

Downstream Analysis – Wrong Method completed by Applicant

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*Downstream Analysis-
Wrong Method completed by Applicant
does not address the potential for
downstream flooding*



- RIDEM requested the Applicant to perform a Downstream Analysis three different times during their review.
- RIDEM accepted a downstream analysis using HydroCAD to model downstream effects
- Applicant completed a “rough drainage analysis of Silver Creek,” by modeling Silver Creek as a Reach using HydroCAD.
- A Reach is a uniform stream, channel, or pipe.
- It has a constant width, side slopes, depth, slope, and surface condition.
- The manual for HydroCAD states that it is not to be used for flood plain analysis.



*3.3.6 Downstream Analysis
A downstream analysis
is required for projects
...when existing
conditions are already
causing a problem (e.g.
known drainage or
flooding conditions*

- **RIDEM has requested in numerous reviews that the Applicant perform a Downstream Analysis.**

A RIDEM review dated December 12, 2017 recognized the downstream flooding and requested that the applicant perform a downstream analysis considering the existing limitation at the twin 48” culverts at the high school. The RIDEM review request is based the *R.I Stormwater Design and Installation Standards Manual* that states when there is a known flooding problem, regardless of whether the peak runoff rates from the proposed development are decreased, a downstream analysis is still required. DiPrete response was that the drainage system, at the proposed hotel site, not only reduced the peak flow rates but also resulted in a decrease in flood volumes from pre to post conditions. This did not represent a valid response to RIDEM request (DiPrete response dated January 23, 2018 p.3).

Since the previous response to RIDEM request for a downstream analysis was inadequate. A RIDEM review on March 12, 2018, Item 2 requested the downstream analysis and even suggested that “a downstream analysis would be to revise the existing *Silver Creek Drainage Study*. DiPrete response was that there is no increase in peak runoff, however in order to verify that peaks do not create flood rate, “we completed a rough drainage analysis....**not having the raw watershed data from Beta study...**” (DiPrete response dated April 10, 2018 p.2).

Again, on July 12, 2022, RIDEM requested on Engineering Review Comments No. 11 that you (the Applicant) submitted analysis indicates pre and post project drainage diagrams of flows to Bristol Harbor. No analysis was provided. DiPrete response was that they completed a rough drainage analysis for Silver Creek (using the wrong methodology) **because “not having the raw watershed data from the Beta Study”** (DiPrete response dated January 4, 2023).

RIDEM complete their review on June 30, 2023 concluding that” the designer has addressed potential downstream flooding concerns by indicating that the submitted analysis shows that the total runoff volume of runoff to the receiving wetlands will be decreased in 1, 10, and 100-year 24 hour Type III storm events”. This is not consistent with RIDEM regulations concerning the requirement for a Downstream Analysis if there is a decrease in the peak runoff rates from the proposed development.

Conclusion A Downstream Analysis should be completed. It is my opinion, that after several RIDEM reviews of the Applicant’s submittals and numerous requests to conduct the analysis, using the appropriate HEC-RAS method, RIDEM accepted a useless and erroneous assessment. RIDEM accepted the Applicant excuse of “Not having the raw watershed data from the BETA study, we model the following parameters. It is curious why RIDEM ignored their own requirements and accepted such a useless assessment of the flooding issues.



Date 1/04/2016

Reviewer Nicholas A Pisani, P E

Application Number

FWW#

15-0033

WQC#

GWD/UIC#

001650

RIPDES#

RIR101247

OTHER

Nicholas A. Pisani P.E.

Applicant Name KenDan, LLC

Project Name Proposed Hotel Facility

Plans and Analysis Reviewed Revised Plans and Reports received by DEM on 9/02/2015

Engineering Review conducted with Checklist rev date 2/20/2014

Recommended Action Several issues have been identified which need to be addressed These are

- 1 Please note that this reviewer was made aware of an oversight in the designer's pre-project time of concentration value The use of the default 6 minute time of concentration value is unacceptable, given the length of the anticipated time of concentration flow path The use of a site specific time of concentration analysis results in smaller existing condition peak runoff discharge rates in the events modeled, such as the 10-year and 100-year 24-hour Type III rainfall events By using a smaller existing condition peak flow for comparison with proposed condition peak flows, the design has utilized a smaller volume of detention storage than what would otherwise be needed This reviewer therefore considers that additional detention storage volume would be needed to properly mitigate against any increases in peak runoff discharge rates to the immediate receiving wetland area If any permit is issued additional detention storage will need to be incorporated into the design so as to avoid any increases in peak runoff discharge rates from the site in the 10 and 100-year 24-hour Type III rainfall events
- 2 The submitted downstream analysis will need to be modified so as to utilize the updated rainfall depths associated with the 10- and 100-year storm events that are found in the 2010 Rhode Island Stormwater Design and Installation Standards Manual (2010 RISDISM) These rainfall depths are 4 9" for the 10-year 24-hour Type III event and 8 6" for the 100-year 24-hour Type III event
- 3 The downstream analysis will need to be extended downstream at least to take into account the twin 48" culvert located at the Mount Hope High School This is considered to be necessary because this represents the first major constriction point in the stream / river proceeding downstream from the subject site The applicant may wish to consider the possible effects of any bypass / weir flow which may exist around the culvert in the area located to the west of the school The relatively low grades in this area may tend to allow some component of large storm events to bypass around the culverts It is unclear as to whether or not such bypass flow was taken into account in the Silver Creek Drainage Study dated November 2007 by Beta Engineers-Scientists Please note that is evaluating any such overland bypass flow, be mindful of the fact that the Town of Bristol has a RI



DEM approval for some proposed grading in that area, as part of proposed athletic field improvements See RI DEM / Freshwater Wetlands Program File 10-0119)

- 4 In order to avoid any questions of any potential discrepancies in floodplain elevations owing to any differences in datum planes used, please address the elevation datum used on the site plan, in the Silver Creek Drainage Study, and on the latest FEMA Flood insurance Rate Map for the site. If different data are used, please provide a conversion to a common datum.
- 5 The site plan needs to clearly depict the proposed connection to sanitary sewer line. This connection will need to avoid and minimize any impacts to wetland areas to the maximum extent practicable.



STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

Date 12/12/2017

Reviewer Nicholas A Pisani, P E

Application Number

FWW#

15-0033

WQC#

GWD/UIC#

001650

RIPDES#

RIR101247

OTHER

Nicholas A. Pisani, P.E.

Applicant Name KenDan, LLC

Project Name Gooding Avenue Development

Plans and Analysis Reviewed Plans and Reports received by DEM on 11/06/2017

Engineering Review conducted with Checklist rev date 2/20/2014

Interim Review Findings

- 1) **Drainage Issues-** See comments below
- 2) **Floodplain Issues-** The site of the proposed work is located inland of the 100-year floodplain

Interim Technical Justification If the site plans for the proposed development include a BMP that does not fully comply with all the applicable design requirements of the RSDISM, then please note below

- 1) The design of the proposed underground infiltration practice will meet the 50' minimum setback to waters of the state assuming permission is granted to fill the area of wetland between A7 and A13, as depicted on the proposed grading plan

Review Comments

- (1) The submitted analysis of the 1 2" storm event models the Isolator Row-TM as a separate storage and infiltration practice. However, the submitted analysis ignores this Isolator Row-TM bypass and the Isolator Rows-TM. Please include the Isolator Row-TM and the Isolator Row-TM by pass in the modeling of the 1, 10, and 100-yr larger storm events
- (2) With respect to the proposed Qp / WQ ByPass structure, the submitted analysis indicates that the 18" outlet pipe to the detention practice will have an invert of 73.50', but the submitted plan shows this pipe at an invert of 73.0'. Please revise the plans and/or analysis to ensure consistency on this matter
- (3) The submitted channel protection volume analysis needs to also include the one-year flow from proposed Subcatchment 107. Please note that the one year discharge to the wetland includes the 0.11 cfs from proposed Pond 106 UDS plus the secondary / bypass discharge of 0.51 cfs from the proposed Pond 108 Forebay to the proposed sand filter. This flow totals about 0.62 cfs, ignoring any time of peak differences. Please revise the design to provide the required channel protection volume storage to attain a total peak one-year event release rate of 0.19 cfs or less from the total collected drainage that is being discharged to the wetland (This is calculated as follows total volume in one year storm equals 0.250 + 0.037 = 0.287 acft, from subcatchments 101 and 107, respectively. This equals 12,502



STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

- cf Multiplying by the required 0.65 factor gives a total of 8126 cf Multiplying by 24 x 60 x 60 gives an average release rate over 24 hours of 0.094 cfs Doubling this amount to provides an approximate peak one -year release rate of 0.188 cfs, which round to 0.19 cfs)
- (4) With respect to pre-development Subcatchment 10, please address whether the Tc flow path represents the path from the most hydraulically distant point in the subwatershed Please note that there are more distant areas to the west of the point chosen If a change is needed, please submit a revised analysis and a revised detention design if needed
 - (5) Please provide a narrative and a drainage diagram to accompany the submitted "Drainage network Hydraulic Calculations" The diagram needs to label each catch basin and manhole in a manner which will allow them to be identified on the submitted utilities plan Also, the in submitted "Drainage Network Hydraulic Calculations", the "Inlet Report" indicates that the pipe system uses the 100-year storm event Please confirm that the "Pipes" analysis table is also based on the 100-year storm event Please confirm that all runoff in the 100-year storm event will enter the proposed drainage system without bypass to the adjacent wetland area
 - ~~*~~ (6) This office is aware of downstream flooding issues along the receiving watercourse One of the most significant concerns is at the Mount Hope High School located downstream of the site Section 3.3.6 of the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM) states that a downstream analysis is required " when deemed appropriate by the approving agency when existing conditions are already causing a problem (e.g., known drainage or flooding conditions or existing channel erosion is evident), to determine whether peak flow impacts are fully attenuated by controlling the 10- and 100-year events" The known drainage or flooding conditions are evidenced in the Silver Creek Drainage Study, Bristol, RI dated November 2007 by Beta Engineers-Scientists Therefore, as per Section 3.3.6 of the RISDISM, please provide a downstream analysis On page 11 of Silver Creek Drainage Study, Bristol, RI, it indicates that there is an existing limitation at the twin 48" culverts at the high school (Mount Hope High School) Please ensure that the downstream analysis extends at least to a point downstream of the twin 48" culverts at Mount Hope High School
 - (7) Please address any potential tailwater conditions in the 100-year storm event that may exist at each of the proposed outlets, including the pipe outfall and the weir outlet from the proposed sediment forebay Please note that the floodplain elevations in the FEMA Study and in the Silver Creek Drainage Study may be exceeded because neither study appears to use the latest available 100-year rainfall data
 - (8) Please add appropriate long-term pollution prevention items to the long-term Operation and Maintenance Plan



DiPrete Engineering

January 23, 2018

Nicholas A. Pisani, P.E.
Office of Water Resources
235 Promenade Street
Providence, RI 02908-5767



RE Gooding Avenue Department
Bristol, Rhode Island
FWW Application No 15-0033
Project # 2536 001

Response to Dec. 2017

Dear Mr. Pisani

We respectfully resubmit the attached revised materials for DEM Office of Water Resources review and approval. The plans and design intent have been modified to address the comment provided by RIDEM in the original denial letter. The area of biological wetlands alternation has been reduced from 5,200 sq ft to approximately 4,700 sq ft, and the total perimeter wetlands alteration has been reduced from 61,215 sq ft to approximately 44,750 sq ft. Additionally, the area of tree clearing and buffer impacts has been reduced significantly to contain disturbance to the northwest portion of the parcel and ensure the functions and values of the wetland are not impacted.

DiPrete Engineering has received your comments dated December 12, 2017. We have reviewed these comments and offer the following in response. The original comments are provided in italics with responses in bold.

Review Comments

- 1 The submitted analysis of the 1 2" storm event models the Isolator Row-TM as a separate storage and infiltration practice. However, the submitted analysis ignores this Isolator Row-TM bypass and the Isolator Rows-TM. Please include the Isolator Row-TM and the Isolator Row-TM by pass in the modeling of the 1, 10, and 100-yr larger storm events.*

The Isolator Row has now been shown in the model for all storm events. Please refer to the revised HydroCad printouts in the Stormwater Report.

- 2 With respect to the proposed Qp / WQ ByPass structure, the submitted analysis indicates that the 18" outlet pipe to the detention practice will have an invert of 73.50', but the submitted plan shows this pipe at an invert of 73.0'. Please revise the plans and/or analysis to ensure consistency on this matter.*

As part of the revised design for optimizing WQ flow, channel protection and isolator bypass, we made minor revisions to the UIS-A/UDS-A model. The invert for the 18" outlet pipe for the proposed Qp/WQ ByPass structure is now 72.50 and labeled identically within the HydroCad analysis and Underground System details.

- 3 The submitted channel protection volume analysis needs to also include the one-year flow from proposed Subcatchment 107. Please note that the one year discharge to the wetland includes the 0.11 cfs from proposed Pond 106 UDS.*

plus the secondary/ bypass discharge of 0.51 cfs from the proposed Pond 108 Forebay to the proposed sand filter. This flow totals about 0.62 cfs, ignoring any time of peak differences. Please revise the design to provide the required channel protection volume storage to attain a total peak one-year event release rate of 0.19 cfs or less from the total collected drainage that is being discharged to the wetland. (This is calculated as follows: total volume in one year storm equals $0.250 + 0.037 = 0.287$ acft, from subcatchments 101 and 107, respectively. This equals 12,502 cf. Multiplying by the required 0.65 factor gives a total of 8126 cf. Multiplying by $24 \times 60 \times 60$ gives an average release rate over 24 hours of 0.094 cfs. Doubling this amount to provide an approximate peak one-year release rate of 0.188 cfs, which rounds to 0.19 cfs.)

In combination with modifying the drainage system to address downstream flooding concerns (see response #6), the design has been modified to optimize the release rate for the 1-year storm event to arrive at a maximum of 0.19 cfs in the updated HydroCad model. This was done for each contributing subcatchment by

- 1) Designing UIS-A with a larger footprint in order to infiltrate greater than the 1.2" storm event and minimizing flow reaching UDS-A for the 1-year storm event. The UDS was able to be designed with a smaller WQ orifice and a smaller WQ flow.
- 2) Adding an underground storage component (UDS-B) connected to the eastern Sand Filter. Stormwater will flow into UDS-B through four 6" pipe openings in the retaining wall which connect to the UDS manifold. The pipe openings will be protected from clogging by trash racks as detailed on Sheet 8.

With these modifications, the revised 1-year storm peak flow combining the Forebay and UDS-A outflows is 0.02 cfs (UDS-A) + 0.17 cfs (Sediment Forebay Secondary Flow) = 0.19 cfs.

4. *With respect to pre-development Subcatchment 10, please address whether the Tc flow path represents the path from the most hydraulically distant point in the subwatershed. Please note that there are more distant areas to the west of the point chosen. If a change is needed, please submit a revised analysis and a revised detention design if needed.*

While the origin of the Tc flow path could have been modeled from a lengthier location, the flow path used for modeling pre-development Subcatchment 10 resulted in a longer time of concentration and was therefore the more conservative and *hydraulically distant* option for the purposes of post-development peak flow comparison. We have included a map and summary of the alternate time of concentration for a separate path upgradient of the driveways. The most distant point results in a sheet flow short of 100' (the flow path hits the first driveway at 57' from the high point) and the ground cover does not take advantage of a section of woods sheet flow as the original 1B-1C segment does.

In summary, the alternate lengthier flow path of 1A-Alt to 1D-Alt will take a total of 14.1 minutes, or 0.5 minutes less than the originally chosen 1A-1E flow path.

Note that if we start from the backyard, the sheet flow is also fully in grassed areas and the overall length of flow path is substantially reduced by reaching the southern subcatchment line quickly.

