 MIN. COVER* | MAX. COVER* |
| HD | 33.0 PSI | 12" | 20" | 24" | 6.99' |

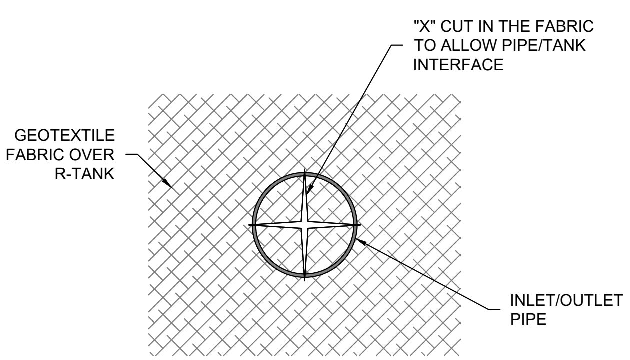
* MINIMUM AND MAXIMUM COVER ARE MEASURED FROM THE TOP OF THE R-TANK UNIT TO THE TOP OF THE FINISHED SURFACE.

NOTES:
1. INSTALLATIONS PER THIS DETAIL MEET GUIDELINES OF HL-93 LOADING PER THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.
2. PROVIDE A LEVEL BASE, SMOOTH, FREE OF LUMPS OR DEBRIS, AND EXTEND 2' BEYOND R-TANK FOOTPRINT. THE ENGINEER OF RECORD IS RESPONSIBLE FOR ASSESSING THE BEARING CAPACITY OF THE SUBGRADE, AND BASE.
3. FOR INSTALLATIONS IN LANDSCAPED AREAS, THE INSTALLATION OF TREES IS PROHIBITED ABOVE THE R-TANK UNITS. PLEASE CONTACT YOUR LOCAL FERGUSON WATERWORKS REPRESENTATIVE FOR MORE INFORMATION.
4. THE R-TANK SYSTEM IS NOT DESIGNED TO SUPPORT LOADS FROM BUILDINGS OR STRUCTURES. THEREFORE, THE ENGINEER OF RECORD MUST COORDINATE WITH THE PROPER DISCIPLINES TO ENSURE NO STRUCTURAL LOADS ARE IMPARTED UPON THE SYSTEM AND ANY INFILTRATION FROM THE SYSTEM HAS BEEN ACCOUNTED FOR IN THE FOUNDATION DESIGN.
5. BACKFILL MATERIAL SHALL BE STONE (ANGULAR AND SMALLER THAN 1.5" IN DIAMETER) OR SOIL (GW, GP, SW, OR SP AS CLASSIFIED BY THE UNIFIED SOIL CLASSIFICATION SYSTEM)



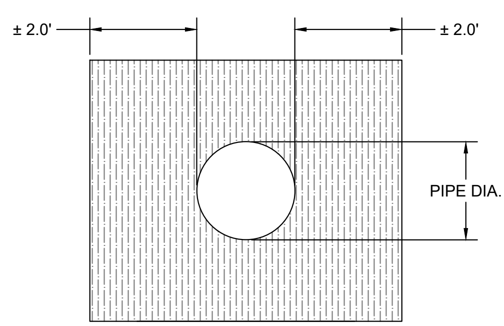

**R-TANK SECTION VIEW**

CUT AN "X" IN THE FABRIC ENVELOPE THAT IS SLIGHTLY LARGER THAN THE PIPE. PULL THE FABRIC FLAPS AROUND THE PIPE, AND SEAL WITH A STAINLESS STEEL BAND.

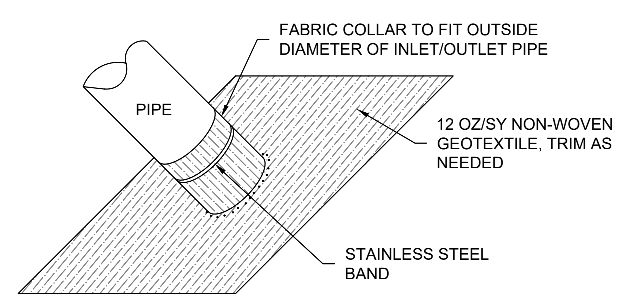



END VIEW OF PIPE/FABRIC CONNECTION

NOTE:
- PIPE BOOTS ARE AVAILABLE IN THE FOLLOWING STANDARD SIZES: 8" | 12" | 15" | 18" | 24".
- LARGER SPECIAL ORDER, CUSTOM SIZES ARE AVAILABLE.

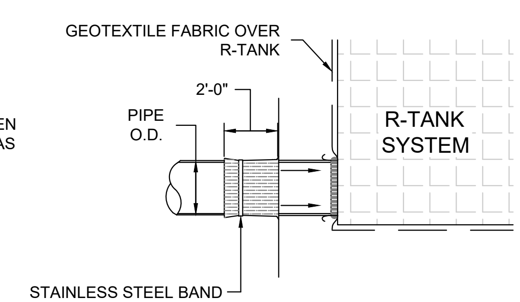



FRONT VIEW OF GEOTEXTILE BOOT

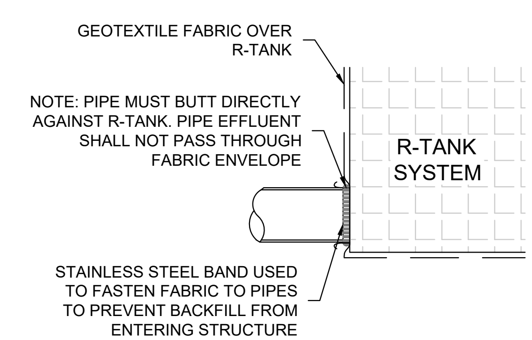



GEOTEXTILE BOOT

AFTER TANK WRAP IS SECURED TO PIPE, SLIDE BOOT AGAINST R-TANK AND SECURE WITH SECOND STAINLESS STEEL BAND, THEN ATTACH BOOT FLAP TO TANK ENVELOPE FABRIC WITH DUCT TAPE OR OTHER ADHESIVE.




SIDE VIEW OF GEOTEXTILE BOOT




SIDE VIEW OF PIPE/FABRIC CONNECTION

**R-TANK TYPICAL TANK INLET/OUTLET W/ GEOTEXTILE PIPE BOOT DETAIL**

| DATE | INITIALS | DESCRIPTIONS |
|---|---|---|
| 2/16/2026 | CRH | INCREASE VOLUME AND CHANGE TANK TYPE |
| 2/19/2026 | CRH | REVISE PIPE CONNECTIONS AND TREATMENT ROWS |
| | | |
| | | |
| | | |

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R-Tank

MODULAR STORMWATER STORAGE SYSTEM

SYSTEM DETAILS
COMPASS & KEY INDUSTRIAL
BROWNSBURG, IN

DRAWN BY
CRH

DATE
11/17/2025

SHEET NO.
4 of 7

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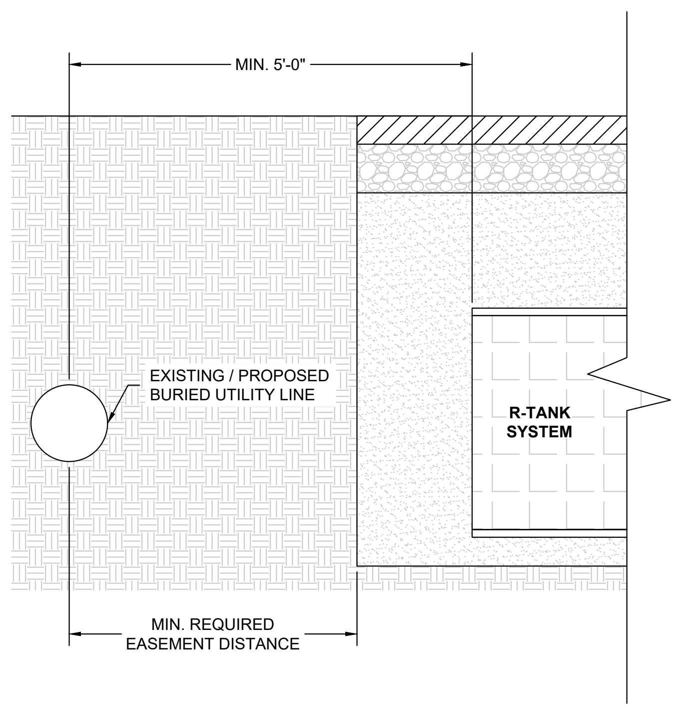
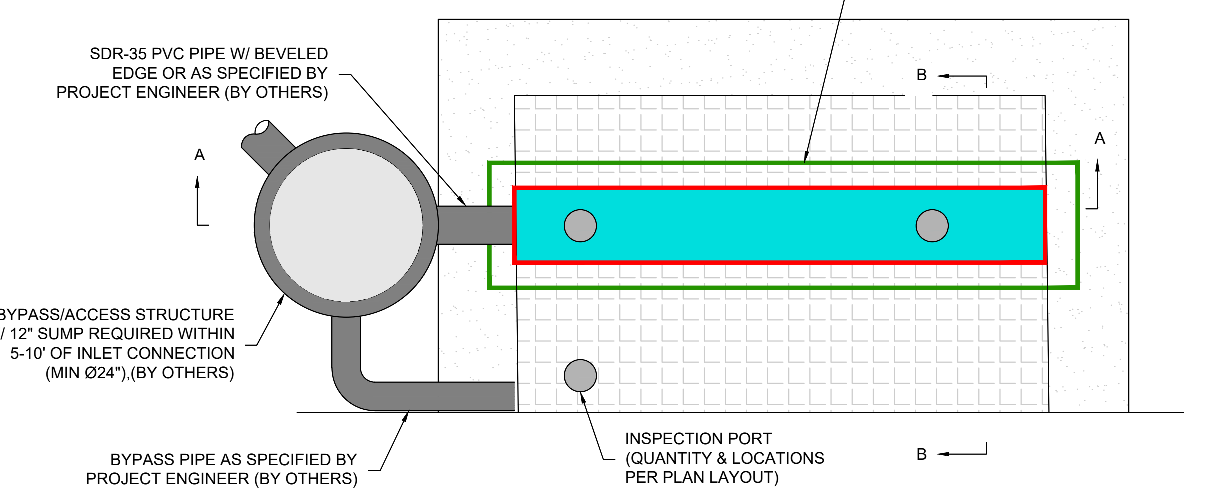


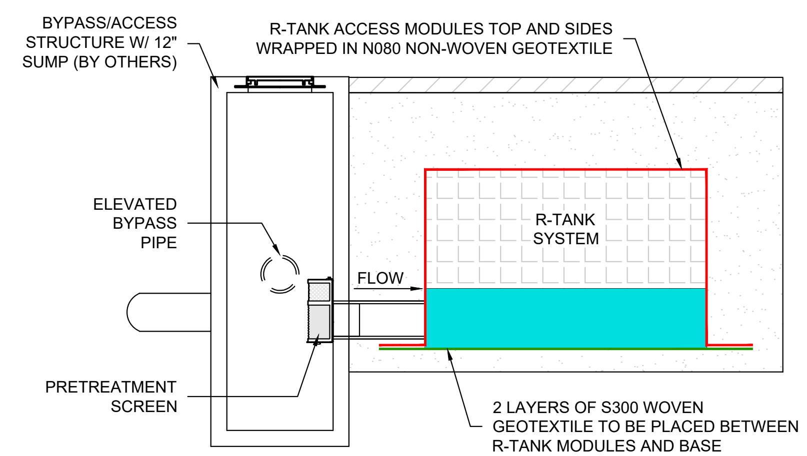

THE EXCAVATION FOR THE PERIMETER OF THE R-TANK SYSTEM SHALL NOT ENCROACH ON ANY EXISTING OR PROPOSED EASEMENTS, UNLESS EXPRESSLY GRANTED. IN CASES WHERE NO EASEMENT EXISTS, THE R-TANK UNITS SHALL BE A MINIMUM 5' FROM THE CENTERLINE OF THE UTILITY LINE, UNLESS EXPRESSLY GRANTED BY THE UTILITY OWNER.

**R-TANK - UTILITY OFFSET DETAIL**

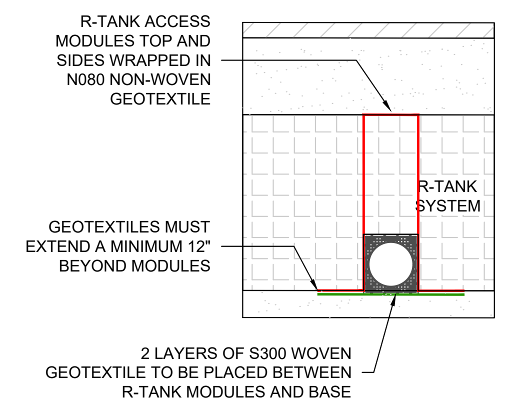
**NOTE: TREATMENT ROW DETAILS ARE PROVIDED FOR ILLUSTATION PURPOSES ONLY. EXACT SIZE, SECTION, AND LOCATION SHALL BE DETERMINED BY THE LAYOUT PLANS AND DETAIL SHEETS.**




**R-TANK TREATMENT ROW PLAN VIEW**




**R-TANK TREATMENT ROW SECTION A-A**




**R-TANK TREATMENT ROW SECTION B-B**

| DATE | INITIALS | DESCRIPTIONS |
|---|---|---|
| 2/16/2026 | CRH | INCREASE VOLUME AND CHANGE TANK TYPE |
| 2/19/2026 | CRH | REVISE PIPE CONNECTIONS AND TREATMENT ROWS |
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MODULAR STORMWATER STORAGE SYSTEM

SYSTEM DETAILS
COMPASS & KEY INDUSTRIAL
BROWNSBURG, IN

DRAWN BY
CRH

DATE
11/17/2025

SHEET NO.
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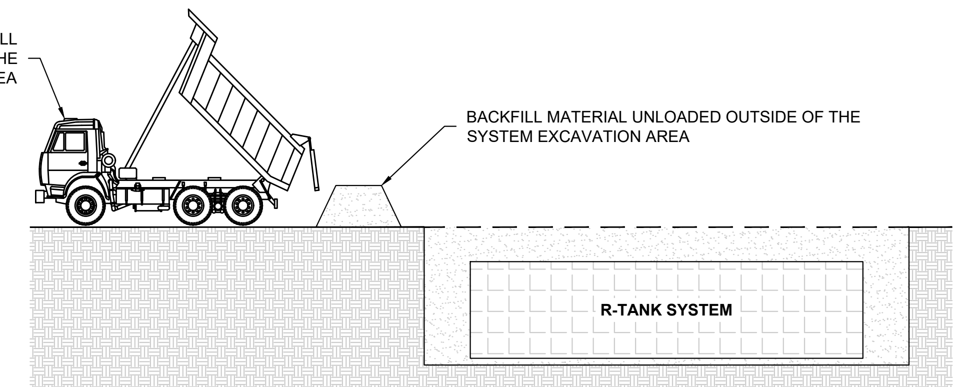
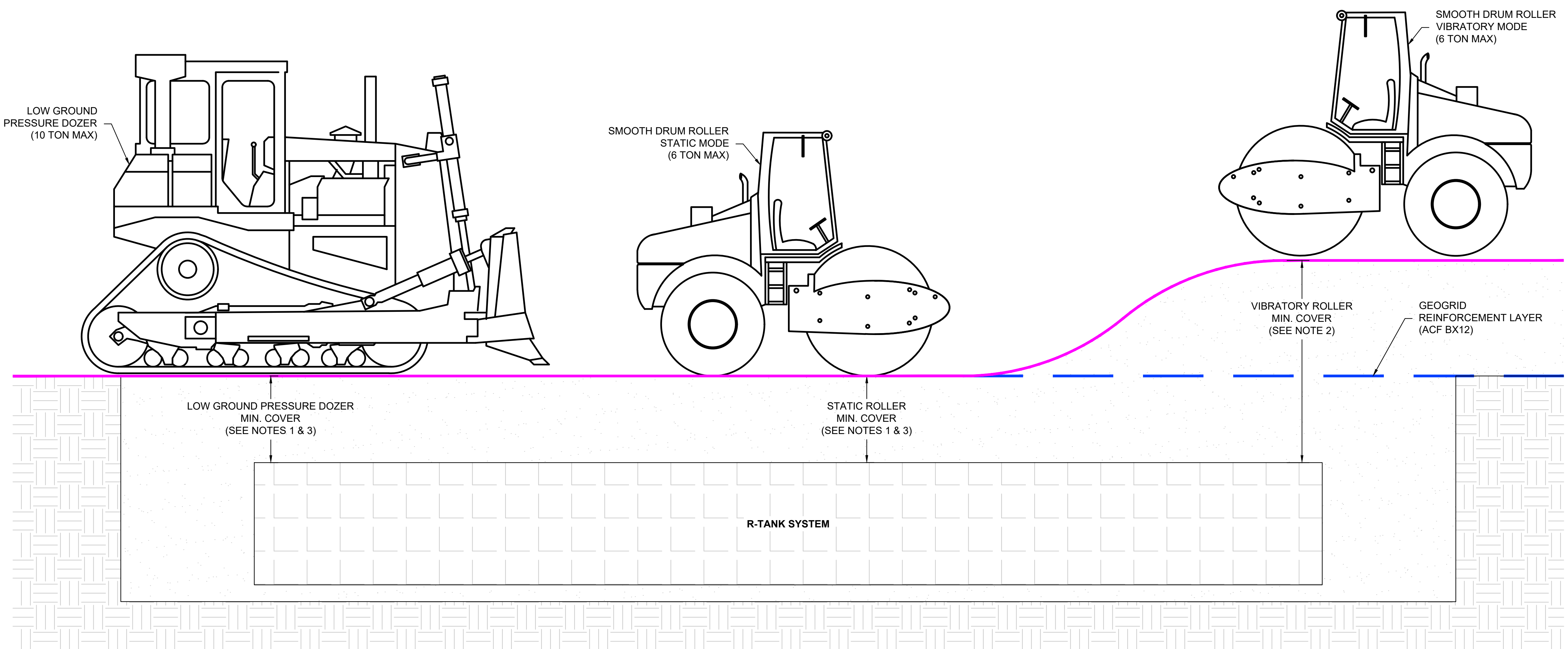
| R-TANK CONSTRUCTION EQUIPMENT RECOMMENDATIONS | | | | |
|---|---|---|---|---|
| UNIT TYPE | COMPRESSION STRENGTH | 10 TON LOW GROUND PRESSURE DOZER MIN. COVER | 6 TON SMOOTH DRUM STATIC ROLLER MIN. COVER | 6 TON SMOOTH DRUM VIBRATORY ROLLER MIN. COVER |
| HD | 33.0 PSI | 12" (SEE NOTE 1, 2 & 3) | 12" (SEE NOTE 1, 2 & 3) | 24" (SEE NOTE 2) |
| SD | 42.0 PSI | 12" (SEE NOTE 1, 2 & 3) | 12" (SEE NOTE 1, 2 & 3) | 24" (SEE NOTE 2) |
| MD | 64.0 PSI | 12" (SEE NOTE 1, 2 & 3) | 12" (SEE NOTE 1, 2 & 3) | 24" (SEE NOTE 2) |

NOTES:

1. FOLLOWING PLACEMENT OF SIDE BACKFILL, A UNIFORM 12" LIFT OF THE FREELY DRAINING MATERIAL (SPEC SECTION 2.03 B1) SHALL BE PLACED OVER THE R-TANK AND LIGHTLY COMPACTED USING A WALK-BEHIND TRENCH ROLLER. ALTERNATELY, A ROLLER (MAXIMUM GROSS VEHICLE WEIGHT OF 6 TONS) MAY BE USED. ROLLER MUST REMAIN IN STATIC MODE UNTIL A MINIMUM OF 24" OF COVER HAS BEEN PLACED OVER THE MODULES. SHEEP FOOT ROLLERS SHOULD NOT BE USED. **SPEC SECTION 3.05 A5**
2. AFTER THE GEOGRID IS INSTALLED OVER THE INITIAL LAYER, THE GRADED AGGREGATE BASE MATERIALS CAN BE PUSHED OUT (MAX MACHINE SIZE IS 10 TON LGP DOZER OR SMALLER) IN A SINGLE LIFT AND STATIC ROLLED BY A MACHINE WITH A MAX GROSS VEHICLE WEIGHT OF 6 TONS. ROLLER MUST REMAIN IN STATIC MODE UNTIL A MINIMUM OF 24" OF COVER HAS BEEN PLACED OVER THE MODULES. SHEEP FOOT ROLLERS SHOULD NOT BE USED. SPEC SECTION 3.05 A5
2. ONLY LOW PRESSURE TIRE OR TRACK VEHICLES (LESS THAN 7 PSI AND OPERATING WEIGHT OF LESS THAN 20,000 LBS) SHALL BE OPERATED OVER THE R-TANK SYSTEM DURING CONSTRUCTION. **SPEC SECTION 3.05 A5**
3. DUMP TRUCKS AND PANS SHALL NOT BE OPERATED WITHIN THE R-TANK SYSTEM AT ANY TIME. WHERE NECESSARY, THE HEAVY EQUIPMENT SHOULD UNLOAD IN AN AREA ADJACENT TO THE R-TANK SYSTEM AND THE MATERIAL SHOULD BE MOVED OVER THE SYSTEM WITH TRACKED EQUIPMENT. **SPEC SECTION 3.05 A5**
4. ENSURE THAT ALL UNRELATED CONSTRUCTION TRAFFIC IS KEPT AWAY FROM THE LIMITS OF EXCAVATION UNTIL THE PROJECT IS COMPLETE AND FINAL SURFACE MATERIALS ARE IN PLACE. NO NON-INSTALLATION RELATED LOADING SHOULD BE ALLOWED OVER THE R-TANK SYSTEM UNTIL THE FINAL DESIGN SECTION HAS BEEN CONSTRUCTED (INCLUDING PAVEMENT). **SPEC SECTION 3.05 B**
5. SEE R-TANK INSTALLATION GUIDE OR CONTACT YOUR LOCAL FERGUSON REPRESENTATIVE FOR ADDITIONAL INFORMATION.




**DUMP TRUCK DETAIL**




**R-TANK HD, SD OR MD CONSTRUCTION EQUIPMENT COVER DETAIL - VEHICULAR TRAFFIC**

| DATE | INITIALS | DESCRIPTIONS |
|---|---|---|
| 2/16/2026 | CRH | INCREASE VOLUME AND CHANGE TANK TYPE |
| 2/19/2026 | CRH | REVISE PIPE CONNECTIONS AND TREATMENT ROWS |
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**R-Tank**

MODULAR STORMWATER STORAGE SYSTEM

CONSTRUCTION EQUIPMENT COVER DETAIL
COMPASS & KEY INDUSTRIAL
BROWNSBURG, IN

| | |
|---|---|
| DRAWN BY | CRH |
| DATE | 11/17/2025 |
| SHEET NO. | 6 of 7 |

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# R-TANK SPECIFICATION

**PART 1 GENERAL**

**1.01 SUMMARY**

A. THIS SECTION INCLUDES SPECIFICATIONS OR THE SUPPLY AND INSTALLATION OF MODULAR STORMWATER STORAGE UNITS, SPECIFICALLY THE FAMILY OF R-TANK STORMWATER STORAGE SYSTEM (HEREAFTER CALLED R-TANK).

**1.02 QUALITY CONTROL**

A. **MANUFACTURER QUALIFICATIONS:** THE R-TANK MODULAR STORMWATER STORAGE UNITS SHALL BE SUPPLIED BY FERGUSON WATERWORKS AND MANUFACTURED IN ISO CERTIFIED FACILITIES.
   a. MANUFACTURER SAMPLES SHALL BE PROVIDED TO THE CLIENT & CONTRACTOR FOR REVIEW UPON REQUEST.
   b. A MANUFACTURER'S REPRESENTATIVE IS AVAILABLE FOR PRE-INSTALLATION CONFERENCE, PER SECTION 1.05 & SITE REVIEW, UPON REQUEST.

**1.03 SUBMITTALS**

A. SUBMIT PRODUCT DATA, INSTALLATION GUIDELINES, AND PRODUCT CERTIFICATIONS FOR THE R-TANK MODULAR STORMWATER STORAGE UNITS.
   a. R-TANK LAYOUT DRAWINGS, INCLUDING TYPICAL SECTIONS, DETAILS AS WELL AS THE REQUIRED BASE ELEVATION OF STONE AND TANKS, MINIMUM COVER REQUIREMENTS AND TANK CONFIGURATION.
   b. R-TANK PRODUCT DATA, INCLUDING COMPRESSIVE STRENGTH, AND INSTALLATION GUIDELINES.
   c. ACCESSORY MATERIAL DOCUMENTATION / CERTIFICATES FOR GEOTEXTILE, GEOGRID, BASE COURSE AND BACKFILL MATERIALS.
B. ANY PROPOSED EQUAL ALTERNATIVE PRODUCT SUBSTITUTION TO THIS SPECIFICATION MUST BE SUBMITTED FOR REVIEW AND APPROVED PRIOR TO BID OPENING. REVIEW PACKAGE SHOULD INCLUDE THIRD PARTY REVIEWED PERFORMANCE DATA THAT MEETS OR EXCEEDS CRITERIA IN TABLE 2.01 B.

**1.04 DELIVERY, STORAGE, AND HANDLING**

A. PROTECT R-TANK AND OTHER MATERIALS FROM DAMAGE DURING DELIVERY AND OFFLOADING. HANDLING IS TO BE PERFORMED WITH EQUIPMENT APPROPRIATE TO THE MATERIALS AND SITE CONDITIONS.
B. STORAGE OF MATERIALS SHOULD BE ON SMOOTH SURFACES, FREE FROM DIRT, MUD AND DEBRIS, AND AWAY FROM ANY OPEN FLAME, WELDING OPERATIONS, OR OTHER POTENTIAL HEAT SOURCES. UV SENSITIVE MATERIALS AND R-TANK UNITS SHOULD BE STORED UNDER A TARP TO PROTECT FROM SUNLIGHT WHEN TIME FROM DELIVERY TO INSTALLATION EXCEEDS TWO WEEKS.
C. WHEN HANDLING AND INSTALLING PRODUCT IN COLD WEATHER:
   a. WHEN THE AIR TEMPERATURE IS 40° F OR BELOW, CARE MUST BE TAKEN WHEN HANDLING PLASTICS TO ENSURE NO CRACKING. DO NOT USE FROZEN MATERIALS, OR MATERIALS COATED WITH ICE OR FROST.
   b. DO NOT BUILD ON FROZEN GROUND OR WET, SATURATED OR MUDDY SUBGRADE.

**1.05 PREINSTALLATION CONFERENCE.**

A. PRIOR TO THE START OF THE INSTALLATION, A PRE-INSTALLATION CONFERENCE SHALL OCCUR WITH THE REPRESENTATIVES FROM THE DESIGN TEAM, THE GENERAL CONTRACTOR, THE EXCAVATION CONTRACTOR, THE R-TANK INSTALLATION CONTRACTOR, AND THE MANUFACTURER'S REPRESENTATIVE.
B. THE PRE-INSTALLATION CONFERENCE SHALL REVIEW THE LAYOUT DRAWINGS, PRE-CONSTRUCTION CHECKLIST, AND DISCUSS KEY STEPS OF THE PROCESS. THE PRE-CONSTRUCTION CHECKLIST SHALL BE SIGNED AND DATED BY ALL PARTICIPANTS.

**1.06 PROJECT CONDITIONS**

A. COORDINATE INSTALLATION FOR THE R-TANK SYSTEM WITH OTHER ON-SITE ACTIVITIES TO ELIMINATE ALL NON-INSTALLATION RELATED CONSTRUCTION TRAFFIC OVER THE COMPLETED R-TANK SYSTEM.
B. PROTECT ADJACENT WORK FROM DAMAGE DURING R-TANK SYSTEM INSTALLATION.
C. PROVIDE PROPER SEDIMENT CONTROLS TO PREVENT SEDIMENT INTRUSION, IF THE SYSTEM IS OPERATIONAL DURING CONSTRUCTION.
D. CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO THE SYSTEM DURING CONSTRUCTION.
E. ALL PRE-TREATMENT SYSTEMS MUST BE IN PLACE AND FUNCTIONAL PRIOR TO OPERATION OF THE R-TANK SYSTEM.

**PART 2 PRODUCTS**

**2.01 R-TANK UNITS**

A. INJECTION MOLDED PLASTIC TANK COMPONENTS ASSEMBLED TO FORM A MODULAR STRUCTURE OF PREDESIGNED HEIGHT.
B. R-TANK UNITS SHALL MEET THE FOLLOWING PHYSICAL & CHEMICAL CHARACTERISTICS:

| PROPERTY | DESCRIPTION | R-Tank$^{HD}$ | R-Tank$^{SD}$ | R-Tank$^{MD}$ | R-Tank$^{UD}$ | R-Tank$^{XD}$ |
|---|---|---|---|---|---|---|
| Void Area | Volume available for water storage | 95% | 95% | 95% | 95% | 90% |
| Surface Void Area | Percentage of exterior available for infiltration | 90% | 90% | 90% | 90% | 90% |
| Vertical Compressive Strength | ASTM D 2412 / ASTM F 2418 | 33.0 psi | 42.0 psi | 64.0 psi | 134.0 psi | 240.0 psi |
| Lateral Compressive Strength | ASTM D 2412 / ASTM F 2418 | 20.0 psi | 22.0 psi | 35.0 psi | 19.0 psi | N/A |
| HS-20 Minimum Cover | Cover required to support HS-20 loads | 20" | 18" | 15" | 12" | 6" |
| HS-25 Minimum Cover | Cover required to support HS-25 loads | 24" | 21" | 18" | 15" | 6" |
| Maximum Cover | Maximum allowable cover depth | < 7 feet | < 10 feet | < 10 feet | < 7 feet | < 10 feet |
| Unit Weight | Weight of plastic per cubic foot of tank | 3.62 lbs/cf | 3.96 lbs / cf | 3.53 lbs / cf | 4.33 lbs / cf | 7.55 lbs / cf |
| Service Temperature | Safe temperature range for use | -14 – 167° F | -14 – 167° F | -14 – 167° F | -14 – 167° F | -14 to 185° F |

**2.02 GEOSYNTHETICS**

A. GEOTEXTILE
   a. STANDARD APPLICATION: THE STANDARD GEOTEXTILE SHALL BE AN 8 OZ PER SQUARE YARD NONWOVEN GEOTEXTILE.
   b. INFILTRATION APPLICATIONS: WHEN WATER MUST INFILTRATE/EXFILTRATE THROUGH THE GEOTEXTILE AS A FUNCTION OF THE SYSTEM DESIGN, A WOVEN MONOFILAMENT SHALL BE USED. IN SPECIALTY APPLICATIONS, A MICROGRID/MESH MAY BE APPROVED AS AN ALTERNATIVE SEPARATION FABRIC, IN CONSULTATION WITH THE MANUFACTURER'S REPRESENTATIVE.
   c. LINED APPLICATIONS: WHEN WATER MUST BE RETAINED WITHIN THE TANKS TO PREVENT INFILTRATION/EXFILTRATION, AN IMPERMEABLE LINER SHALL BE USED. THE LINER MATERIAL AND THICKNESS SHALL BE SPECIFIED BY THE PROJECT DESIGN ENGINEER. THIS LINER SHOULD BE INSTALLED PER LINER MANUFACTURER SPECIFICATIONS AND INDUSTRY ACCEPTED TECHNIQUES.
B. GEOGRID
   a. FOR INSTALLATIONS SUBJECT TO TRAFFIC LOADS, INSTALL GEOGRID TO REINFORCE BACKFILL ABOVE THE R-TANK SYSTEM.
   b. GEOGRID IS NOT REQUIRED FOR R-TANK$^{XD}$ AND IS OFTEN NOT REQUIRED FOR NON-TRAFFIC LOAD APPLICATIONS.