- 5 Please provide a narrative and a drainage diagram to accompany the submitted "Drainage network Hydraulic Calculations" The diagram needs to label each catch basin and manhole in a manner which will allow them to be identified on the submitted utilities plan Also, in the submitted "Drainage Network Hydraulic Calculations", the "Inlet Report" indicates that the pipe system uses the 100 year storm event Please confirm that the "Pipes" analysis table is also based on the 100-year storm event Please confirm that all runoff in the 100 year storm event will enter the proposed drainage system without bypass to the adjacent wetland area

The proposed drainage capacity spreadsheets were originally placed in Appendix A3 4 2 which was not fully referenced from the accompanying narrative in Section 3 4 1 We have revised the report layout to include and reference the tables directly after this aforementioned section Also, a statement has been added to the end of Section 3 4 1 to confirm the drainage system will fully handle the 100-year storm flow without bypass

The "Line ID" numbers correlate to the structure numbers shown on the Utility Plan For example, Inlet Report Line No 1 with Inlet ID of 6 refers to CB-6 located in the south central portion of the parking area And Pipes Line No 1 for Line ID 6-7 refers to the 18" HDPE pipe segment located between CB 6 and 6' diameter DMH-7

- * 6 This office is aware of downstream flooding issues along the receiving watercourse One of the most significant concerns is at the Mount Hope High School located downstream of the site Section 3 3 6 of the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM) states that a downstream analysis is required " when deemed appropriate by the approving agency when existing conditions are already causing a problem (e g , known drainage or flooding conditions or existing channel erosion is evident), to determine whether peak flow impacts are fully attenuated by controlling the 10- and 100 year events" The known drainage or flooding conditions are evidenced in the Silver Creek Drainage Study, Bristol RI dated November 2007 by Beta Engineers-Scientists Therefore, as per Section 3 3 6 of the RISDISM, please provide a downstream analysis On page 11 of Silver Creek Drainage Study, Bristol RI, it indicates that there is an existing limitation at the twin 48" culverts at the high school (Mount Hope High School) Please ensure that the downstream analysis extends at least to a point downstream of the twin 48" culverts at Mount Hope High School

- * The applicant has revised the drainage system to not only reduce peak flow rates, but also results in a decrease in flow volume from pre to post-development conditions Therefore, there will be no change or slightly improved flood conditions due to this development See Section 3 5 6 for the pre to post-development volume summary

- 7 Please address any potential tailwater conditions in the 100 year storm event that may exist at each of the proposed outlets, including the pipe outfall and the weir outlet from the proposed sediment forebay Please note that the floodplain elevations in the FEMA Study and in the Silver Creek Drainage Study may be exceeded because neither study appears to use the latest available 100 year rainfall data

Based on the Silver Creek Drainage Study, the 100 year storm event tailwater behind the existing High School culverts extending past the subject site is elevation 67 0 Based on reviewing the downstream area and from online topographic information, it appears there

would be outlets at a lower elevation for the water to bypass the culverts to the downstream water body prior to reaching an elevation well above the low point of Gooding Avenue

That said, for the purposes of reviewing tailwater conditions, we conservatively estimated an additional 3' of floodwater to an elevation of 70.0 to account for the increase in 100-year storm events between the original analysis and the new Stormwater Regulations

As shown in Appendix A3.5.4.6 of the Stormwater Report, we modeled a Reach approximating the section of Silver Creek adjacent to the subject site. As detailed in the previous Drainage Study, we modeled a 2,100'+/- reach with a starting bottom elevation of 59 and end elevation of 56, for a slope of 0.14%. We estimated the side slopes of the stream, and set both the depth of reach and depth of constant flow at 11' to set a consistent water elevation of 70.0. Subcatchment 100, Pond 106 (UDS-A) and Pond 108 (Forebay) were connected to this reach to determine any impacts due to tailwater.

As shown in our analysis, the tailwater will not negatively impact the drainage system and no flooding will result. The minimum finish grade within the building, driveways and parking area portion of the site is proposed to be approximately 71 at the eastern-most curb cut along Gooding Avenue.

8. Please add appropriate long-term pollution prevention items to the long term Operation and Maintenance Plan.

The Operation and Maintenance Plan has been reviewed and a few notes added to ensure all items are covered.

Please feel free to contact me if you have any further questions regarding this matter.

Sincerely,
DiPrete Engineering Associates, Inc



Kevin DeMers, PE
Senior Project Engineer

cc: Kendan, LLC
Jane Kelly, DEM OWR

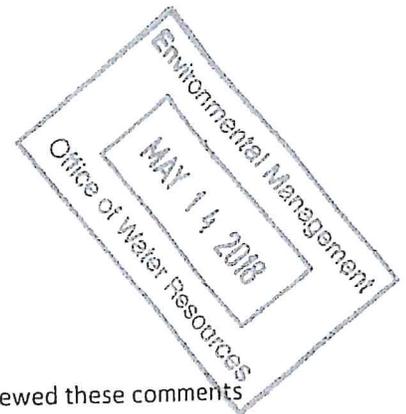


DiPrete Engineering

April 10, 2018
Revised May 11, 2018

Nicholas A. Pisani, P.E.
Office of Water Resources
235 Promenade Street
Providence, RI 02908-5767

RE: Gooding Avenue Department
Bristol, Rhode Island
FWW Application No. 15-0033
Project #: 2536-001



missing

Dear Mr. Pisani:

DiPrete Engineering (DE) has received your comments dated 3/12/2018. We have reviewed these comments as well as the guidance and clarification from our meeting on 3/20/2018 and offer the following in response. The original comments are provided in italics with responses in bold.

Review Comments:

- The latest revision states that the proposed total runoff volume will not be increased in the 100-year event by utilization of infiltration. The concerned party has raised concern that the soil at the site may be able to accept this larger runoff volume. Therefore, as per RISDISM Section 5.3.1 b7, the design be revised to demonstrate a minimum 4' separation to the seasonal high groundwater table (SHGWT) from the proposed bottom of stone of proposed infiltration practice. Also, the designer should submit a groundwater mounding analysis to attempt to demonstrate that none of the infiltrated runoff volume will break out to the ground surface in storm events up to and including the 100-year event. This should also consider the possible outflow through any proposed weep holes in the proposed retaining wall to be located between the proposed underground infiltration practice and the receiving wetland.*

The proposed infiltration practices are proposed as recharge (Rev) for the water quality volume (WQv) only. Channel Protection Volume (CPv) and Overbank Flood Protection (Qp) are both managed by an underground detention system (UDS). As per the RISDISM Section 7.4.1, a groundwater mounding analysis shall be done if the infiltration practice is designed for a 10-year storm event or greater.

To determine the likely location of breakout to the surface on the east/wetlands side of the development, DE reviewed the horizontal hydraulic conductivity. Based on a guidance document, "Representative hydraulic conductivities in saturated groundwater flow", authors Xavier Sanchez-Villa, Alberto Guadagnini, and Jesus Carrera, published 23 September 2006, the horizontal hydraulic conductivity may be estimated as approximately an order of magnitude (10 times) higher than the vertical conductivity. In order to perform the most conservative calculation, rather than use the RISDISM book value of 0.52 inches per hour the maximum value of the USDA.gov published range of 0.6-2 in/hr was used to arrive at a more conservative horizontal conductivity of 2 in/hr x 10 = 20 inches per hour. This will result in a rise:run gradient of 0.52 inches per hour / 20 inches per hour = 0.026 vertical feet per horizontal foot (2.6% slope).

On the eastern side of the UIS, the applicant proposes an impermeable line to elevation 68.0 to eliminate sidewall infiltration and promote vertical flow of infiltrated stormwater. At the bottom

of impermeable barrier, the infiltrated column of water can be modeled to travel a 1 run 0 026 drop slope at 20 inches (1 67 feet) per hour in the horizontal direction The proposed distance of the retaining wall from the eastern edge of UIS is 32 feet As per the attached analysis, the time when the first infiltrated stormwater reaches the subsoil is at Hour 5 4

The first flush of infiltrated stormwater will reach the wall at time
 $5.4 \text{ hours} + (50' / (1.67' / \text{hr})) = 35.3 \text{ hours}$ into the storm

The elevation of infiltrated stormwater at this point assuming unsaturated conditions is $68 - (0.026 \times 50.0) = \text{Elevation } 66.7$ More likely, this infiltrated flow will join the gradient of saturated soil as it approaches the new wetlands line east of proposed retaining wall In any case, the infiltrated stormwater will be at or below the bottom ground surface of 67.8 at the base of wall

2 If the increase in total runoff volume being discharged to the receiving wetland, then the designer should provide a downstream analysis Please note that one option in the preparation of such a downstream analysis would be to revise the existing Silver Creek Drainage Study, Bristol, RI (Beta Engineers-Scientists, 2007) to use the updated rainfall amounts and the existing and proposed conditions at the subject site