**2.03 BEDDING, BACKFILL & COVER MATERIALS**

A. ALL MATERIALS SHALL BE FREE FROM LUMPS, DEBRIS, AND ANY SHARP OBJECTS THAT COULD CUT THE GEOTEXTILE.
B. **BEDDING MATERIALS:** STONE (ANGULAR AND SMALLER THAN 1.5" IN DIAMETER) OR SOIL (GW, GP, SW, OR SP AS CLASSIFIED BY THE UNIFIED SOIL CLASSIFICATION SYSTEM) SHALL BE USED BELOW THE R-TANK SYSTEM (3" MINIMUM AND 12" MAXIMUM). FOR INFILTRATION APPLICATIONS BEDDING MATERIAL SHALL BE FREE DRAINING.
C. **SIDE AND TOP BACKFILL:** RECOMMENDED BACKFILL MATERIAL SHOULD BE CLEAN AND FREE OF DEBRIS, WITH A PARTICLE SIZE DISTRIBUTION THAT IS APPROPRIATE FOR THE SPECIFIC APPLICATION. IDENTICAL BACKFILL MATERIAL SHALL BE USED ON THE SIDE AND TOP OF THE UNITS.
   a. TRAFFIC APPLICATIONS: BACKFILL MATERIALS SHALL BE FREE DRAINING STONE (ANGULAR AND SMALLER THAN 1.5" IN DIAMETER) OR SOIL (GW, GP, SW, OR SP AS CLASSIFIED BY THE UNIFIED SOIL CLASSIFICATION SYSTEM).
   b. NON-TRAFFIC APPLICATIONS - FOR ALL R-TANK MODULES INSTALLED IN GREEN SPACES AND NOT SUBJECTED TO VEHICULAR LOADS, BACKFILL MATERIALS MAY EITHER FOLLOW THE GUIDELINES FOR TRAFFIC APPLICATIONS ABOVE, OR THE TOP BACKFILL LAYER MAY CONSIST OF AASHTO #57 STONE BLENDED WITH 30-40% (BY VOLUME) TOPSOIL TO AID IN ESTABLISHING VEGETATION.
   c. BIOFILTRATION / BIORETENTION APPLICATIONS - BACKFILL MATERIALS SHALL BE IN ACCORDANCE WITH THE CROSS-SECTION FOR THE SPECIFIC BIOFILTRATION/BIORETENTION APPLICATION AND MEDIA. A LAYER OF BRIDGING STONE SHALL SEPARATE THE SOIL MEDIA FROM THE R-TANK UNITS.
D. **ADDITIONAL COVER MATERIALS:** ADDITIONAL COVER MATERIAL SHALL BE STRUCTURAL FILL MEETING THE GRADATIONAL REQUIREMENTS OF SM, SP, SW, GM, GP, OR GW AS CLASSIFIED BY THE UNIFIED SOIL CLASSIFICATION SYSTEM. STRUCTURAL FILL SHALL BE SPECIFIED BY THE ENGINEER OF RECORD.

**2.04 OTHER MATERIALS**

A. **UTILITY MARKER:** INSTALL METALLIC TAPE AT CORNERS OF R-TANK SYSTEM TO MARK THE AREA FOR FUTURE UTILITY DETECTION.

**PART 3 EXECUTION**

**3.01 EXCAVATION PREPARATION**

A. VERIFY THE SITE CONDITIONS ARE SUITABLE FOR PRODUCT STORAGE AND INSTALLATION PER GUIDELINES.
B. ALL EXCAVATIONS MUST MEET OSHA SAFETY STANDARDS FOR SLOPES OR SHORING.
C. STAKE OUT, EXCAVATE, AND PREPARE THE SUBGRADE AREA PER GEOTECHNICAL ENGINEER'S RECOMMENDATIONS AND/OR AS SHOWN ON THE DESIGN DRAWINGS, TO PROVIDE ADEQUATE SUPPORT FOR PROJECT DESIGN LOADS.
   a. ENSURE THAT THE EXCAVATION IS AT LEAST 2 FEET GREATER THAN R-TANK DIMENSIONS IN EACH DIRECTION ALLOWING FOR INSTALLATION OF GEOTEXTILE FILTER FABRIC, R-TANK MODULES, AND FREE DRAINING BACKFILL MATERIALS.
   b. BASE OF THE EXCAVATION SHALL BE UNIFORM, LEVEL, AND FREE OF LUMPS OR DEBRIS AND SOFT OR YIELDING SUBGRADE AREAS.
D. **UNSUITABLE SOILS OR CONDITIONS:** ALL QUESTIONS ABOUT THE BASE OF THE EXCAVATION SHALL BE DIRECTED TO THE OWNER'S ENGINEER. THE OWNER'S ENGINEER SHALL DETERMINE THE REQUIRED BEARING CAPACITY OF THE R-TANK SUBGRADE; HOWEVER, IN NO CASE SHALL A BEARING CAPACITY OF LESS THAN 2,000 POUNDS PER SQUARE FOOT BE PROVIDED.

**3.02 BEDDING PREPARATION**

A. WHERE A GEOTEXTILE WRAP IS SPECIFIED BETWEEN THE NATIVE SOIL AND STONE BASE, CUT STRIPS TO LENGTH, AND INSTALL IN EXCAVATION, REMOVING WRINKLES SO MATERIAL LAYS FLAT.
   a. OVERLAP GEOTEXTILE A MINIMUM 12" OR AS RECOMMENDED BY MANUFACTURER. USE TAPE, SPECIAL ADHESIVES, SANDBAGS, OR OTHER BALLAST TO SECURE OVERLAPS.
   b. WHERE AN IMPERVIOUS LINER IS SPECIFIED, INSTALL THE LINER PER MANUFACTURER'S RECOMMENDATIONS AND THE CONTRACT DOCUMENTS. THE LINER SHOULD BE SANDWICHED BETWEEN LAYERS OF NON-WOVEN GEOTEXTILE AT A MINIMUM.
   c. AS GEOTEXTILES CAN BE DAMAGED BY EXTREME HEAT, SMOKING IS NOT PERMISSIBLE ON/NEAR THE GEOTEXTILE, AND TOOLS USING A FLAME TO TACK THE OVERLAPS, SUCH AS PROPANE TORCHES, ARE PROHIBITED.
B. PLACE A THIN LAYER (3" UNLESS OTHERWISE SPECIFIED) OF BEDDING MATERIAL (SECTION 2.03B), WITHIN ½" (+/- ¼") OF LEVEL OR AS SHOWN ON THE PLANS. VIBRATORY TAMP OR STATIC ROLL TO PREPARE BEDDING MATERIALS UNTIL THEY ARE FIRM AND UNYIELDING.
C. OUTLINE THE FOOTPRINT OF THE R-TANK SYSTEM ON THE EXCAVATION FLOOR USING SPRAY PAINT OR CHALK LINE TO ENSURE A 2' PERIMETER IS AVAILABLE AROUND THE R-TANK SYSTEM FOR PROPER INSTALLATION AND COMPACTION OF BACKFILL.

**3.03 LAYOUT AND INSTALLATION OF R-TANK UNITS**

A. INSTALL A GEOTEXTILE WRAP BY CUTTING STRIPS TO LENGTH AND REMOVING WRINKLES SO MATERIAL LAYS FLAT.
   a. OVERLAP GEOTEXTILE A MINIMUM 12" OR AS RECOMMENDED BY MANUFACTURER. USE TAPE, SPECIAL ADHESIVES, SANDBAGS, OR OTHER BALLAST TO SECURE OVERLAPS.
   b. WHERE AN IMPERVIOUS LINER IS SPECIFIED, INSTALL THE LINER PER MANUFACTURER'S RECOMMENDATIONS AND THE CONTRACT DOCUMENTS. THE LINER SHOULD BE SANDWICHED BETWEEN LAYERS OF NON-WOVEN GEOTEXTILE AT A MINIMUM.
   c. AS GEOTEXTILES CAN BE DAMAGED BY EXTREME HEAT, SMOKING IS NOT PERMISSIBLE ON/NEAR THE GEOTEXTILE, AND TOOLS USING A FLAME TO TACK THE OVERLAPS, SUCH AS PROPANE TORCHES, ARE PROHIBITED.
B. MARK OR OUTLINE THE UNIT AREA TO ENSURE A SQUARE AND STRAIGHT INSTALLATION.
C. ASSEMBLE R-TANK UNITS IN ACCORDANCE WITH THE R-TANK DRAWINGS AND INSTALLATION GUIDELINES.
D. INSTALL R-TANK MODULES BY PLACING SIDE BY SIDE, IN ACCORDANCE WITH THE DESIGN DRAWINGS. THE MODULES ARE TO BE ORIENTED AS PER THE DESIGN DRAWING WITH REQUIRED DEPTH AS SHOWN ON PLANS.
   a. FOR HD AND SD INSTALLATIONS, THE LARGE SIDE PLATE OF THE TANK SHOULD BE PLACED ON THE PERIMETER OF THE SYSTEM. THIS WILL TYPICALLY REQUIRE THAT THE ENDS OF THE TANK AREA WILL HAVE A ROW OF TANKS PLACED PERPENDICULAR TO ALL OTHER TANKS. REFER TO R-TANK DRAWINGS AND INSTALLATION GUIDE FOR MORE DETAILS.
   b. FOR MD, UD, AND XD INSTALLATIONS, THERE IS NO PERPENDICULAR END ROW REQUIRED.
   c. FOR MD INSTALLATION, EXTERNAL SIDE PANELS SHALL BE INSTALLED AROUND THE PERIMETER OF THE SYSTEM. STACKING CLIPS SHALL BE INSTALLED IN EACH TIER AND EACH DIRECTION, AS SHOWN ON DESIGN DRAWING DETAILS.
   d. FOR XD INSTALLATIONS, INSTALL STACKING CLIPS AS SPECIFIED IN DESIGN DRAWINGS.
E. COMPLETELY ENCAPSULATE THE R-TANK UNITS IN THE SPECIFIED GEOTEXTILE TO PREVENT BACKFILL ENTRY INTO THE SYSTEM. OVERLAP GEOTEXTILE 12" OR AS RECOMMENDED BY MANUFACTURER. TAKE GREAT CARE TO AVOID DAMAGE TO GEOTEXTILE (AND, IF SPECIFIED, IMPERVIOUS LINER) DURING PLACEMENT.
F. IDENTIFY ANY INLET(S) OR OUTLET(S) LOCATIONS. THE GEOTEXTILE FABRIC SHALL BE CUT TO ENABLE HYDRAULIC CONTINUITY BETWEEN THE CONNECTIONS AND THE R-TANK UNITS. THESE CONNECTIONS SHALL BE SECURED USING PIPE BOOTS WITH STAINLESS STEEL PIPE CLAMPS. SUPPORT PIPE IN TRENCHES DURING BACKFILL OPERATIONS TO PREVENT PIPE FROM SETTLING AND DAMAGING THE GEOTEXTILE WRAP OR PIPE. ENSURE END OF PIPE IS INSTALLED SNUG AGAINST R-TANK SYSTEM.
G. INSTALL INSPECTION AND VENTILATION PORTS IN LOCATIONS NOTED ON PLANS. AT A MINIMUM ONE MAINTENANCE PORT SHALL BE INSTALLED WITHIN 10' OF EACH INLET & OUTLET CONNECTION, AND WITH A MAXIMUM SPACING OF APPROXIMATELY 50' ON CENTER. INSTALL ALL PORTS AS NOTED IN THE R-TANK INSTALLATION GUIDE.

**3.04 BACKFILLING OF THE R-TANK UNITS**

A. BACKFILL WITH MATERIALS IN ACCORDANCE WITH SECTION 2.03C AND PROJECT SPECIFICATIONS
   a. PLACE MATERIAL AROUND THE PERIMETER OF THE UNITS IN LIFTS WITH A MAXIMUM THICKNESS OF 12" AND COMPACTED WITH WALK BEHIND COMPACTION EQUIPMENT.
      1. EACH LIFT SHALL BE PLACED AROUND THE ENTIRE PERIMETER SUCH THAT EACH LIFT IS NO MORE THAN 24" HIGHER THAN THE SIDE BACKFILL ALONG ANY OTHER LOCATION ON THE PERIMETER OF THE R-TANK SYSTEM.
      2. NO FILL SHALL BE PLACED OVER TOP OF TANKS UNTIL THE SIDE BACKFILL HAS BEEN COMPLETED.
      3. EACH LIFT SHALL BE COMPACTED PROJECT SPECIFICATIONS OR UNTIL NO FURTHER DENSIFICATION IS OBSERVED (FOR SELF-COMPACTING STONE MATERIALS). EVEN WHEN "SELF-COMPACTING" BACKFILL MATERIALS ARE SELECTED, A WALK BEHIND VIBRATORY COMPACTOR MUST BE USED.
      4. TAKE CARE TO ENSURE THAT THE COMPACTION PROCESS DOES NOT ALLOW THE MACHINERY TO CONTACT THE MODULES DUE TO THE POTENTIAL FOR DAMAGE TO THE GEOTEXTILE AND R-TANK UNITS.
      5. NO COMPACTION EQUIPMENT IS PERMISSIBLE TO OPERATE DIRECTLY ON THE R-TANK MODULES.
   b. PLACE A TOP BACKFILL LAYER ON THE UNITS TO THE THICKNESS SPECIFIED IN THE R-TANK DRAWINGS AND IN ACCORDANCE WITH PROJECT SPECIFICATIONS.
      1. ONLY LOW-PRESSURE TRACK VEHICLES SHALL BE OPERATED OVER THE R-TANK SYSTEM DURING CONSTRUCTION. DUMP TRUCKS AND PANS SHALL NOT BE OPERATED WITHIN THE R-TANK SYSTEM FOOTPRINT AT ANY TIME. HEAVY EQUIPMENT SHOULD UNLOAD IN AN AREA ADJACENT TO THE R-TANK SYSTEM AND THE MATERIAL SHOULD BE MOVED OVER THE SYSTEM USING LOW GROUND PRESSURE TRACKED EQUIPMENT.
      2. LIGHTLY COMPACTED USING A WALK-BEHIND TRENCH ROLLER. ALTERNATELY, A ROLLER (MAXIMUM GROSS VEHICLE WEIGHT OF 6 TONS) MAY BE USED. ROLLER MUST REMAIN IN STATIC MODE UNTIL A MINIMUM OF 24" OF COVER HAS BEEN PLACED OVER THE MODULES. SHEEP FOOT ROLLERS SHOULD NOT BE USED.
B. IF SPECIFIED, COMPLETELY ENCAPSULATE THE BACKFILL IN THE SPECIFIED GEOTEXTILE. OVERLAP GEOTEXTILE 12" OR AS RECOMMENDED BY MANUFACTURER. TAKE GREAT CARE TO AVOID DAMAGE TO GEOTEXTILE (AND, IF SPECIFIED, IMPERVIOUS LINER) DURING PLACEMENT.
C. IF REQUIRED, INSTALL A GEOGRID AS SHOWN ON PLANS. GEOGRID SHALL EXTEND A MINIMUM OF 3 FEET BEYOND THE LIMITS OF THE EXCAVATION WALL. IN CASES OF LIMITATIONS SUCH AS CURB, PROPERTY LINE, ETC. CONSULT A MANUFACTURER'S REPRESENTATIVE ABOUT REDUCING THE MINIMUM EXTENSION LENGTH.
D. FOLLOWING PLACEMENT AND COMPACTION OF THE INITIAL COVER, SUBSEQUENT LIFTS OF STRUCTURAL FILL (SECTION 2.03D) SHALL BE PLACED AND COMPACTED PER ENGINEER OF RECORD SPECIFICATIONS. DO NOT EXCEED MAXIMUM COVER DEPTHS LISTED IN TABLE 2.01B.
E. ENSURE THAT ALL UNRELATED CONSTRUCTION TRAFFIC IS KEPT AWAY FROM THE LIMITS OF EXCAVATION UNTIL THE PROJECT IS COMPLETE AND FINAL SURFACE MATERIALS ARE IN PLACE. IT IS RECOMMENDED THAT HIGH VISIBILITY TAPE OR OTHER DEVICES BE PLACED AROUND THE SYSTEM TO PREVENT TRAFFIC ACCESS.
F. PLACE SURFACING MATERIALS, SUCH AS GROUNDCOVERS (NO LARGE TREES), OR PAVING MATERIALS OVER THE STRUCTURE WITH CARE TO AVOID DISPLACEMENT OF COVER FILL AND DAMAGE TO SURROUNDING AREAS.