There is no increase in total runoff volume discharged to the receiving wetland As shown above, the infiltration's daylighting within the new wetland edge will not begin until hour 35.8 at the earliest, and the sum from the two "discarded" flows from the UIS and Isolator Row is 0.13 cfs Even if directly adding in the infiltrated runoff back into the total volume reaching the proposed design point, the volume goes from 1.402 acre-feet for existing conditions to 1.058 (surface) + (1.7 hours x 3600 seconds x 0.13 cfs) / 43,560 (infiltrated) = 1.076 acre-feet for proposed conditions at Hour 24 of the 100-year storm event

However, in order to verify that peaks do not combine to create a greater flow rate or volume from pre to post-development conditions, DE completed a rough drainage analysis for Silver Creek

* Not having the raw watershed data from the BETA study, we modeled the following parameters

Leading to onsite Wetland Design Point

Area = 352.93

Ground cover was broken into grassland, woods, 1/3 acre residential, and urban industrial uses based on aerial mapping

Majority C soils were observed on the USDA mapping and therefore C soils were entirely used for the HydroCad ground covers

Time of concentration = 42.7 minutes using slopes based on USGS topography

Downstream of onsite Wetland Design Point

Area = 897.07

Ground cover was broken into grassland, woods, 1/3 acre residential, and urban industrial uses based on aerial mapping

Majority C soils were observed on the USDA mapping and therefore C soils were entirely used for the HydroCad ground covers

Time of concentration = 57.8 minutes using slopes based on USGS topography

Modified Reach 11/111

Modified from summation point only to V channel reach

Length of channel to Bristol Harbor based on USGS = 7,022 feet and Slope = 0.0078'/'

Used 5' depth and approximate side slopes based on segment of stream through subject site
 Assumed Manning's n of 0.035 (earth, dense weeds)

The resulting runoff is not meant to be an accurate output for the Silver Creek watershed, only a representation of the overall watershed for the purposes of determining the development's effect on watershed flows

As shown on the attached supplemental HydroCad analysis, the resulting flows/volumes at the onsite and Bristol Harbor reaches are as follows

| Subwatershed (design point) | 100-yr Peak Flow (cfs) | | 100-yr Peak Volume (ac-ft) | |
|--------------------------------|---------------------------|-------|-------------------------------|--------|
| | Pre | Post | Pre | Post |
| DP-11/111 (Onsite DP) | 1,270 | 1,266 | 194.10 | 193.86 |
| DP-12/112 (Proposed DP) | 3,555 | 3,551 | 656.81 | 656.55 |

Therefore we have confirmed there will be no adverse impacts on the overall Silver Creek watershed due to the proposed development

3. Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis.

As described in response #1, the earliest estimated arrival of infiltrated runoff to the existing ground within the new wetlands edge (east of the retaining wall) will occur at 35.3 hours into the storm event. Based on the proposed hydrograph for the upgradient watershed, the flow at that time will be roughly 1% or less of the peak flow occurring at 12.57 hours.

Also as calculated in #2, even if the sum of infiltrated volume was directly added to the surface runoff, there will be a substantial decrease in water from the site reaching the Creek from pre to post development conditions at Hour 24 of the 100-year storm event.

4. Please provide a comparison of the existing condition hydrograph and the proposed condition hydrograph. Please address whether there will be an increase in either the peak of any of the proposed condition hydrographs or whether there will be any change in the time of the peak of the proposed condition hydrograph. Please perform this task for the 1, 10, and 100 year 24 hour Type III storm events.

A comparison of pre to post-development for each of the 1, 10 and 100-year storm events is provided. For each of the 1 and 10-year storm events, the proposed hydrograph stays entirely under the existing hydrograph as flows approach zero around Hour 24 of the respective storm events. During the 100-year storm event, the proposed hydrograph stays entirely under the existing conditions hydrograph until approximately Hour 16.5, when both the existing and proposed flows are roughly 0.5 cfs. As shown on the 100-year hydrograph table for the overall Silver Creek watershed to the site Design Point, the flow within the stream is approximately 8% of the peak flow occurring at 12.57 hours. Therefore this minimal increase in peak flow between Hours 16.5 to 24 will not impact the overall flood issues of Silver Creek.

Also of note is the proposed 100-year storm outflow to the wetland Design Point will reduce to below 0.29 cfs between Hour 24 and 25, which is the allowable channel protection release rate for the 1-year storm event

- 5 *The proposed underground infiltration practice UIS-A does not maintain the minimum standard 50' to waters of the state (the adjacent wetland to the east, just in front of the proposed retaining wall, in vicinity of Wetland Flag #13). Please provide a written technical justification for this design addressing any potential water quality issues.*

The closed drainage system and UDS geometry have been revised in order to enable a shift of the UIS to a location 50' from the nearest wetland areas under proposed conditions. The existing grades at each corner are shown for reference to confirm the average seasonal high groundwater table (SHGWT) does not change from what was previously provided. The average groundwater will be 72.5 (average existing grade) - 2.5 (TP groundwater depth) = 70.0. Therefore no elevation changes need to be made to UIS A or connected UDS-A.

DE respectfully encloses the revised plans for your review and approval. The reports remain unchanged since the previous copies were submitted on 1/23/2018 (Soil Erosion & Sediment Control Reports and Operations and Maintenance Plans) and 4/11/2018 (Stormwater Management Reports), respectively. Note that the response to comments letter submitted digitally dated March 9, 2018 is also attached for your use.

Please feel free to contact me if you have any further questions regarding this matter, or if further copies are needed.

Sincerely,
DiPrete Engineering Associates, Inc



Kevin DeMers, PE
Senior Project Engineer

cc Kendan, LLC
Jane Kelly, DEM OWR



DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

OFFICE OF WATER RESOURCES

STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

STW/WQA File copy

Date: 7/12/2022

Reviewer: Nicholas A. Pisani, P.E.

Application Number:

FWW#:

22-0264

WQC#:

22-114

GWD/UIC#:

UIC 001650

RIPDES#:

RIR101247

OTHER:

Nicholas A. Pisani P.E.

Applicant Name: KenDan, LLC

Project Name: Gooding Avenue Development

Plans and Analysis Reviewed: Plans and Reports received by DEM on 6/27/2022.

Engineering Review conducted with Checklist rev. date: 2/20/2014.

Interim Review Findings:

- 1) **Drainage Issues-** See comments below.
- 2) **Floodplain Issues-** The site of the proposed work is not located within a 100-year floodplain.

Interim Technical Justification: If the site plans for the proposed development include a BMP that does not fully comply with all the applicable design requirements of the RIDEM Stormwater Management Design and Installation Rules (250-RICR-150-10-8), then please note below:

- 1) NA

Review Comments:

- (1) In Appendix A Please provide a waterbody name for the ultimate receiving waterbody. Please note that in Appendix A Table 4.1 Silver Creek is appropriately indicated.
- (2) In Appendix A, with respect to the entry for the required recharge value, please provide a supporting calculation. Please note that the soils present are C and D hydrologic groups. Therefore an apportioning analysis is appropriate. In any case the recharge provide is sufficient.
- (3) With respect to the proposed sand filter, the table on Sheet 9 indicates a bottom of pond elevation of 69.0'. However, the lowest contour on the submitted site plan for this sand filter shows a 68.0 contour at its bottom. Please revise the plan to provide consistency on this item.



STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

- (4) Please indicate the invert and diameter of the four (4) pipes from the sand filter to the proposed Underground Detention System B.
- (5) With respect to proposed Underground Detention System B, the submitted analysis indicates the length of pipes to be 85'. However the length represented on the detail site plan on Sheet 9 appears to only be 78'. Therefore, please revise the plans and/or the analysis to provide consistency on this item.
- (6) With respect to the proposed Pond 104: UIS (Isolator Row) please revise the detail of the proposed Isolator Rows-TM so as to provide an adequate access structure and adequate diameter of inlet pipe to allow for the efficient "hydro-jetting of sediments and vactoring (vacuuming)" as indicated in the submitted long-term operation and maintenance plan. The arrangement as is proposed, and the small diameter of inlet pipes proposed present concerns as to how the required maintenance will be successfully performed.
- (7) With respect to proposed Pond 104: UIS A (Isolator Row) the submitted analysis indicates a 6" diameter outlet at invert elevation of 74.0' Please direct the reviewer to where on the plan this outlet is located.
- (8) With respect to proposed large Underground Detention System, the submitted analysis indicates the length of the 13 interior pipes to be 75'. However the length represented on the detail site plan on Sheet 9 appears to only be 67'. Therefore, please revise the plans and/or the analysis to provide consistency on this item.
- (9) With respect to proposed Pond 104 UIS A (Isolator Row) and Pond 105 (UIS A) please revise their labels to indicate that they contain underground sand filter layers and as such are considered as sand filters.
- (10) Please revise the submitted "Written Narrative in Support of an Application to Alter a Freshwater Wetland for a Hotel Development, A.P. 111, Lot 1; Gooding Avenue, Bristol, Rhode Island". Please note that this document contains more than one instance of information that is not accurate with respect to the current submittal, including incorrect plan preparer information and incorrect proposed stormwater practice.
- (11) With respect to the submitted analysis, the submitted drainage diagram indicates pre- and post- project drainage diagrams of flows to Bristol Harbor (Reaches 12 pre-project and Reach 112 post-project). However, no supporting analysis has been provided. Please provide this supporting



STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

analysis.

- (12) The submittal indicates that proposed total runoff volume will not be increased in the 100-year year event by utilization of infiltration. Please provide a groundwater mounding analysis to attempt to demonstrate that none of the infiltrated runoff volume will break out to the ground surface in storm events up to and including the 100-year event. This should also consider the possible outflow through any proposed weep holes in the proposed retaining wall to be located between the proposed underground infiltration practice and the receiving wetland. This should also consider the possible outflow through any proposed weep holes in the proposed retaining wall to be located between the proposed underground infiltration practice and the receiving wetland.
- (13) Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis. Please provide a comparison of hydrographs to demonstrate that the volume being discharged from the site over time will not increase the discharge to the river in comparison with the existing condition hydrograph discharge from the site.
- (14) Please provide a comparison of the existing condition hydrograph and the proposed condition hydrograph. Please address whether there will be an increase in either the peak of any of the proposed condition hydrographs or whether there will be any change in the time of the peak of the proposed condition hydrograph. Please perform this task for the 1, 10, and 100-year 24-hour Type III storm events.
- (15) Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis.



DiPrete Engineering

January 4, 2023

Martin D. Wencek, Supervisor
RIDEM Office of Water Resources
Freshwater Wetlands Program
235 Promenade Street
Providence, RI 02908-5767

RE: Gooding Avenue Department
Bristol, Rhode Island
FWW Application No. 22-0264
Owner: KenDan, LLC
Project #: 2536-001

STW/W&C No.
22-114

Dear Mr. Wencek:

DiPrete Engineering (DE) has received your comments dated August 1, 2022. We have reviewed these comments and offer the following in response. The original comments are provided in italics with responses in bold.

Biological Review Comments:

1. *Please revise the site plans to depict a permanent buffer marker along the Limit of Disturbance (LOD) approximately 32 feet north of wetland flag A2, as shown on the previously approved plans dated August 22, 2018.*

Awaiting copy of previously approved plans from Kev D.

2. *Please label the wetland as a "Swamp" on the site plans, as shown on the previously approved plans dated August 22, 2018.*

Awaiting copy of previously approved plans from Kev D.

3. *Please note that the submitted "Written Narrative in Support of an Application to Alter a Freshwater Wetland for a Hotel Development, A.P. 111, Lot 1; Gooding Avenue, Bristol, Rhode Island", states that 5,000 square feet of alterations to swamp and 61,215 square feet of alterations to the 50-foot perimeter wetland are proposed. However, the application form states that approximately 4,717 square feet of swamp and approximately 45,200 square feet of the 50-foot perimeter wetland would be altered by your project. Please update the written narrative. See comment 10 under Engineering Review Comments.*

The narrative has been updated for consistency with the application form (see copies of report Revised December 22, 2022.

4. *Please provide an updated abutter's map drawn to scale of not less than one inch to one hundred feet (1" = 100') showing the properties, lot numbers, and corresponding owners within a radius of two hundred feet (200') of the outermost boundary of the area of the proposed wetland alteration(s) as required per Rule 250-RICR-150-15-1.10(B)(2)(e). Please provide an updated list of the current property owners whose properties lie within two hundred feet (200') of the outermost boundary of the area of the proposed wetland alteration(s).*

An updated 200' radius abutters map and list has been provided.

Engineering Review Comments:

- ✓ 1. *In Appendix A Please provide a waterbody name for the ultimate receiving waterbody. Please note that in Appendix A Table 4.1 Silver Creek is appropriately indicated.*

Silver Creek (RI0007026R-01) has been added to Appendix A as the ultimate receiving waterbody.

- ✓ 2. *In Appendix A, with respect to the entry for the required recharge value, please provide a supporting calculation. Please note that the soils present are C and D hydrologic groups. Therefore an apportioning analysis is appropriate. In any case the recharge provide is sufficient.*

A calculation has been included in Table 2-1 of Appendix A. Note that the onsite impervious area is located entirely on soils in the D hydrologic group.

- ✓ 3. *With respect to the proposed sand filter, the table on sheet 9 indicates a bottom of pond elevation of 69.0'. However, the lowest contour on the submitted site plan for this sand filter shows a 68.0 contour at its bottom. Please revise the plan to provide consistency on this item.*

The plan view has been revised to show the correct bottom of sand filter contour of 69.

- ✓ 4. *Please indicate the invert and diameter of the four (4) pipes from the sand filter to the proposed Underground Detention System B.*

The invert and diameter of the four (4) pipes from the sand filter to the proposed Underground Detention System B have been shown on Sheet 9.

- ✓ 5. *With respect to the Underground Detention System B, the submitted analysis indicates the length of pipes to be 85'. However, the length represented on the detail site plan on Sheet 9 appears to only be 78'. Therefore, please revise the plans and/or the analysis to provide consistency on this item.*

The detail site plan on Sheet 9 has been revised to be consistent with the submitted analysis indicated length of 85'.

- * 6. *With respect to the proposed Pond 104: UIS (Isolator Row) please revise the detail of the proposed Isolator Rows-TM so as to provide an adequate access structure and adequate diameter of inlet pipe to allow for the efficient "hydro-jetting of sediments and vactoring (vacuuming)" as indicated in the submitted long-term operation and maintenance plan. The arrangement as is proposed, and the small diameter of inlet pipes proposed present concerns as to how the required maintenance will be sufficiently performed.*

The proposed Pond 104: UIS (Isolator Row) and related details have been updated on Sheet 8 and Sheet 9.

- ✓ 7. *With respect to Pond 104: UIS-A (Isolator Row) the submitted analysis indicates a 6" diameter outlet at invert elevation 74.0'. Please direct the reviewer to where on the plan this outlet is located.*

Based on new updates and revisions, we no longer need the 6" outlet connection and have removed it from the plans and the analysis.

8. *With respect to proposed large Underground Detention System, the submitted analysis indicates the length of the 13 interior pipes to be 75'. However, the length represented on the detail site plan on Sheet 9 appears to only be 67'. Therefore, please revise the plans and/or the analysis to provide consistency on this item.*

The length of the interior pipes, for the large Underground Detention System shown on Sheet 9, has been revised to 75' to be consistent with the analysis.

9. *With respect to proposed Pond 104 UIS A (Isolator Row) and Pond 105 (UIS A) please revise their labels to indicate that they contain underground sand filter layers and as such are considered as sand filters.*

The labels have been revised in the analysis and the plan set.

10. *Please revise the submitted "Written Narrative in Support of an Application to Alter a Freshwater Wetland for a Hotel Development, A.P. 111, Lot 1; Gooding Avenue, Bristol, Rhode Island". Please note that this document contains more than one instance of information that is not accurate with respect to the current submittal, including incorrect plan preparer information and incorrect stormwater practice.*

The narrative has been updated for consistency with the application form (see copies of report Revised December 22, 2022).