**3.05 MAINTENANCE REQUIREMENTS**

A. ROUTINE MAINTENANCE EFFORT IS REQUIRED TO ENSURE PROPER PERFORMANCE OF THE R-TANK SYSTEM. THE MAINTENANCE PROGRAM SHOULD BE FOCUSED ON PRETREATMENT SYSTEMS. ENSURING THESE STRUCTURES ARE CLEAN AND FUNCTIONING PROPERLY WILL REDUCE THE RISK OF CONTAMINATION OF THE R-TANK SYSTEM AND STORMWATER RELEASED FROM THE SITE. MAINTAIN AS NEEDED USING ACCEPTABLE PRACTICES OR FOLLOWING MANUFACTURER'S GUIDELINES (FOR PROPRIETARY SYSTEMS).
B. ALL INLET PIPES AND INSPECTION AND/OR MAINTENANCE PORTS IN THE R-TANK SYSTEM WILL NEED TO BE INSPECTED FOR ACCUMULATION OF SEDIMENTS AT LEAST QUARTERLY THROUGH THE FIRST YEAR OF OPERATION AND AT LEAST YEARLY THEREAFTER.
C. IF SEDIMENT HAS ACCUMULATED TO THE LEVEL NOTED IN THE R-TANK OPERATION AND MAINTENANCE GUIDE OR BEYOND A LEVEL ACCEPTABLE TO THE OWNER'S ENGINEER, THE R-TANK SYSTEM SHOULD BE FLUSHED.

| DATE | INITIALS | DESCRIPTIONS |
|---|---|---|
| 2/16/2026 | CRH | INCREASE VOLUME AND CHANGE TANK TYPE |
| 2/19/2026 | CRH | REVISE PIPE CONNECTIONS AND TREATMENT ROWS |
| | | |
| | | |
| | | |
| | | |

R TANK

DISTRIBUTED BY:

FERGUSON WATERWORKS

**R-Tank**

MODULAR STORMWATER STORAGE SYSTEM

R-TANK SPECIFICATION
COMPASS & KEY INDUSTRIAL
BROWNSBURG, IN

DRAWN BY
CRH

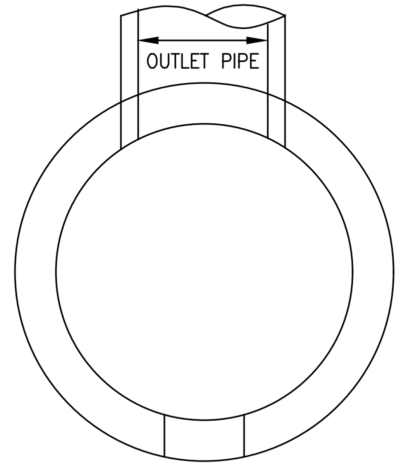
DATE
11/17/2025

SHEET NO.
7 of 7

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO FERGUSON WATERWORKS BY THE DESIGN ENGINEER, CONTRACTOR, OR OTHER PROJECT REPRESENTATIVE. THE ENGINEER OF RECORD SHALL REVIEW AND APPROVED THAT THE DEPICTED LAYOUT AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE REGULATIONS AND PROJECT SPECIFIC REQUIREMENTS.

# APPENDIX J

# OUTLET CONTROL STRUCTURE




PLAN

* NOTE

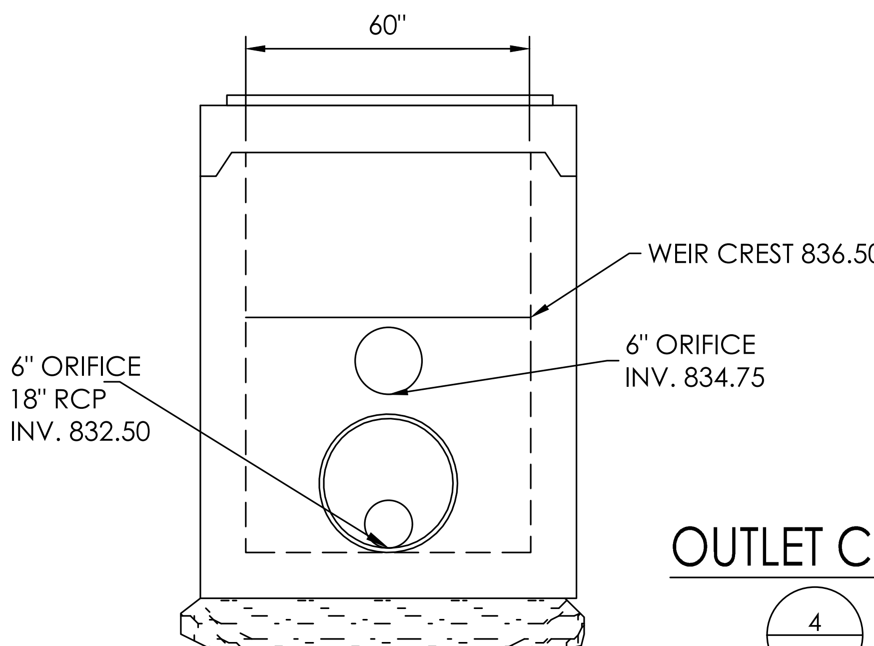
- GRANULAR LEVELING MATERIAL REQUIRED FOR PRECAST BASE.
- GRANULAR MATERIAL SHALL BE No. 8 OR No. 53 STONE MEETING INDOT STANDARD SPECIFICATIONS AT A MINIMUM 6 INCHES IN DEPTH AND COMPACTED TO 95% STD. PROCTOR DENSITY

GENERAL NOTES:

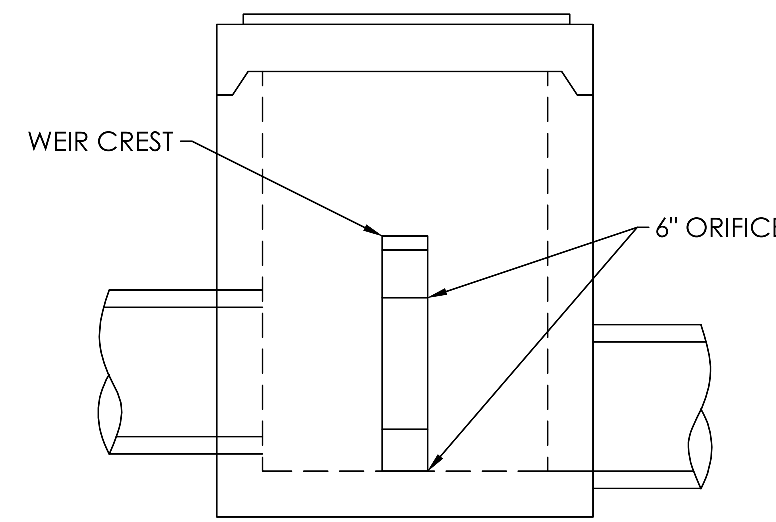
1. STRUCTURE SHALL BE PRECAST CONCRETE AND SHALL BE IN ACCORDANCE WITH ASTM C890

2. APPROVED TRASH RACK SHALL MATCH STRUCTURALLY AND HYDRAULICALLY.

3. SEE PLANS FOR ORIENTATION OF STRUCTURES AND OUTLET PIPES.




ELEVATION




SECTION

## OUTLET CONTROL STRUCTURE

NOT TO SCALE

4
C801

# APPENDIX K

# SQU SIZING CALCULATIONS

Water Quality printed 2/12/2026

cells in blue must be completed by user

| | | | | | | |
|---|---|---|---|---|---|---|
| CNwq | | UNIT = | 420 | | | |
| | = 1000/[10+5P+10Qa -10 SQRT(Qa^2 +1.25QaP)] | | | | | |
| | P | 1 | inch rainfall | From 151.23 | | |
| | Impervious | 64.52 | % | C | 0.445 | runoff coefficient |
| | Qa | 0.63068 | | Tc | 30 | min |
| | | | | I | 2.34 | in/hr (2-yr storm at Tc) |
| CNwq = | 96 | | | I/2 | 1.17 | in/hr |
| | | | | Qwq | 1.33 | cfs Rational |
| WQv | | | | | | |
| | = (P * Rv * A) / 12 | | | | | |
| | A | 2.56 | Area (AC) | | | |
| WQv = | 0.1345 | ac-ft | | | | |
| | 5861 | CF | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| CNwq | | UNIT = | 310 | | | |
| | = 1000/[10+5P+10Qa -10 SQRT(Qa^2 +1.25QaP)] | | | | | |
| | P | 1 | inch rainfall | From 151.23 | | |
| | Impervious | 64.52 | % | C | 0.445 | runoff coefficient |
| | Qa | 0.63068 | | Tc | 30 | min |
| | | | | I | 2.34 | in/hr (2-yr storm at Tc) |
| CNwq = | 96 | | | I/2 | 1.17 | in/hr |
| | | | | Qwq | 0.59 | cfs Rational |
| WQv | | | | | | |
| | = (P * Rv * A) / 12 | | | | | |
| | A | 1.14 | Area (AC) | | | |
| WQv = | 0.0599 | ac-ft | | | | |
| | 2610 | CF | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| CNwq | | UNIT = | 116 | | | |
| | = 1000/[10+5P+10Qa -10 SQRT(Qa^2 +1.25QaP)] | | | | | |
| | P | 1 | inch rainfall | From 151.23 | | |
| | Impervious | 64.52 | % | C | 0.445 | runoff coefficient |
| | Qa | 0.63068 | | Tc | 30 | min |
| | | | | I | 2.34 | in/hr (2-yr storm at Tc) |
| CNwq = | 96 | | | I/2 | 1.17 | in/hr |
| | | | | Qwq | 1.19 | cfs Rational |
| WQv | | | | | | |
| | = (P * Rv * A) / 12 | | | | | |
| | A | 2.29 | Area (AC) | | | |
| WQv = | 0.1204 | ac-ft | | | | |
| | 5243 | CF | | | | |

# APPENDIX L

# SQU O&M

# Aqua-Swirl® XCelerator® High Performance Stormwater Treatment System

# Inspection and Maintenance Manual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**Chattanooga, TN 37343**
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**August 2025**

# Aqua-Swirl® XCelerator® High Performance Stormwater Treatment System

The Aqua-Swirl® XCelerator® High Performance Stormwater Treatment System (XCelerator® XP) is a hydrodynamic separator designed and supplied by AquaShield™, Inc. (AquaShield™). technology removes pollutants including suspended solids and debris from stormwater runoff. Both treatment and storage are accomplished in the single treatment chamber without the use of multiple or hidden blind access chambers.

## System Operation

Operation begins when stormwater enters the treatment chamber, where sediment capture and storage are accomplished. Water initially flows downward from the inlet and is then forced upward through an array of inclined plates. This design encourages particles to settle onto the surfaces of the inclined plates and accumulate at the bottom of the chamber.

## Aqua-Swirl® XCelerator® XP System Maintenance

The long-term performance of any stormwater treatment structure, including manufactured or land-based systems, depends on a consistent maintenance plan. Inspection and maintenance functions are simple and easy for the Aqua-Swirl® XCelerator® XP, allowing all maintenance actions to be performed from the surface. It is important that a routine inspection and maintenance program be established for each unit based on: (a) the volume or load of the contaminants of concern, (b) the frequency of releases of contaminants at the facility, and (c) the nature of the area being drained. In order to ensure that our systems are being maintained properly, AquaShield™ offers a maintenance solution to all of our customers. We will arrange to have maintenance performed at the stakeholder's request.

## Inspection

The XCelerator® XP can be inspected from the surface, eliminating the need to enter the system to determine when cleanout should be performed. In most cases, AquaShield™ recommends a quarterly inspection during construction and, for the first year of operation, developing an appropriate schedule of maintenance. The XCelerator® XP should be inspected and cleaned at the end of construction, regardless of whether it has reached its pollutant storage capacity. Based on observation of the system's first year in operation, we recommend that the inspection schedule be revised to reflect the site-specific conditions encountered. Typically, the inspection schedule for subsequent years is once per year.

## Maintenance

The XCelerator® XP has been designed to minimize and simplify the inspection and maintenance process. The single-chamber system can be inspected and maintained entirely from the surface, thereby eliminating the need for confined space entry. Inspection of any floatable debris can be directly observed and maintained through the manhole access provided directly over the treatment chamber.

**Inspection Procedure**

To inspect the XCelerator® XP, a hook is typically needed to remove the manhole cover. AquaShield™ provides a customized manhole cover with our distinctive logo to make it easy for maintenance crews to locate the system in the field. We also provide a permanent metal information plate affixed inside the access riser, which provides our contact information, the XCelerator® XP model size, and serial number.

The only tools needed to inspect the XCelerator® XP system are a flashlight and a measuring device, such as a stadia rod or pole. Given the easy and direct accessibility provided, any floating trash and debris can be observed directly from the surface. Sediment depths can easily be determined by lowering a measuring device around the internal components to the top of the sediment pile and to the surface of the water. AquaShield™ recommends that the units be cleaned when sediment depth reaches 7.25 inches, representing 50% sediment storage capacity. The full sediment storage depth in the XCelerator® XP is 14.5 inches.

It should be noted that, to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the *top* of the sediment pile. Keep in mind that the finer sediment at the top of the pile may offer less resistance to the measuring device than the larger particles, which typically occur deeper within the sediment pile.

**Aqua-Swirl® XCelerator® XP Cleanout Procedure**

Cleaning the XCelerator® XP is simple and quick. Floatable debris, if present, can be observed and removed directly through the provided 30-inch service access riser. A vacuum truck is typically used to remove the accumulated sediment and debris. After water is evacuated from the system, a water jet can be used to clean the space between the plates from the outlet channel. Access to the outlet channel is provided through the riser. Since there are no multiple or limited (blind) access chambers in the XCelerator® XP, there are no restrictions to prohibit on-site maintenance tasks.

*Sediment inspection using a stadia rod*

**Disposal of Recovered Materials**

AquaShield™ recommends that all maintenance activities be performed in accordance with appropriate health and safety practices for the tasks and equipment being used. AquaShield™ also recommends that all materials removed from the XCelerator® XP and any external structures (e.g, bypass features for off-line configurations) be handled and disposed of in full accordance with any applicable local and state requirements.

*Vacuum (vactor) truck quickly cleans the single open access swirl chamber*

## ***Aqua-Swirl® XCelerator® XP Inspection and Maintenance Work Sheets on Following Pages***

## Aqua-Swirl® XCelerator® XP Inspection and Maintenance Manual Work Sheets

### SITE and OWNER INFORMATION

Site Name: ______________________________

Site Location: ______________________________

Date: ____________________ Time: ____________________

Inspector Name: ______________________________

Inspector Company: ____________________ Phone #: ____________________

Owner Name: ______________________________

Owner Address: ______________________________

Owner Phone #: ____________________ Emergency Phone #: ____________________

### INSPECTIONS

**I. Trash and Debris**

1. Remove manhole lid to expose liquid surface of the Aqua-Swirl® XCelerator® XP.
2. Remove floatable debris with basket or net, if any present.

**II. Sediment Accumulation**

1. Lower measuring device (e.g. stadia rod) into treatment chamber and around the internal components through service access until top of sediment pile is reached.
2. Record distance to top of sediment pile from top of standing water: ____________ inches.
3. Maximum recommended sediment depth prior to cleanout is 7.25 inches for all models. Consult system shop drawing for treatment chamber depth as measured from the inlet pipe invert to base of the unit.

**III. Diversion Structures (External Bypass Features)**

If a diversion (external bypass) configuration is present, it should be inspected as follows:

1. Inspect weir or other bypass feature for structural decay or damage. Weirs are more susceptible to damage than offset piping and should be checked to confirm that they are not crumbling (concrete or brick) or decaying (steel).
2. Inspect diversion structure and bypass piping for signs of structural damage or blockage from debris or sediment accumulation.
3. When feasible, measure elevations on diversion weir or piping to ensure it is consistent with site plan designs.

4. Inspect downstream (convergence) structure(s) for sign of blockage or structural failure as noted above.

## CLEANING

Schedule cleaning with local vactor company or AquaShield™ to remove sediment, trash, and other pollutants. The captured material generally does not require special treatment or handling for disposal. Site-specific conditions or the presence of known contaminants may necessitate appropriate actions be taken to clean and dispose of materials captured and retained by the XCelerator® XP. All cleaning activities should be performed in accordance with property health and safety procedures.

AquaShield™ always recommends that all materials removed from the XCelerator® XP during the maintenance process be handled and disposed of in accordance with local and state environmental or other regulatory requirements.

## MAINTENANCE SCHEDULE

### I. During Construction

Inspect the XCelerator® XP every three (3) months and clean the system as needed. The XCelerator® XP should be inspected and cleaned at the end of construction, regardless of whether it has reached its maintenance trigger.

### II. First Year Post-Construction

Inspect the unit every three (3) months and clean the system as needed.

Inspect and clean the system once annually, regardless of whether it has reached its pollutant storage capacity.

### III. Second and Subsequent Years Post-Construction

If the system did not reach full pollutant capacity in the First Year Post-Construction period, the system can be inspected and cleaned annually.

If the XCelerator® XP reached full pollutant capacity in less than 12 months in the First Year Post-Construction period, the system should be inspected once every six (6) months and cleaned as needed. The unit should be cleaned annually, regardless of whether it reaches its pollutant capacity.

### IV. Bypass Structures

Bypass structures for off-line configurations should be inspected whenever the XCelerator® XP is inspected. Maintenance should be performed on bypass structures as needed.

## MAINTENANCE COMPANY INFORMATION

Company Name: ______________________________

Street Address: ______________________________

City: ____________________ State/Prov.:__________ Zip/Postal Code: __________

Contact: ____________________ Title: __________

Office Phone: ____________________ Cell Phone: ____________________

## ACTIVITY LOG

Date of Cleaning: ____________________ (Next inspection should be 3 months from this data for first year).

Time of Cleaning: Start: ____________________ End: ____________________

Date of Next Inspection: ______________

Floatable debris present: Yes No

Notes: ______________________________

______________________________

______________________________

## STRUCTURAL CONDITIONS and OBSERVATIONS

Structural damage: Yes No Where: ______________________________

Structural wear: Yes No Where: ______________________________

Odors present: Yes No Describe: ______________________________

Clogging: Yes No Describe: ______________________________

Other Observations: ______________________________

______________________________

______________________________

## NOTES

| Additional Comments and/or Actions To Be Taken | Time Frame |
| --- | --- |
| | |
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| | |

## ATTACHMENTS

- Attach site plan showing Aqua-Swirl® XCelerator® XP location.
- Attach detail drawing showing Aqua-Swirl® XCelerator® XP dimensions and model number.
- If a diversion configuration is used, attach details showing basic design and elevations (where feasible).

# Aqua-Swirl® XCelerator® XP

## TABULAR MAINTENANCE SCHEDULE

Date Construction Started: ______________________________

Date Construction Ended: ______________________________

## During Construction

| | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Activity** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Inspect and Clean as needed | | | X | | | X | | | X | | | X |
| Inspect Bypass and maintain as needed | | | X | | | X | | | X | | | X |
| Clean System* | | | | | | | | | | | | X* |

* The Aqua-Swirl® XCelerator® XP should be cleaned **once a year,** regardless of whether it has reached full pollutant storage capacity. In addition, the system should be cleaned at the **end of construction,** regardless of whether it has reached full pollutant storage capacity.

## First Year Post-Construction

| | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Activity** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Inspect and Clean as needed | | | X | | | X | | | X | | | X |
| Inspect Bypass and maintain as needed | | | X | | | X | | | X | | | X |
| Clean System* | | | | | | | | | | | | X* |

* The Aqua-Swirl® XCelerator® XP should be cleaned **once a year,** regardless of whether it has reached full pollutant storage capacity.

## Second and Subsequent Years Post-Construction

| | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Activity** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Inspect and Clean as needed | | | | | | | | | | | | X* |
| Inspect Bypass, maintain as needed | | | | | | | | | | | | X* |
| Clean System* | | | | | | | | | | | | X* |

* If the Aqua-Swirl® XCelerator® XP did **not** reach full pollutant capacity in the First Year Post-Construction period, the system can be inspected and cleaned once per year.

If the Aqua-Swirl® XCelerator® XP **reached** full pollutant capacity in less than 12 months in the First Year Post-Construction period, the system should be inspected once every six (6) months or more frequently if history warrants, and cleaned as needed. The system should be cleaned annually, regardless of whether it reaches its full pollutant capacity.

# Design and Maintenance Considerations for SNOUT® Stormwater Quality Systems

**Background:**

The SNOUT system from Best Management Products, Inc. (BMP, Inc.) is based on a vented hood that can reduce floatable trash and debris, free oils, and other solids from stormwater discharges. In its most basic application, a SNOUT hood is installed over the outlet pipe of a catch basin or other stormwater quality structure with a deep sump (see Installation Drawing). The SNOUT forms a baffle that traps floatable debris and free oils on the surface, while permitting heavier solids to sink to the bottom of the sump. The clarified intermediate layer is forced out of the structure through the open bottom of the SNOUT by displacement from incoming flow. The resultant discharge contains considerably less unsightly trash and other gross pollutants, and can also offer reductions of free-oils and finer solids.

As with any structural stormwater quality design, maintenance considerations will have a dramatic impact on SNOUT system performance over the life of the facility. The most important factor to consider when designing structures with a SNOUT is the depth of the sump. Sump is defined as the depth from the invert of the outlet pipe to the bottom of the structure. *Simply put, the deeper the sump, the more effective the unit will be both in terms of pollutant removals and reducing frequency of maintenance.* More volume in a structure means more quiescence, thus allowing the pollutants a better chance to separate out. Secondly, more volume means fewer cycles between maintenance, because the structure has a greater capacity. Of equal importance to good performance is putting SNOUTs in multiple structures. The closer one captures pollution to where it enters the infrastructure (e.g. at the inlet), the less mixing of runoff there is, and the easier it will be to separate out pollutants. Putting SNOUTs and deep sumps in all inlets that can be easily maintained develops a powerful structural treatment train with a great deal of effective storage volume, where even finer particles may have chance to settle out.

**Design Notes:**

- The SNOUT size is ALWAYS greater than the nominal pipe size. The SNOUT should cover the pipe OD and optimally the grouted area around the pipe (e.g. for a 12” pipe, an 18” SNOUT is the correct choice).
- As a rule of thumb, BMP, Inc. recommends *minimum* sump depths based on outlet pipe inside diameters of 2.5 to 3 times the outlet pipe size.
- For best performance, the inlet pipe and outlet pipe should have inverts close to the same elevation (a six inch or less deviation is optimal).
- Special note for smaller pipes: A minimum sump depth of 36 inches for all

pipe sizes 12 inches ID or less, and 48 inches for pipe 15-18 inches ID is required if collection of finer solids is desired.

- The plan dimension of the structure should be up to 6 to 7 times the flow area of the outlet pipe. Increasing area beyond that has a minimal impact on performance. However, the structure wall where the SNOUT is mounted must accommodate the size of the SNOUT (either the correct diameter or enough width).
- To optimize pollutant removals establish a “treatment train” with SNOUTs placed in as many inlets where it is feasible to do so (this protocol applies to most commercial, institutional or municipal applications and any application with direct discharge to surface waters).
- At a minimum, SNOUTs should be used in every third structure for less critical applications (less critical areas might include flow over grassy surfaces, very low traffic areas in private, non-commercial or non-institutional settings, single family residential sites).
- Use Bio-Skirts® for increased hydrocarbon reduction. Bio-Skirts are highly recommended for fueling or vehicle service stations, convenience stores, restaurants, loading docks, marinas, beaches, schools or high traffic applications. Each Bio-Skirt can retain about one gallon of oils.
- Use the Stainless TrashScreen for “Full Trash Capture” requirements.
- Use BMP Turbo Plates™ for increased sediment capture.
- The “R” series SNOUTs (12R, 18R, 24R, 30R, 30R/96, 42RTB/60, 52RTB/72, 52RTB/84 and 72RTB/96) are available for round manhole type structures of up to 96” ID; the “F” series SNOUTs (LP318F, 12F, 18F, 24F, 30F, 36F, 48F, 72F and 96F) are available for flat walled structures; the “NP” series SNOUTs (NP1218R, NP1524R, NP1830R, and NP2430R) are available for smaller diameter structures up to 30” ID.

**Example Structure Sizing Calculation:**

A SNOUT equipped structure with a 15 inch ID outlet pipe (1.23 sqft. flow area) will offer best performance with a minimum plan area of 7.4 sqft. and 48 inch sump. Thus, a readily available 48 inch diameter manhole-type structure, or a rectangular structure of 2 feet x 4 feet will offer sufficient size when combined with a sump depth of 48 inches or greater.

**Maintenance Recommendations:**

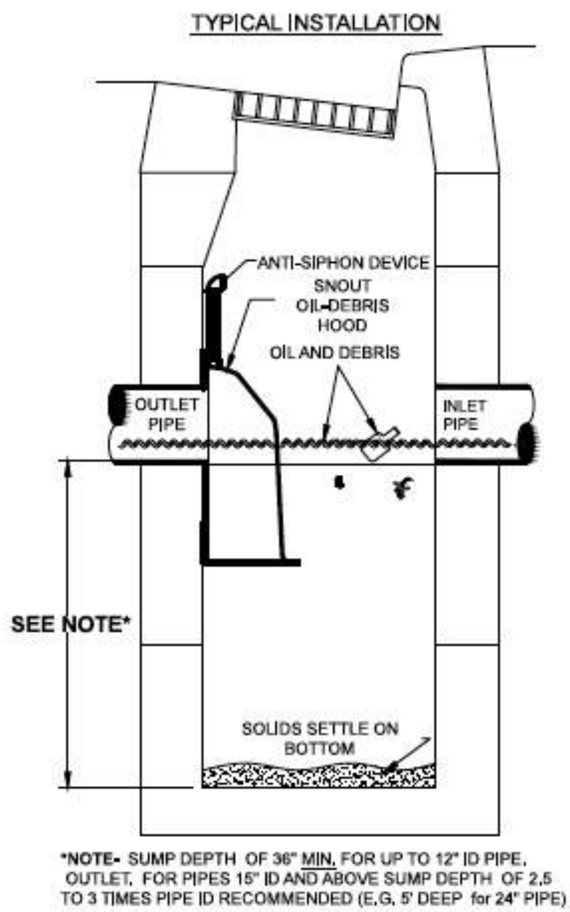
- Monthly monitoring for the first year of a new installation after the site has been stabilized is a recommended practice.
- Measurements should be taken after each rain event of .5 inches or more, or monthly, as determined by local weather conditions.
- Checking sediment depth and noting the surface pollutants in the structure will be helpful in planning maintenance.
- The pollutants collected in SNOUT equipped structures will consist of floatable debris and oils on the surface of the captured water, and grit and sediment on the bottom of the structure.
- It is best to schedule maintenance based on the solids collected in the sump.
- Optimally, the structure should be cleaned when the sump is half full (e.g. when 2 feet of material collects in a 4 foot sump, clean it out).
- Structures should also be cleaned if a spill or other incident causes a larger

than normal accumulation of pollutants in a structure.

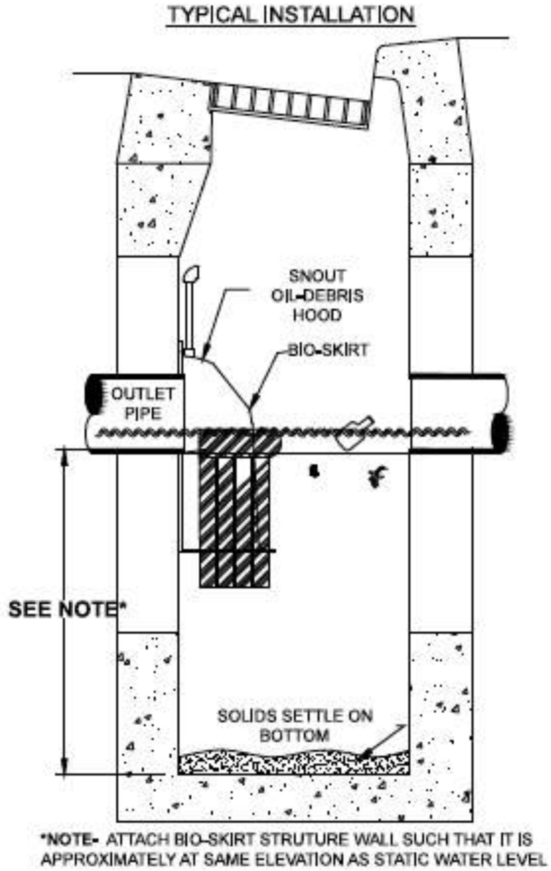
- Maintenance is best done with a vacuum truck.
- If Bio-Skirts are being used in the structure to enhance hydrocarbon capture, they should be checked on a monthly basis for the first year, and serviced or replaced when more than 2/3 of the boom is submerged, indicating a nearly saturated state. Assuming a typical pollutant-loading environment exists, Bio-Skirts should be serviced* annually or replaced as necessary.
- In the case of an oil spill, the structure should be checked and serviced and Bio-Skirts (if present) replaced or serviced immediately.
- All collected wastes must be handled and disposed of according to local environmental requirements.
- To maintain the SNOUT hoods, an annual inspection of the anti-siphon vent and access hatch are recommended. A simple flushing of the vent, or a gentle rodding with a flexible wire are all that's typically needed to maintain the anti-siphon properties. Opening and closing the access hatch once a year ensures a lifetime of trouble-free service.

*To extend the service life of a Bio-Skirt, the unit may be "wrung out" to remove oils and washed in an industrial washing machine with warm water. The Bio-Skirt may then be re-deployed if the material maintains it's structural integrity. A maintained Bio-Skirt can last for several years. Each Bio-Skirt can hold about on gallon of oils.

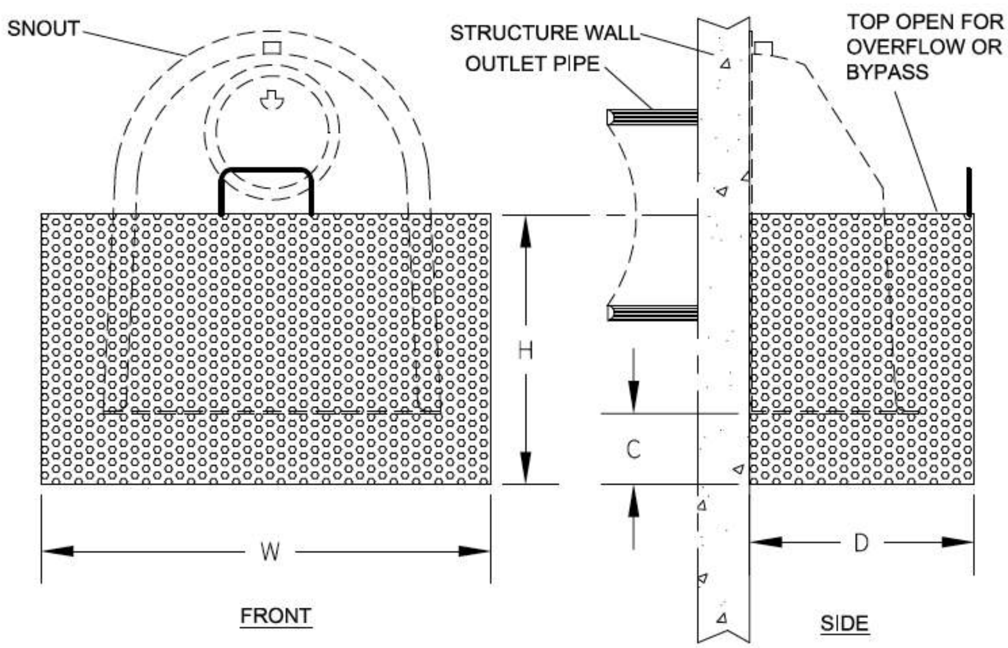
SNOUT INSTALLATION:



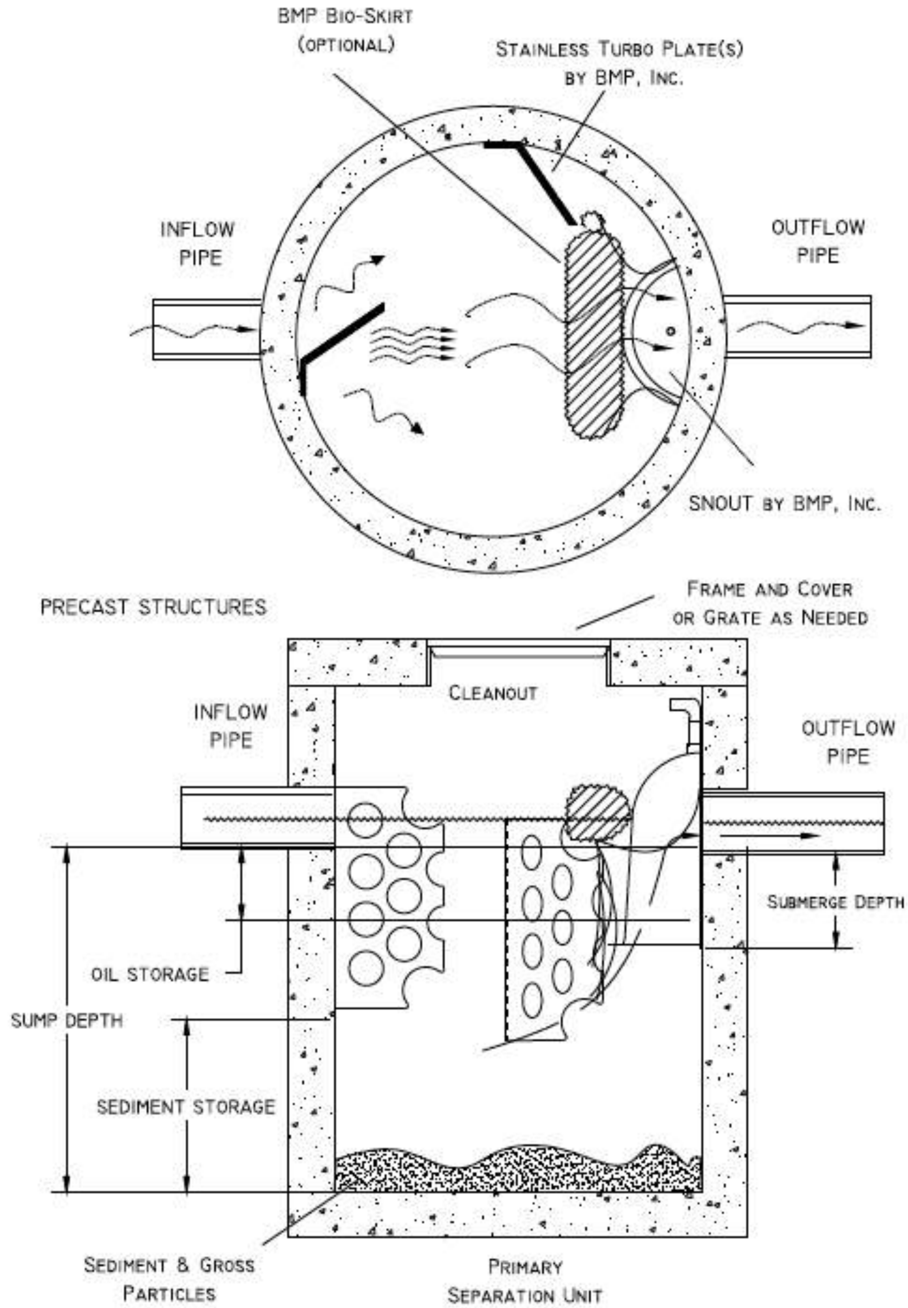
BIO-SKIRT INSTALLATION:




STAINLESS TRASHSCREEN INSTALLATION:



TURBO PLATE INSTALLATION:




**Contact Information:** Please contact T. J. Mullen at 800-504-8008, tjm@bmpinc.com or Matt White at 888-434-0277, mwhite@bmpinc.com for design assistance.