11. *With respect to the submitted analysis, the submitted drainage diagram indicates pre- and post-drainage diagrams of flows to Bristol Harbor (Reaches 12 pre-project and Reach 112 post-project). However, no supporting analysis has been provided. Please provide this supporting analysis.*

The supporting analysis has been provided in the attached printouts. In order to verify that peaks do not combine to create a greater flow rate or volume from pre to post-development conditions, DE completed a rough drainage analysis for Silver Creek. Not having the raw watershed data from the BETA study, we modeled the following parameters:

Leading to onsite Wetland Design Point:

Area = 352.93

Ground cover was broken into grassland, woods, 1/3 acre residential, and urban industrial uses based on aerial mapping.

Majority C soils were observed on the USDA mapping and therefore C soils were entirely used for the HydroCad ground covers.

Time of concentration = 42.7 minutes using slopes based on USGS topography.

Downstream of onsite Wetland Design Point:

Area = 897.07

Ground cover was broken into grassland, woods, 1/3 acre residential, and urban industrial uses based on aerial mapping.

Majority C soils were observed on the USDA mapping and therefore C soils were entirely used for the HydroCad ground covers.

Time of concentration = 57.8 minutes using slopes based on USGS topography.

Modified Reach 11/111:

Modified from summation point only to V channel reach.

Length of channel to Bristol Harbor based on USGS = 7,022 feet and Slope = 0.0078'/'.

Used 5' depth and approximate side slopes based on segment of stream through subject site.

Assumed Manning's n of 0.035 (earth, dense weeds).

The resulting runoff is not meant to be an accurate output for the Silver Creek watershed, only a representation of the overall watershed for the purposes of determining the development's effect on watershed flows.

As shown on the attached supplemental HydroCad analysis, the resulting flows/volumes at the onsite and Bristol Harbor reaches are as follows:

| Subwatershed (design point) | 100-yr Peak Flow (cfs) | | 100-yr Peak Volume (ac-ft) | |
|--------------------------------|---------------------------|-------|-------------------------------|--------|
| | Pre | Post | Pre | Post |
| DP-11/111 (Onsite DP): | 1,270 | 1,266 | 194.10 | 193.86 |
| DP-12/112 (Proposed DP): | 3,555 | 3,551 | 656.81 | 656.57 |

Therefore we have confirmed there will be no adverse impacts on the overall Silver Creek watershed due to the proposed development.

- The submittal indicates that proposed total runoff volume will not be increased in the 100-year event by utilization of infiltration. Please provide a groundwater mounding analysis to attempt to demonstrate that none of the infiltrated runoff volume will break out to the ground surface in storm events up to and including the 100-year event. This should also consider the possible outflow through any proposed weep holes in the proposed retaining wall to be located between the proposed underground infiltration practice and the receiving wetland.

To determine the likely location of breakout to the surface on the east/wetlands side of the development, DE reviewed the horizontal hydraulic conductivity. Based on a guidance document, "Representative hydraulic conductivities in saturated groundwater flow", authors Xavier Sanchez-Villa, Alberto Guadagnini, and Jesus Carrera, published 23 September 2006, the horizontal hydraulic conductivity may be estimated as approximately an order of magnitude (10 times) higher than the vertical conductivity. In order to perform the most conservative calculation, rather than use the RISDISM book value of 0.52 inches per hour the maximum value of the USDA.gov published range of 0.6-2 in/hr was used to arrive at a more conservative horizontal conductivity of 2 in/hr x 10 = 20 inches per hour. This will result in a rise:run gradient of 0.52 inches per hour / 20 inches per hour = 0.026 vertical feet per horizontal foot (2.6% slope).

On the eastern side of the UIS, the applicant proposes an impermeable liner to elevation 68.0 to eliminate sidewall infiltration and promote vertical flow of infiltrated stormwater. At the bottom of impermeable barrier, the infiltrated column of water can be modeled to travel a 1 run: 0.026 drop slope at 20 inches (1.67 feet) per hour in the horizontal direction. The proposed distance of the retaining wall from the eastern edge of UIS is 32 feet. As per the attached analysis, the time when the first infiltrated stormwater reaches the subsoil is at Hour 5.4.

The first flush of infiltrated stormwater will reach the wall at time:

$$5.4 \text{ hours} + (50' / (1.67' / \text{hr})) = 35.3 \text{ hours into the storm.}$$

The elevation of infiltrated stormwater at this point assuming unsaturated conditions is $68 - (0.026 \times 50.0) = \text{Elevation } 66.7$. More likely, this infiltrated flow will join the gradient of saturated soil as it approaches the new wetlands line east of proposed retaining wall. In any case, the infiltrated stormwater will be at or below the bottom ground surface of 67.8 at the base of wall. ✓

13. Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis. Please provide a comparison of hydrographs to demonstrate that the volume being discharged from the site over time will not increase the discharge to the river in comparison with the existing condition hydrograph discharge from the site.

Response above also summarizes timeline of infiltrated stormwater flowing towards the wetland area. See attachment for hydrograph table detail of potential arrival of infiltrated stormwater to the edge of wetlands, as well as the point where the post-development hydrograph flow will surpass the pre-development hydrograph flow. ✓

14. Please provide a comparison of the existing condition hydrograph and the proposed condition hydrograph. Please address whether there will be an increase in either the peak of any of the proposed condition hydrographs or whether there will be any change in the time of the peak of the proposed condition hydrograph. Please perform this task for the 1, 10, and 100-year 24-hour Type III storm events.

Comparison of the design points has been provided for each of these storms. The peak flows under proposed conditions will be at a lower magnitude for all storms, and occur approximately 0.1 hours earlier. As shown in these comparisons, the only occurrence of the proposed outflow surpassing existing outflow occurs at approximately hour 16.5, when both the existing and proposed flows are under 0.5 cfs. As marked on the hydrograph table provided in response to #13, this crossing of hydrographs will occur when the Silver Creek design point is discharging at 82.3 cfs, a fraction of the peak of 1,266 cfs occurring at Hour 12.57. ✓

15. Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis. ✓

This comment has been addressed under Comment 13.

Please feel free to contact me if you have any further questions regarding this matter, or if further copies are needed.

Sincerely,
DiPrete Engineering Associates, Inc.



2536-001-ALLS-PHCD-INHS

Type III 24-hr 100-Year Rainfall=8.60"

Prepared by DiPrete Engineering

HydroCAD@ 10.00.22 s/n 01125 © 2018 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs dt=0.01 hrs, 7201 points

Runoff by SCS TR-20 method UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment200 UpgradientOffsite Runoff Area=352.930 ac 38.27% Impervious Runoff Depth=6.55"
 Flow Length=5.196' Tc=42.7 min CN=83 Runoff=1,264.25 cfs 192.697 af

Subcatchment200 UpgradientOffsite Runoff Area=352.930 ac 38.27% Impervious Runoff Depth=6.55"
 Flow Length=5.196' Tc=42.7 min CN=83 Runoff=1,264.25 cfs 192.697 af

Subcatchment201 DowngradientOffsite Runoff Area=897.070 ac 28.39% Impervious Runoff Depth=6.19"
 Flow Length=9.823' Tc=57.8 min CN=80 Runoff=2,598.31 cfs 462.710 af