Website: www.bmpinc.com

The SNOUT, Bio-Skirt and TrashScreen are protected by: US Patents 6126817, 7857966, 7951294 and 8512556. More US patents are pending and BMP holds Canadian patents for much of the technology patented in the US. Canadian Patents numbers include 2285146, 2688012, 2690156 and 2740678. The SNOUT®, Bio-Skirt® Turbo Plate ™ and Stainless TrashScreen™ are trademarks of Best Management Products,

# APPENDIX M

# STORM SEWER CALCULATIONS

| Line No. | Inlet ID | Invert Dn (ft) | Invert Up (ft) | HGL Dn (ft) | HGL Up (ft) | Line Size (in) | Line Slope (%) | Line Length (ft) | Drng Area (ac) | Runoff Coeff (C) | Vel Ave (ft/s) | Flow Rate (cfs) | Capac Full (cfs) | Gnd/Rim El Up (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 101 | 832.23 | 832.31 | 832.81 | 832.96 | 24 | 0.31 | 25.429 | 0.00 | 0.00 | 3.42 | 2.81 | 12.69 | 838.25 |
| 2 | Null Structure | 832.31 | 832.44 | 833.05 | 833.11 | 24 | 0.30 | 42.893 | 0.00 | 0.00 | 2.85 | 2.81 | 12.45 | 838.80 |
| 3 | 111 | 832.50 | 832.54 | 834.87 | 834.87 | 18 | 0.30 | 12.333 | 0.00 | 0.00 | 1.06 | 1.88 | 5.78 | 838.76 |
| 4 | 112 | 832.54 | 832.59 | 834.89 | 834.91 | 18 | 0.25 | 19.999 | 0.00 | 0.00 | 2.15 | 3.80 | 5.30 | 838.93 |
| 5 | 113 | 832.59 | 832.75 | 834.92 | 835.01 | 18 | 0.26 | 63.102 | 0.31 | 0.80 | 2.19 | 3.87 | 5.32 | 837.35 |
| 6 | 114 | 832.75 | 833.14 | 835.05 | 835.14 | 18 | 0.25 | 156.027 | 0.00 | 0.00 | 1.46 | 2.59 | 5.28 | 839.96 |
| 7 | 115 | 833.14 | 833.53 | 835.18 | 835.26 | 18 | 0.32 | 120.052 | 0.41 | 0.50 | 1.56 | 2.76 | 5.95 | 837.45 |
| 8 | 116 | 833.53 | 834.03 | 835.28 | 835.54 | 12 | 0.32 | 155.996 | 0.39 | 0.50 | 1.85 | 1.45 | 2.02 | 837.45 |
| 9 | 117 | 832.54 | 832.58 | 834.89 | 834.89 | 12 | 0.30 | 14.250 | 0.00 | 0.00 | 0.01 | 0.01 | 1.97 | 838.47 |
| 10 | 112 | 832.58 | 832.59 | 834.89 | 834.89 | 12 | 0.09 | 14.000 | 0.00 | 0.00 | 0.01 | 0.01 | 1.06 | 838.93 |
| 11 | 211 | 833.40 | 833.42 | 834.87 | 834.91 | 12 | 0.30 | 7.476 | 0.15 | 0.80 | 3.13 | 2.46 | 1.96 | 837.62 |
| 12 | 212 | 833.42 | 833.75 | 835.13 | 835.39 | 12 | 0.30 | 107.997 | 0.23 | 0.50 | 2.20 | 1.73 | 1.96 | 837.62 |
| 13 | 213 | 833.75 | 834.08 | 835.43 | 835.51 | 12 | 0.30 | 108.005 | 0.17 | 0.80 | 1.29 | 1.01 | 1.96 | 837.62 |
| 14 | 301 | 833.78 | 833.83 | 834.87 | 834.88 | 12 | 0.30 | 16.345 | 0.00 | 0.00 | 1.19 | 0.93 | 1.96 | 837.99 |
| 15 | 302 | 833.83 | 833.89 | 834.90 | 834.99 | 12 | 0.30 | 19.999 | 0.00 | 0.00 | 2.96 | 2.32 | 1.96 | 838.41 |
| 16 | 303 | 833.89 | 834.14 | 835.01 | 835.38 | 12 | 0.30 | 82.585 | 0.40 | 0.80 | 3.03 | 2.38 | 1.96 | 837.71 |
| 17 | 304 | 833.83 | 833.87 | 834.90 | 834.90 | 12 | 0.30 | 14.250 | 0.00 | 0.00 | 0.01 | 0.01 | 1.96 | 838.17 |
| 18 | 302 | 833.87 | 833.92 | 834.90 | 834.90 | 12 | 0.30 | 13.861 | 0.00 | 0.00 | 0.01 | 0.01 | 1.97 | 838.41 |
| 19 | 201 | 832.50 | 832.50 | 834.87 | 834.88 | 18 | -0.01 | 31.499 | 0.00 | 0.00 | 0.80 | 1.42 | 0.00 | 833.73 |
| 20 | 501 | 833.20 | 833.23 | 834.87 | 834.93 | 12 | 0.43 | 7.674 | 0.23 | 0.80 | 4.12 | 3.24 | 2.35 | 837.62 |
| 21 | 502 | 833.23 | 833.59 | 835.33 | 835.72 | 12 | 0.32 | 112.488 | 0.00 | 0.00 | 2.66 | 2.09 | 2.01 | 837.61 |
| 22 | 503 | 833.59 | 833.92 | 835.77 | 836.15 | 12 | 0.32 | 103.497 | 0.15 | 0.80 | 2.75 | 2.16 | 2.01 | 837.62 |
| 23 | 504 | 833.92 | 834.23 | 836.21 | 836.34 | 12 | 0.35 | 88.000 | 0.23 | 0.80 | 1.74 | 1.37 | 2.11 | 837.73 |

Project File: compass_key_storm3.stm | Number of lines: 31 | Date: 2/20/2026

NOTES: ** Critical depth

# TERRA des

10 YR STORM INTENSITY

| Line No. | Inlet ID | Invert Dn (ft) | Invert Up (ft) | HGL Dn (ft) | HGL Up (ft) | Line Size (in) | Line Slope (%) | Line Length (ft) | Drng Area (ac) | Runoff Coeff (C) | Vel Ave (ft/s) | Flow Rate (cfs) | Capac Full (cfs) | Gnd/Rim El Up (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 401 | 832.50 | 832.53 | 834.87 | 834.87 | 24 | 0.20 | 14.543 | 0.46 | 0.80 | 1.22 | 3.83 | 10.12 | 838.16 |
| 25 | 420 | 832.53 | 832.56 | 834.90 | 834.90 | 24 | 0.23 | 14.334 | 0.00 | 0.00 | 1.41 | 4.44 | 10.75 | 838.00 |
| 26 | 402 | 832.56 | 832.59 | 834.93 | 834.94 | 24 | 0.23 | 13.945 | 0.00 | 0.00 | 1.42 | 4.48 | 10.75 | 838.08 |
| 27 | 403 | 832.59 | 832.78 | 834.96 | 835.12 | 18 | 0.23 | 82.528 | 0.00 | 0.00 | 2.60 | 4.59 | 4.99 | 837.06 |
| 28 | 404 | 832.78 | 833.13 | 835.17 | 835.50 | 18 | 0.23 | 155.960 | 0.00 | 0.00 | 2.73 | 4.82 | 4.99 | 838.58 |
| 29 | 405 | 833.13 | 833.50 | 835.62 | 835.89 | 18 | 0.31 | 120.014 | 0.45 | 0.80 | 2.84 | 5.01 | 5.84 | 837.54 |
| 30 | 406 | 833.50 | 834.06 | 835.95 | 836.76 | 12 | 0.36 | 155.996 | 0.43 | 0.80 | 3.26 | 2.56 | 2.13 | 837.56 |
| 31 | 402 | 832.53 | 832.59 | 834.90 | 834.90 | 12 | 0.30 | 20.000 | 0.00 | 0.00 | 0.01 | 0.01 | 1.96 | 838.08 |

| Project File: compass_key_storm3.stm | Number of lines: 31 | Date: 2/20/2026 |
|---|---|---|

NOTES: ** Critical depth

# TERRA des

25 YR STORM INTENSITY



| Line No. | Inlet ID | Invert Dn (ft) | Invert Up (ft) | HGL Dn (ft) | HGL Up (ft) | Line Size (in) | Line Slope (%) | Line Length (ft) | Drng Area (ac) | Runoff Coeff (C) | Vel Ave (ft/s) | Flow Rate (cfs) | Capac Full (cfs) | Gnd/Rim El Up (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 101 | 832.23 | 832.31 | 832.81 | 832.96 | 24 | 0.31 | 25.429 | 0.00 | 0.00 | 3.42 | 2.81 | 12.69 | 838.25 |
| 2 | Null Structure | 832.31 | 832.44 | 833.05 | 833.11 | 24 | 0.30 | 42.893 | 0.00 | 0.00 | 2.85 | 2.81 | 12.45 | 838.80 |
| 3 | 111 | 832.50 | 832.54 | 834.87 | 834.88 | 18 | 0.30 | 12.333 | 0.00 | 0.00 | 1.24 | 2.19 | 5.78 | 838.76 |
| 4 | 112 | 832.54 | 832.59 | 834.89 | 834.93 | 18 | 0.25 | 19.999 | 0.00 | 0.00 | 2.54 | 4.49 | 5.30 | 838.93 |
| 5 | 113 | 832.59 | 832.75 | 834.94 | 835.06 | 18 | 0.26 | 63.102 | 0.31 | 0.80 | 2.58 | 4.57 | 5.32 | 837.35 |
| 6 | 114 | 832.75 | 833.14 | 835.12 | 835.25 | 18 | 0.25 | 156.027 | 0.00 | 0.00 | 1.71 | 3.02 | 5.28 | 839.96 |
| 7 | 115 | 833.14 | 833.53 | 835.29 | 835.40 | 18 | 0.32 | 120.052 | 0.41 | 0.50 | 1.81 | 3.20 | 5.95 | 837.45 |
| 8 | 116 | 833.53 | 834.03 | 835.43 | 835.77 | 12 | 0.32 | 155.996 | 0.39 | 0.50 | 2.13 | 1.67 | 2.02 | 837.45 |
| 9 | 117 | 832.54 | 832.58 | 834.89 | 834.89 | 12 | 0.30 | 14.250 | 0.00 | 0.00 | 0.01 | 0.01 | 1.97 | 838.47 |
| 10 | 112 | 832.58 | 832.59 | 834.89 | 834.89 | 12 | 0.09 | 14.000 | 0.00 | 0.00 | 0.01 | 0.01 | 1.06 | 838.93 |
| 11 | 211 | 833.40 | 833.42 | 834.87 | 834.92 | 12 | 0.30 | 7.476 | 0.15 | 0.80 | 3.65 | 2.86 | 1.96 | 837.62 |
| 12 | 212 | 833.42 | 833.75 | 835.23 | 835.57 | 12 | 0.30 | 107.997 | 0.23 | 0.50 | 2.56 | 2.01 | 1.96 | 837.62 |
| 13 | 213 | 833.75 | 834.08 | 835.62 | 835.74 | 12 | 0.30 | 108.005 | 0.17 | 0.80 | 1.48 | 1.16 | 1.96 | 837.62 |
| 14 | 301 | 833.78 | 833.83 | 834.87 | 834.89 | 12 | 0.30 | 16.345 | 0.00 | 0.00 | 1.39 | 1.09 | 1.96 | 837.99 |
| 15 | 302 | 833.83 | 833.89 | 834.92 | 835.03 | 12 | 0.30 | 19.999 | 0.00 | 0.00 | 3.41 | 2.68 | 1.96 | 838.41 |
| 16 | 303 | 833.89 | 834.14 | 835.06 | 835.55 | 12 | 0.30 | 82.585 | 0.40 | 0.80 | 3.49 | 2.74 | 1.96 | 837.71 |
| 17 | 304 | 833.83 | 833.87 | 834.92 | 834.92 | 12 | 0.30 | 14.250 | 0.00 | 0.00 | 0.01 | 0.01 | 1.96 | 838.17 |
| 18 | 302 | 833.87 | 833.92 | 834.92 | 834.92 | 12 | 0.30 | 13.861 | 0.00 | 0.00 | 0.01 | 0.01 | 1.97 | 838.41 |
| 19 | 201 | 832.50 | 832.50 | 834.87 | 834.88 | 18 | -0.01 | 31.499 | 0.00 | 0.00 | 0.80 | 1.42 | 0.00 | 833.73 |
| 20 | 501 | 833.20 | 833.23 | 834.87 | 834.96 | 12 | 0.44 | 7.674 | 0.23 | 0.80 | 4.80 | 3.77 | 2.35 | 837.62 |
| 21 | 502 | 833.23 | 833.59 | 835.49 | 836.02 | 12 | 0.32 | 112.488 | 0.00 | 0.00 | 3.09 | 2.43 | 2.01 | 837.61 |
| 22 | 503 | 833.59 | 833.92 | 836.09 | 836.60 | 12 | 0.32 | 103.497 | 0.15 | 0.80 | 3.18 | 2.50 | 2.01 | 837.62 |
| 23 | 504 | 833.92 | 834.23 | 836.68 | 836.85 | 12 | 0.35 | 88.000 | 0.23 | 0.80 | 2.01 | 1.58 | 2.11 | 837.73 |

Project File: compass_key_storm3.stm | Number of lines: 31 | Date: 2/20/2026

NOTES: ** Critical depth

# TERRA des

25 YR STORM INTENSITY

| Line No. | Inlet ID | Invert Dn (ft) | Invert Up (ft) | HGL Dn (ft) | HGL Up (ft) | Line Size (in) | Line Slope (%) | Line Length (ft) | Drng Area (ac) | Runoff Coeff (C) | Vel Ave (ft/s) | Flow Rate (cfs) | Capac Full (cfs) | Gnd/Rim El Up (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 401 | 832.50 | 832.53 | 834.87 | 834.88 | 24 | 0.20 | 14.543 | 0.46 | 0.80 | 1.41 | 4.44 | 10.12 | 838.16 |
| 25 | 420 | 832.53 | 832.56 | 834.91 | 834.91 | 24 | 0.23 | 14.334 | 0.00 | 0.00 | 1.66 | 5.20 | 10.75 | 838.00 |
| 26 | 402 | 832.56 | 832.59 | 834.96 | 834.96 | 24 | 0.23 | 13.945 | 0.00 | 0.00 | 1.67 | 5.24 | 10.75 | 838.08 |
| 27 | 403 | 832.59 | 832.78 | 835.00 | 835.21 | 18 | 0.23 | 82.528 | 0.00 | 0.00 | 3.04 | 5.36 | 4.99 | 837.06 |
| 28 | 404 | 832.78 | 833.13 | 835.28 | 835.73 | 18 | 0.23 | 155.960 | 0.00 | 0.00 | 3.17 | 5.60 | 4.99 | 838.58 |
| 29 | 405 | 833.13 | 833.50 | 835.88 | 836.25 | 18 | 0.31 | 120.014 | 0.45 | 0.80 | 3.28 | 5.80 | 5.84 | 837.54 |
| 30 | 406 | 833.50 | 834.06 | 836.33 | 837.40 | 12 | 0.36 | 155.996 | 0.43 | 0.80 | 3.75 | 2.95 | 2.13 | 837.56 |
| 31 | 402 | 832.53 | 832.59 | 834.91 | 834.91 | 12 | 0.30 | 20.000 | 0.00 | 0.00 | 0.01 | 0.01 | 1.96 | 838.08 |

Project File: compass_key_storm3.stm | Number of lines: 31 | Date: 2/20/2026

NOTES: ** Critical depth

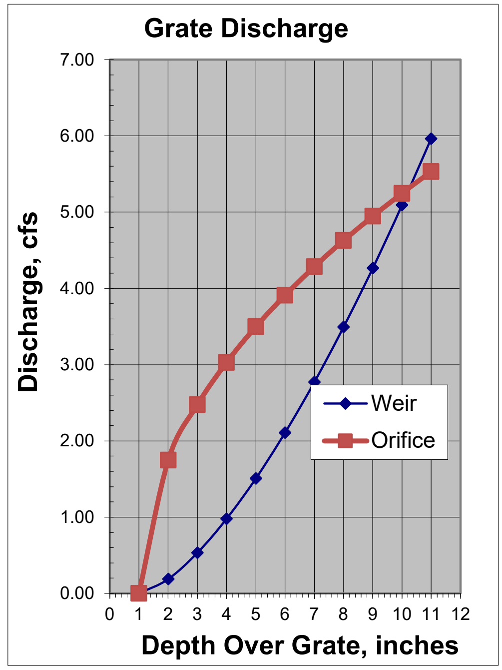
# APPENDIX N

# GRATE CAPACITY CALCULATIONS

# Sump Grate Ponding Depth Calculation

| Structure Number | | 113 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



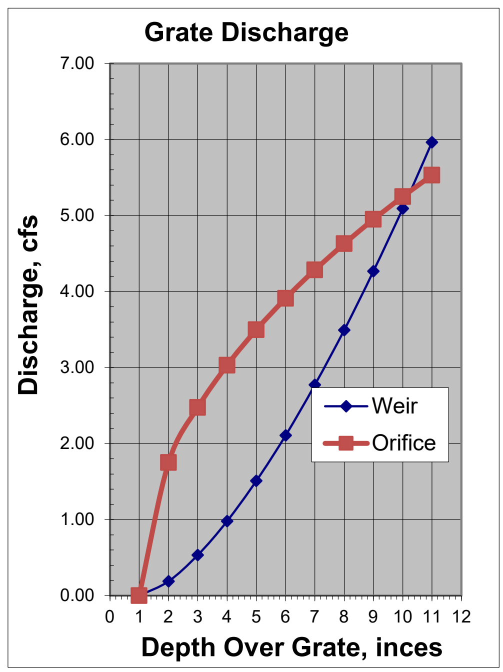

*Q=CiA*

| | |
|---|---|
| i = | 7.27 |
| C= | 0.80 |
| A= | 0.12 |
| Q= C x I x A = | 0.70 cfs |

| | |
|---|---|
| weir depth | 0.120 ft |
| orifice depth | 0.008 ft |

| Structure Number | | 114 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |




*Q=CiA*

| | |
|---|---|
| i = | 7.27 |
| C= | 0.80 |
| A= | 0.28 |
| Q= C x I x A = | 1.63 cfs |

| | | |
|---|---|---|
| weir depth | 0.210 | ft |
| orifice depth | 0.043 | ft |

# Sump Grate Ponding Depth Calculation

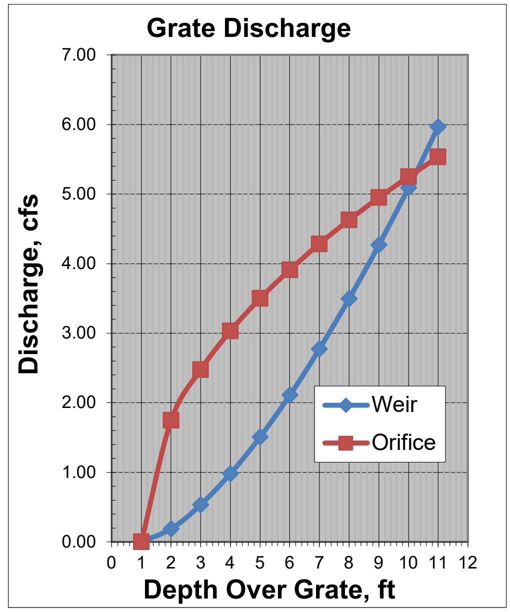
| Structure Number | | 115 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

*Q=CiA*

| | | |
|---|---|---|
| i = | 7.27 | |
| C= | 0.80 | |
| A= | 0.10 | |
| Q= C x I x A = | | 0.58 |

| | |
|---|---|
| weir depth | 0.106 |
| orifice depth | 0.006 |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



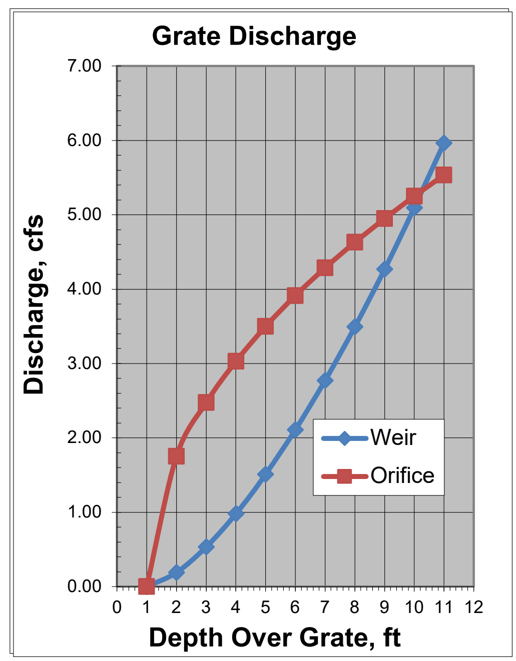

| Structure Number | | 307 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

*Q=CiA*

| | | |
|---|---|---|
| i = | 7.27 | |
| C= | 0.80 | |
| A= | 0.11 | |
| Q= C x I x A = | | 0.64 |

| | |
|---|---|
| weir depth | 0.113 |
| orifice depth | 0.007 |

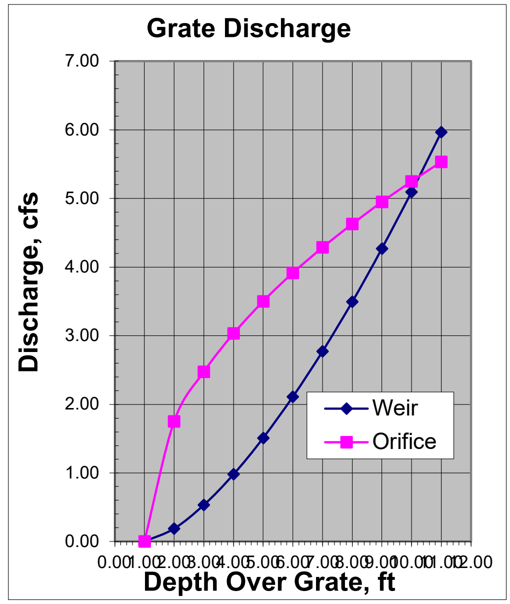
| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



# Sump Grate Ponding Depth Calculation

| Structure Number | | 306 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



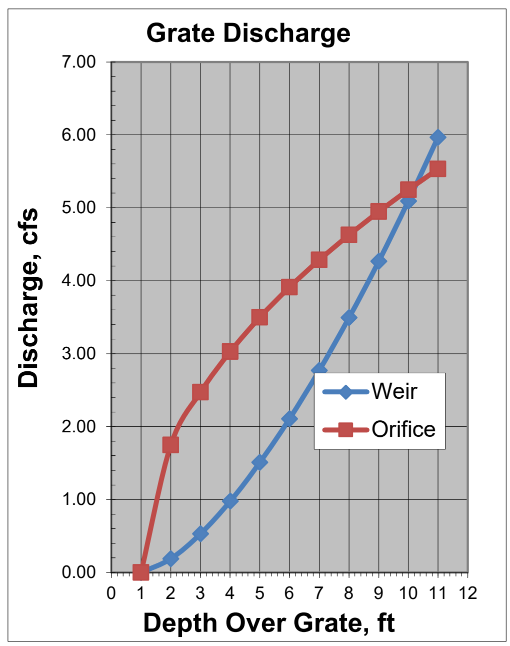

*Q=CiA*

| | | |
|---|---|---|
| i = | 7.27 | |
| C= | 0.80 | |
| A= | 0.23 | |
| Q= C x I x A = | | 1.34 |

weir depth 0.185
orifice depth 0.029

| Structure Number | | 305 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |




*Q=CiA*

| | | |
|---|---|---|
| i = | 7.27 | |
| C= | 0.80 | |
| A= | 0.46 | |
| Q= C x I x A = | | 2.68 |

weir depth 0.293
orifice depth 0.117

# Sump Grate Ponding Depth Calculation

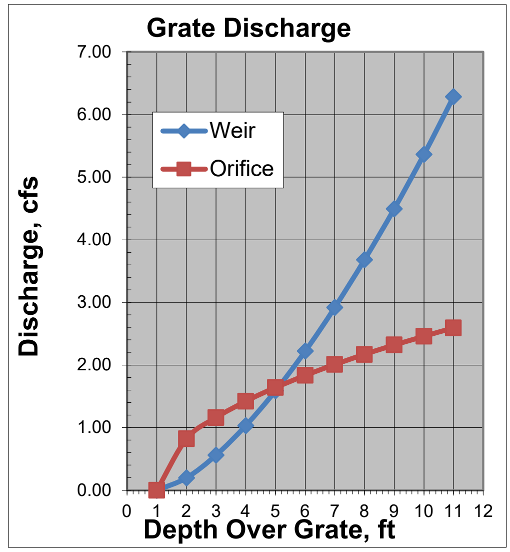
| **Structure Number** | | **304** |
|---|---|---|
| Casting | Neenah | R3405 |
| Area | 1.5 | $ft^2$ |
| Perimeter | 7.9 | ft |
| 3/4 P | 5.925 | ft |
| 1/2 A | 0.75 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

<u>*Q=CiA*</u>

| | | |
|---|---|---|
| i = | 7.27 | |
| C= | 0.80 | |
| A= | 0.41 | |
| Q= C x I x A = | | 2.38 |

| | |
|---|---|
| weir depth | 0.262 |
| orifice depth | 0.423 |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.20 | 0.82 |
| 0.10 | 0.56 | 1.16 |
| 0.15 | 1.03 | 1.42 |
| 0.20 | 1.59 | 1.64 |
| 0.25 | 2.22 | 1.83 |
| 0.30 | 2.92 | 2.01 |
| 0.35 | 3.68 | 2.17 |
| 0.40 | 4.50 | 2.32 |
| 0.45 | 5.37 | 2.46 |
| 0.50 | 6.28 | 2.59 |
| GRATE FLOW IN CFS | | |



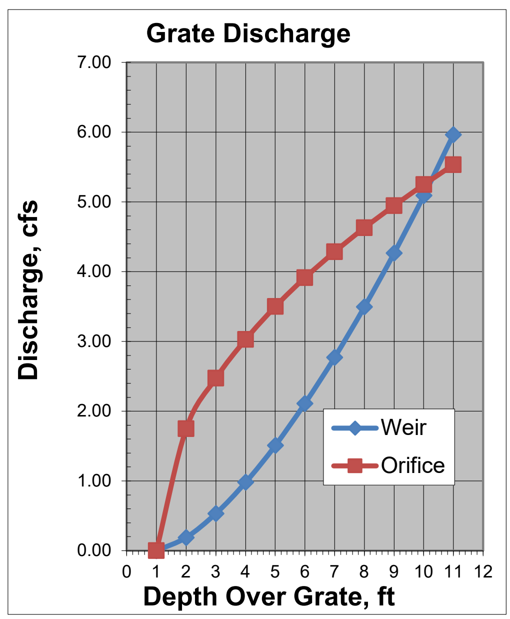

| **Structure Number** | | **413** |
|---|---|---|
| Casting | Neenah | r3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

<u>*Q=CiA*</u>

| | | |
|---|---|---|
| i = | 7.27 | in/hr |
| C= | 0.80 | |
| A= | 0.09 | Acres |
| Q= C x I x A = | | 0.52 |

| | |
|---|---|
| weir depth | 0.099 |
| orifice depth | 0.004 |

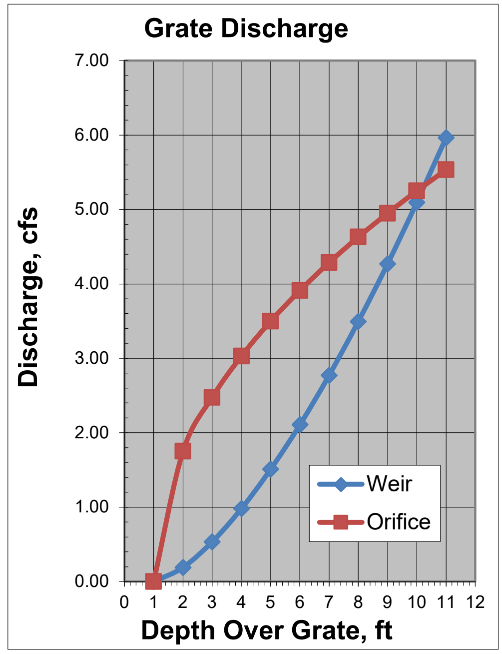
| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



# Sump Grate Ponding Depth Calculation

| Structure Number | | 412 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



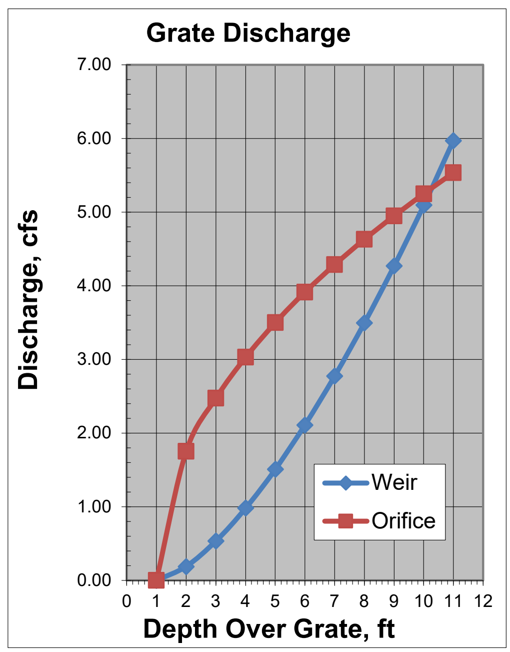

<u>*Q=CiA*</u>

i = 7.27
C= 0.80
A= 0.23
Q= C x I x A = 1.34

weir depth 0.185
orifice depth 0.029

| Structure Number | | 411 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |




<u>*Q=CiA*</u>

i = 7.27
C= 0.80
A= 0.07
Q= C x I x A = 0.41

weir depth 0.084
orifice depth 0.003

# Sump Grate Ponding Depth Calculation

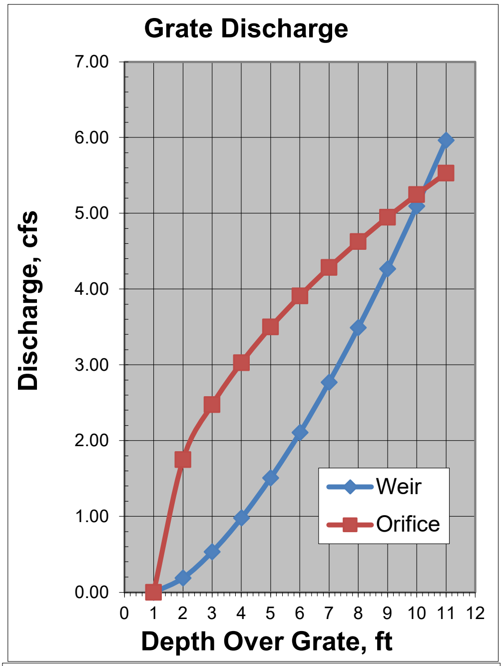
| Structure Number | | 410 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