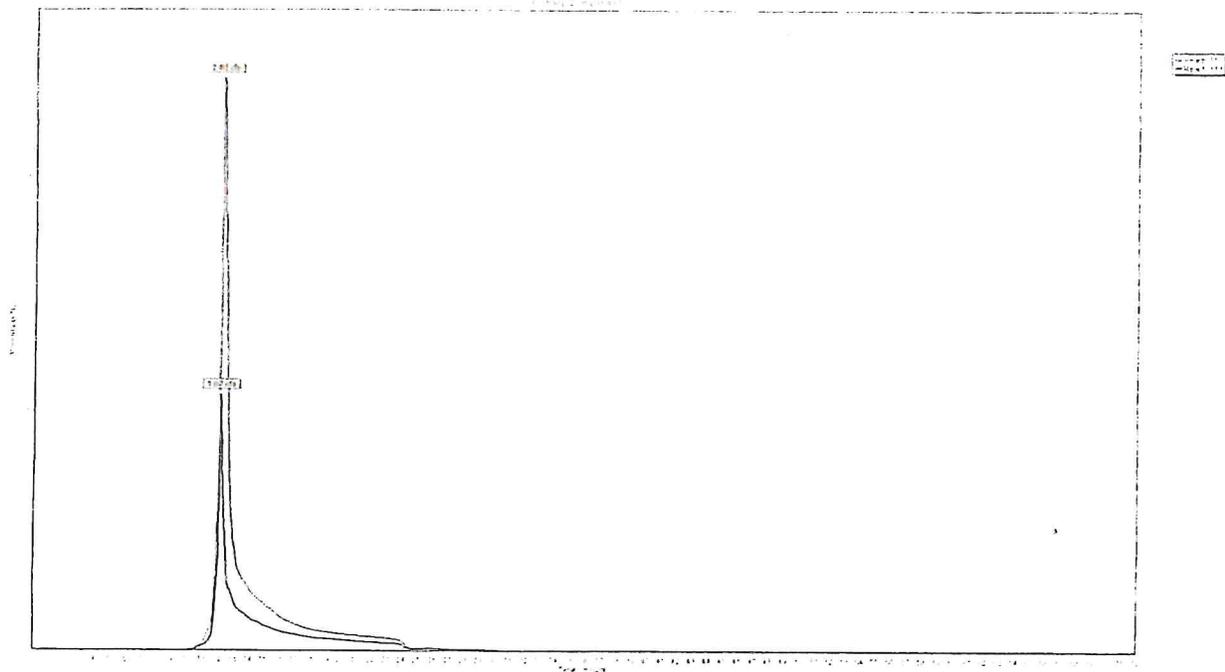
Subcatchment201 Downgradient Runoff Area=897.070 ac 28.39% Impervious Runoff Depth=6.19"
 Flow Length=9.823' Tc=57.8 min CN=80 Runoff=2,598.31 cfs 462.710 af

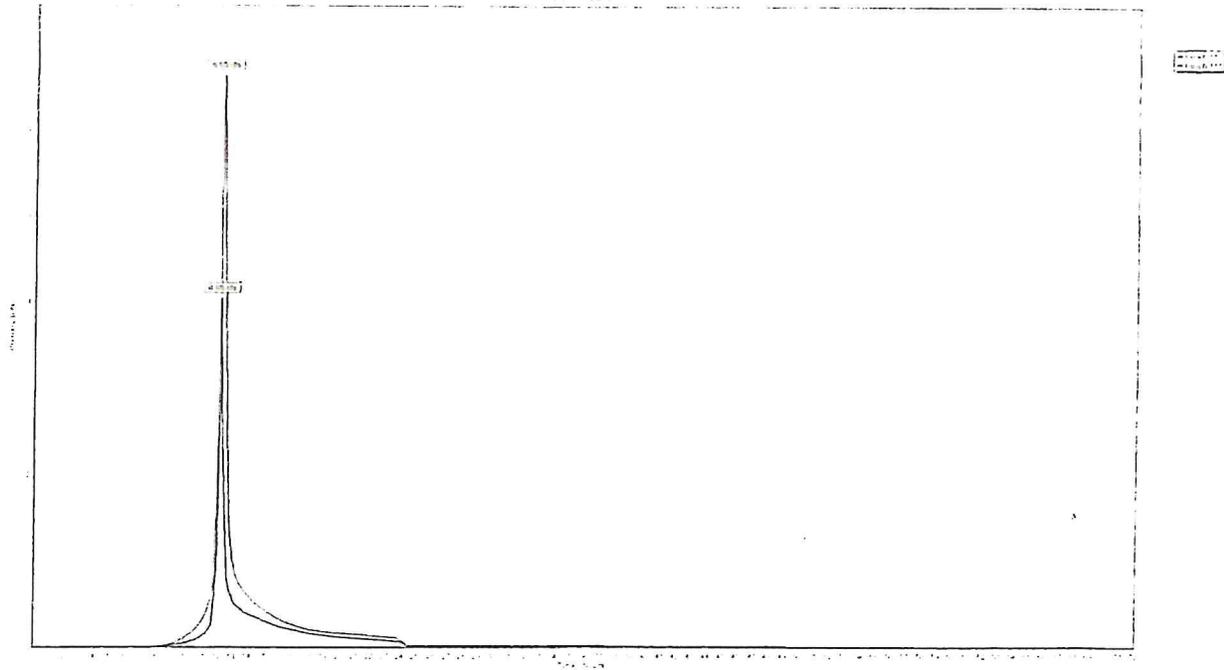
Reach 11 Silver Creek from site Avg Flow Depth=2.39' Max Vel=4.23 fps Inflow=1,269.86 cfs 194.099 af
 n=0.035 L=7,022.0' S=0.0078 ' Capacity=6,919.98 cfs Outflow=967.37 cfs 194.099 af

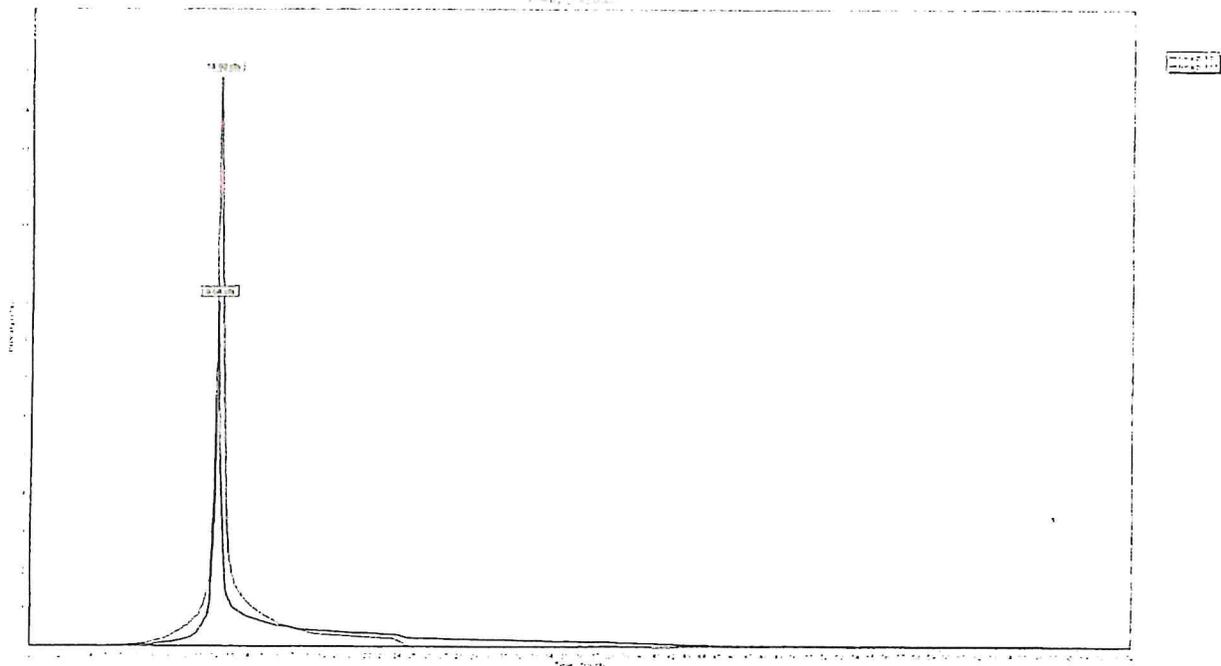
Reach 12 Bristol Harbor Inflow=3,555.02 cfs 656.809 af
 Outflow=3,555.02 cfs 656.809 af

Reach 111 Silver Creek from site Avg Flow Depth=2.39' Max Vel=4.23 fps Inflow=1,266.08 cfs 193.864 af
 n=0.035 L=7,022.0' S=0.0078 ' Capacity=6,919.98 cfs Outflow=963.80 cfs 193.860 af

Reach 112 Bristol Harbor Inflow=3,551.01 cfs 656.570 af
 Outflow=3,551.01 cfs 656.570 af