*Q=CiA*

i = 7.27
C= 0.80
A= 0.08
Q= C x I x A = 0.47

weir depth 0.091
orifice depth 0.004

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



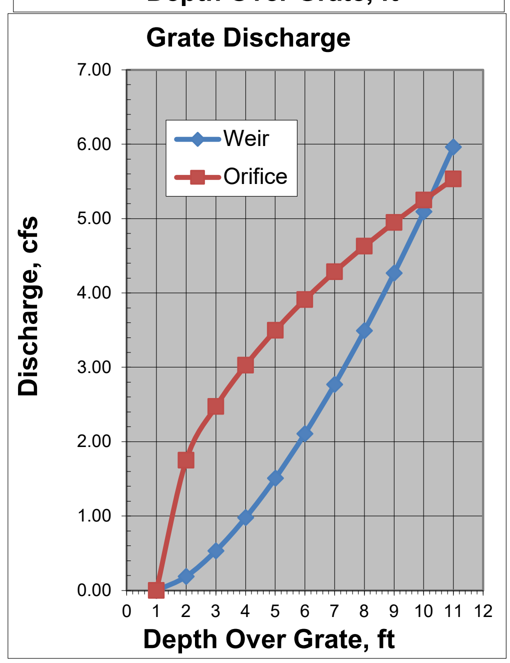

| Structure Number | | 409 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

*Q=CiA*

i = 7.27
C= 0.80
A= 0.23
Q= C x I x A = 1.34

weir depth 0.185
orifice depth 0.029

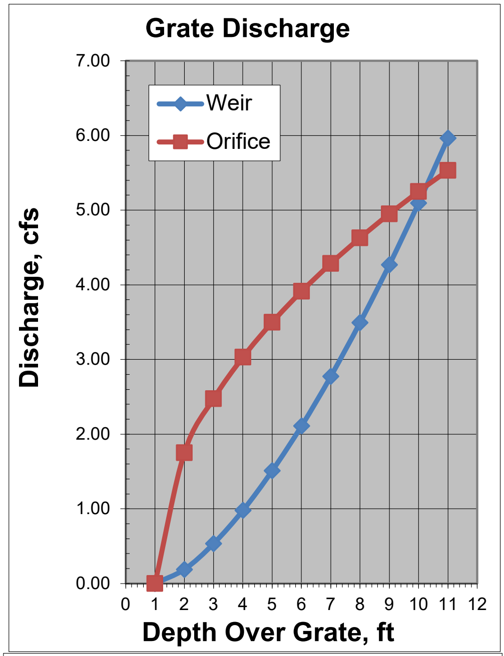
| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



# Sump Grate Ponding Depth Calculation

| Structure Number | | 408 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |



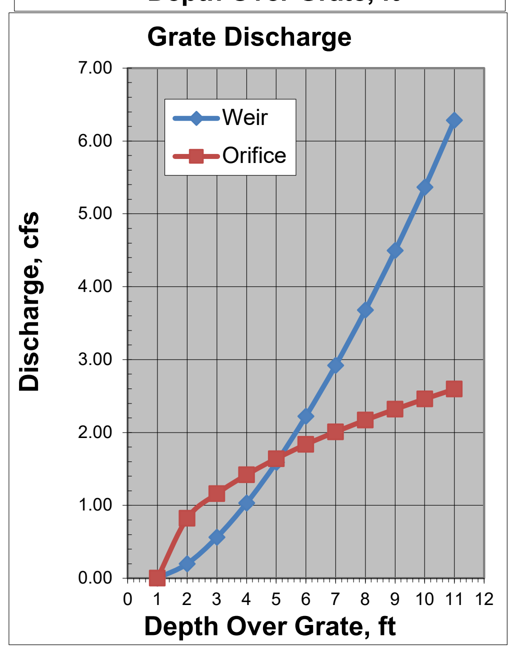

*Q=CiA*

i = 7.27
C= 0.80
A= 0.46
Q= C x I x A = 2.68

weir depth 0.293
orifice depth 0.117

| Structure Number | | 494 |
|---|---|---|
| Casting | Neenah | R3405 |
| Area | 1.5 | $ft^2$ |
| Perimeter | 7.9 | ft |
| 3/4 P | 5.925 | ft |
| 1/2 A | 0.75 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.20 | 0.82 |
| 0.10 | 0.56 | 1.16 |
| 0.15 | 1.03 | 1.42 |
| 0.20 | 1.59 | 1.64 |
| 0.25 | 2.22 | 1.83 |
| 0.30 | 2.92 | 2.01 |
| 0.35 | 3.68 | 2.17 |
| 0.40 | 4.50 | 2.32 |
| 0.45 | 5.37 | 2.46 |
| 0.50 | 6.28 | 2.59 |
| GRATE FLOW IN CFS | | |




*Q=CiA*

i = 7.27
C= 0.80
A= 0.26
Q= C x I x A = 1.51

weir depth 0.193
orifice depth 0.170

# Sump Grate Ponding Depth Calculation

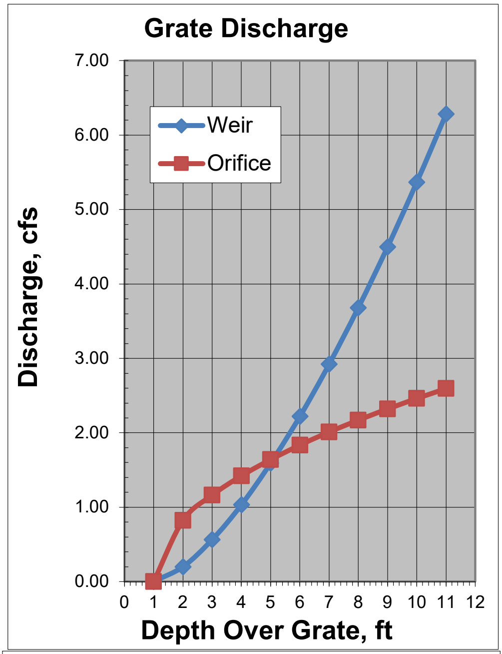
| Structure Number | | 406 |
|---|---|---|
| Casting | Neenah | R3405 |
| Area | 1.5 | $ft^2$ |
| Perimeter | 7.9 | ft |
| 3/4 P | 5.925 | ft |
| 1/2 A | 0.75 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

*Q=CiA*

i = 7.27
C= 0.80
A= 0.45
Q= C x I x A = 2.62

weir depth 0.279
orifice depth 0.509

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.20 | 0.82 |
| 0.10 | 0.56 | 1.16 |
| 0.15 | 1.03 | 1.42 |
| 0.20 | 1.59 | 1.64 |
| 0.25 | 2.22 | 1.83 |
| 0.30 | 2.92 | 2.01 |
| 0.35 | 3.68 | 2.17 |
| 0.40 | 4.50 | 2.32 |
| 0.45 | 5.37 | 2.46 |
| 0.50 | 6.28 | 2.59 |
| GRATE FLOW IN CFS | | |



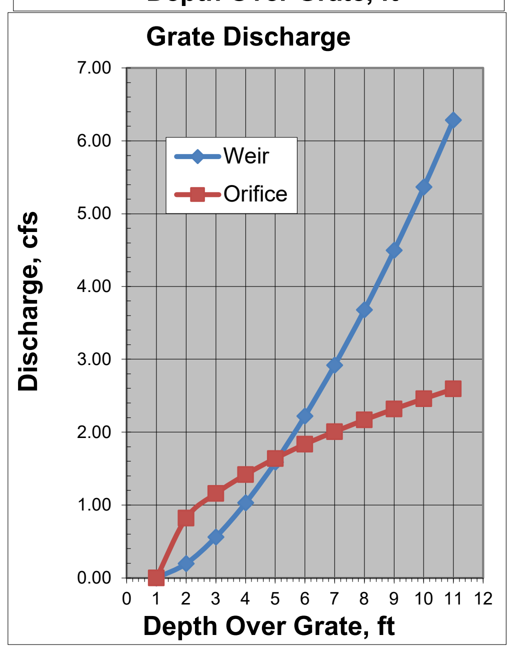

| Structure Number | | 407 |
|---|---|---|
| Casting | Neenah | R3405 |
| Area | 1.5 | $ft^2$ |
| Perimeter | 7.9 | ft |
| 3/4 P | 5.925 | ft |
| 1/2 A | 0.75 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

*Q=CiA*

i = 7.27
C= 0.80
A= 0.43
Q= C x I x A = 2.50

weir depth 0.271
orifice depth 0.465

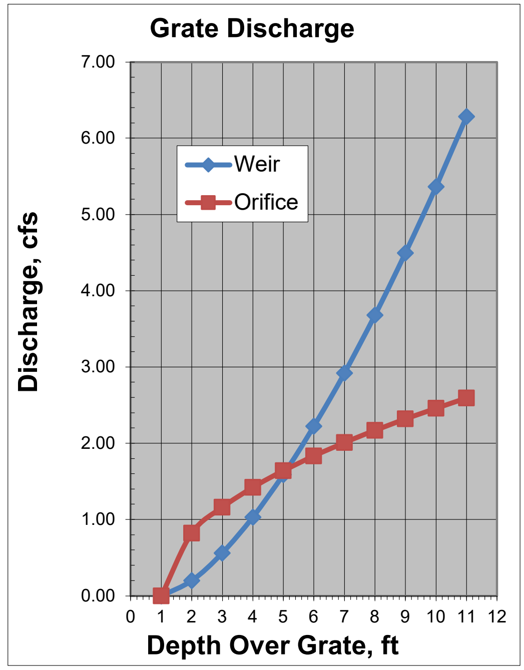
| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.20 | 0.82 |
| 0.10 | 0.56 | 1.16 |
| 0.15 | 1.03 | 1.42 |
| 0.20 | 1.59 | 1.64 |
| 0.25 | 2.22 | 1.83 |
| 0.30 | 2.92 | 2.01 |
| 0.35 | 3.68 | 2.17 |
| 0.40 | 4.50 | 2.32 |
| 0.45 | 5.37 | 2.46 |
| 0.50 | 6.28 | 2.59 |
| GRATE FLOW IN CFS | | |



# Sump Grate Ponding Depth Calculation

| Structure Number | | 120 |
|---|---|---|
| Casting | Neenah | R3405 |
| Area | 1.5 | $ft^2$ |
| Perimeter | 7.9 | ft |
| 3/4 P | 5.925 | ft |
| 1/2 A | 0.75 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.20 | 0.82 |
| 0.10 | 0.56 | 1.16 |
| 0.15 | 1.03 | 1.42 |
| 0.20 | 1.59 | 1.64 |
| 0.25 | 2.22 | 1.83 |
| 0.30 | 2.92 | 2.01 |
| 0.35 | 3.68 | 2.17 |
| 0.40 | 4.50 | 2.32 |
| 0.45 | 5.37 | 2.46 |
| 0.50 | 6.28 | 2.59 |
| GRATE FLOW IN CFS | | |



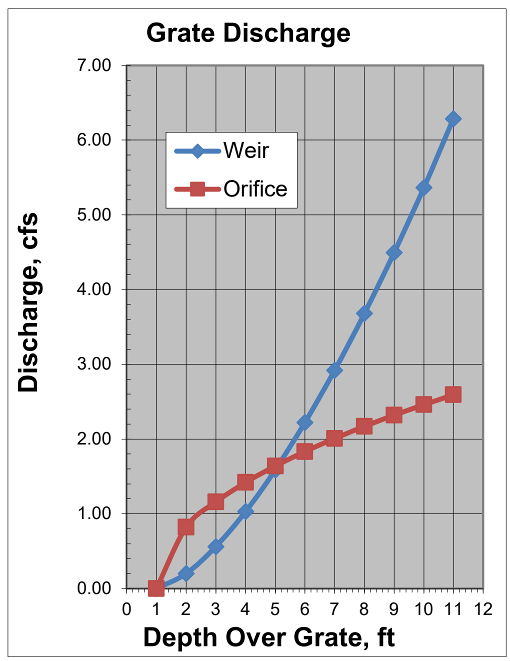

*Q=CiA*

| | | |
|---|---|---|
| i = | 7.27 | |
| C= | 0.80 | |
| A= | 0.39 | |
| Q= C x I x A = | | 2.27 |

| | |
|---|---|
| weir depth | 0.254 |
| orifice depth | 0.383 |

| Structure Number | | 119 |
|---|---|---|
| Casting | Neenah | R3405 |
| Area | 1.5 | $ft^2$ |
| Perimeter | 7.9 | ft |
| 3/4 P | 5.925 | ft |
| 1/2 A | 0.75 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.20 | 0.82 |
| 0.10 | 0.56 | 1.16 |
| 0.15 | 1.03 | 1.42 |
| 0.20 | 1.59 | 1.64 |
| 0.25 | 2.22 | 1.83 |
| 0.30 | 2.92 | 2.01 |
| 0.35 | 3.68 | 2.17 |
| 0.40 | 4.50 | 2.32 |
| 0.45 | 5.37 | 2.46 |
| 0.50 | 6.28 | 2.59 |
| GRATE FLOW IN CFS | | |




*Q=CiA*

| | | |
|---|---|---|
| i = | 7.27 | |
| C= | 0.80 | |
| A= | 0.41 | |
| Q= C x I x A = | | 2.38 |

| | |
|---|---|
| weir depth | 0.262 |
| orifice depth | 0.423 |

# Sump Grate Ponding Depth Calculation

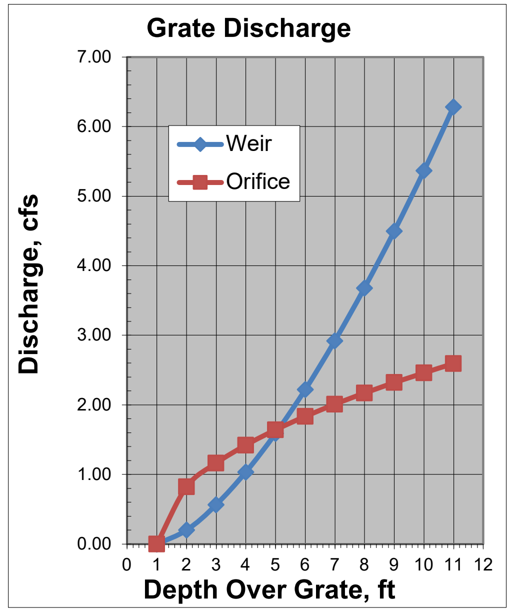
| Structure Number | | 117 |
|---|---|---|
| Casting | Neenah | R3405 |
| Area | 1.5 | $ft^2$ |
| Perimeter | 7.9 | ft |
| 3/4 P | 5.925 | ft |
| 1/2 A | 0.75 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.20 | 0.82 |
| 0.10 | 0.56 | 1.16 |
| 0.15 | 1.03 | 1.42 |
| 0.20 | 1.59 | 1.64 |
| 0.25 | 2.22 | 1.83 |
| 0.30 | 2.92 | 2.01 |
| 0.35 | 3.68 | 2.17 |
| 0.40 | 4.50 | 2.32 |
| 0.45 | 5.37 | 2.46 |
| 0.50 | 6.28 | 2.59 |
| GRATE FLOW IN CFS | | |

<u>*Q=CiA*</u>

i = 7.27
C= 0.80
A= 0.29
Q= C x I x A = 1.69

weir depth 0.208
orifice depth 0.211




| Structure Number | | 121 |
|---|---|---|
| Casting | Neenah | R3287 |
| Area | 3.2 | $ft^2$ |
| Perimeter | 7.5 | ft |
| 3/4 P | 5.625 | ft |
| 1/2 A | 1.6 | $ft^2$ |
| Q=3.0*P*D^1.5 | | (Weir) |
| Q=4.89*A*D^0.5 | | (Orifice) |

| Depth | Weir | Orifice |
|---|---|---|
| 0.00 | 0.00 | 0.00 |
| 0.05 | 0.19 | 1.75 |
| 0.10 | 0.53 | 2.47 |
| 0.15 | 0.98 | 3.03 |
| 0.20 | 1.51 | 3.50 |
| 0.25 | 2.11 | 3.91 |
| 0.30 | 2.77 | 4.29 |
| 0.35 | 3.49 | 4.63 |
| 0.40 | 4.27 | 4.95 |
| 0.45 | 5.09 | 5.25 |
| 0.50 | 5.97 | 5.53 |
| GRATE FLOW IN CFS | | |

<u>*Q=CiA*</u>

i = 7.27
C= 0.80
A= 0.46
Q= C x I x A = 2.68

weir depth 0.293
orifice depth 0.117