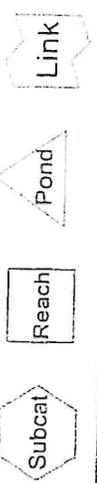
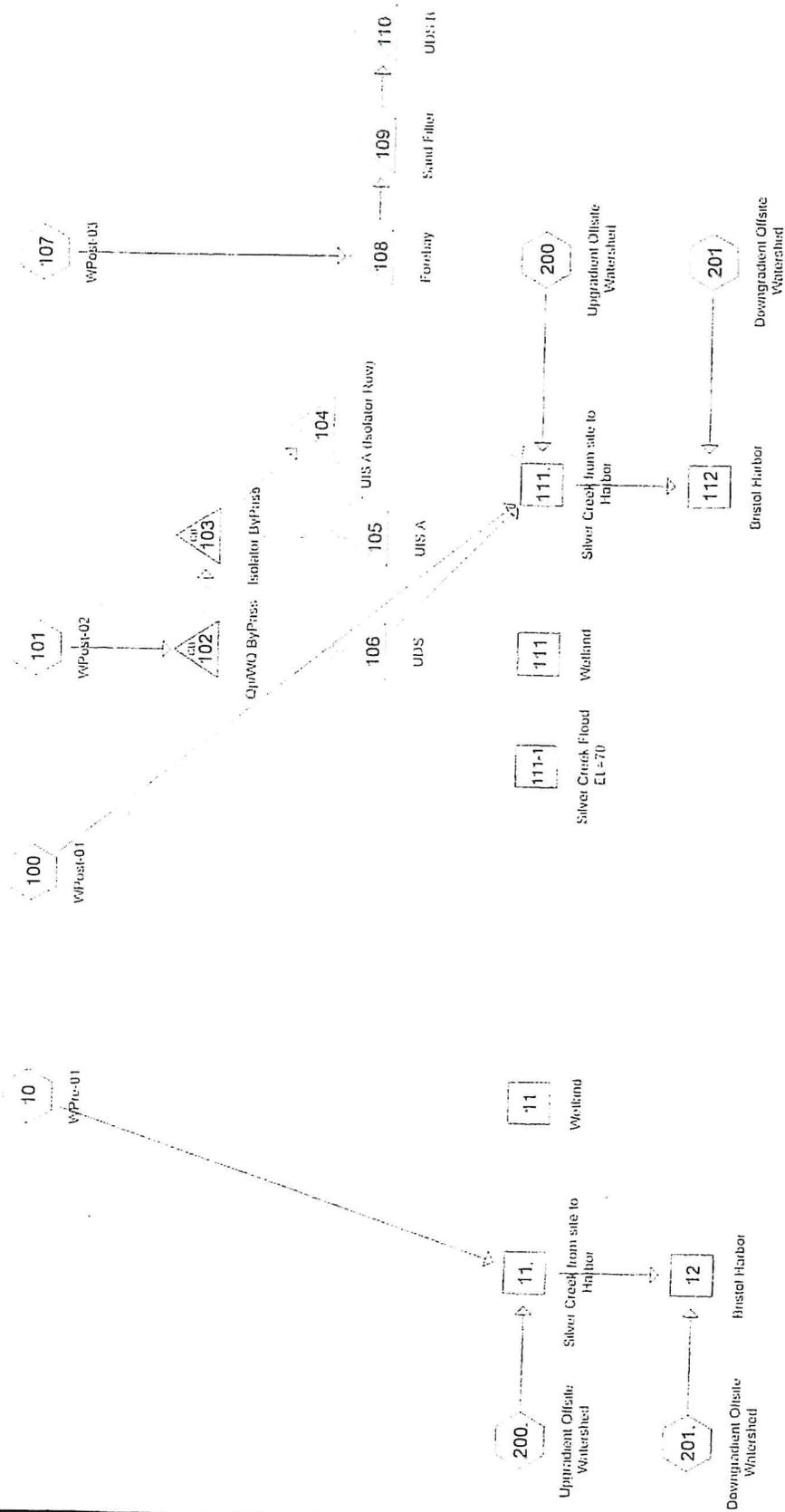


Hydrograph for Reach 111.: Silver Creek from site to Harbor

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Outflow (cfs) |
|--------------|--------------|----------------------|------------------|---------------|
| 0.00 | 0.00 | 0 | 55.00 | 0.00 |
| 0.50 | 0.00 | 0 | 55.00 | 0.00 |
| 1.00 | 0.00 | 0 | 55.00 | 0.00 |
| 1.50 | 0.00 | 0 | 55.00 | 0.00 |
| 2.00 | 0.00 | 0 | 55.00 | 0.00 |
| 2.50 | 0.00 | 0 | 55.00 | 0.00 |
| 3.00 | 0.00 | 0 | 55.00 | 0.00 |
| 3.50 | 0.00 | 0 | 55.00 | 0.00 |
| 4.00 | 0.00 | 0 | 55.00 | 0.00 |
| 4.50 | 0.00 | 0 | 55.00 | 0.00 |
| 5.00 | 0.55 | 272 | 55.02 | 0.01 |
| 5.50 | 2.52 | 2,753 | 55.10 | 0.20 |
| 6.00 | 5.05 | 8,612 | 55.17 | 0.92 |
| 6.50 | 7.91 | 17,376 | 55.25 | 2.32 |
| 7.00 | 11.72 | 28,800 | 55.32 | 4.57 |
| 7.50 | 16.57 | 43,159 | 55.39 | 7.81 |
| 8.00 | 22.34 | 60,242 | 55.46 | 12.18 |
| 8.50 | 29.27 | 79,673 | 55.53 | 17.67 |
| 9.00 | 39.64 | 103,161 | 55.61 | 24.91 |
| 9.50 | 53.00 | 132,806 | 55.69 | 34.90 |
| 10.00 | 68.52 | 167,949 | 55.77 | 47.73 |
| 10.50 | 86.79 | 207,445 | 55.86 | 63.23 |
| 11.00 | 114.09 | 255,741 | 55.95 | 83.56 |
| 11.50 | 154.98 | 318,986 | 56.07 | 112.21 |
| 12.00 | 339.84 | 457,285 | 56.28 | 181.37 |
| 12.50 | 1,237.44 | 1,211,339 | 57.08 | 664.61 |
| 13.00 | 732.31 | 1,543,866 | 57.34 | 918.30 |
| 13.50 | 325.19 | 1,081,528 | 56.96 | 571.37 |
| 14.00 | 206.01 | 739,175 | 56.62 | 344.01 |
| 14.50 | 156.64 | 552,559 | 56.40 | 233.36 |
| 15.00 | 132.37 | 447,441 | 56.26 | 176.16 |
| 15.50 | 114.90 | 384,097 | 56.17 | 143.74 |
| 16.00 | 98.18 | 338,158 | 56.10 | 121.25 |
| 16.50 | 82.33 | 298,855 | 56.03 | 102.88 |
| 17.00 | 71.93 | 265,845 | 55.97 | 88.02 |
| 17.50 | 64.18 | 240,233 | 55.92 | 76.90 |
| 18.00 | 56.79 | 218,929 | 55.88 | 67.95 |
| 18.50 | 49.92 | 199,667 | 55.84 | 60.08 |
| 19.00 | 46.06 | 183,541 | 55.81 | 53.70 |
| 19.50 | 43.61 | 171,783 | 55.78 | 49.18 |
| 20.00 | 41.34 | 162,837 | 55.76 | 45.79 |
| 20.50 | 39.18 | 155,447 | 55.74 | 43.03 |
| 21.00 | 37.39 | 149,021 | 55.73 | 40.70 |
| 21.50 | 35.73 | 143,404 | 55.71 | 38.66 |
| 22.00 | 34.05 | 138,290 | 55.70 | 36.81 |
| 22.50 | 32.40 | 133,404 | 55.69 | 35.11 |
| 23.00 | 30.78 | 128,577 | 55.68 | 33.44 |
| 23.50 | 29.12 | 123,779 | 55.66 | 31.78 |
| 24.00 | 27.45 | 118,989 | 55.65 | 30.12 |

Post-development passes pre-development hydrograph (both flows less than 0.5 cfs)





Routing Diagram for 2536-001-ALLS-PHCD-INHS
 Prepared by DIPrete Engineering
 HydroCAD® 10.00-22 s/n 01125 © 2018 HydroCAD Software Solutions LLC



FRESHWATER WETLANDS / STORMWATER ENGINEERING
CLEARANCE for NOTICE & FINAL REVIEW

Sturwacht

Date: 6/30/2023

Reviewer: Nicholas A. Pisani, P.E.

Nicholas A. Pisani P.E.

| | | |
|----------------------------|------------------|-------------|
| Application Number: | FWW#: | 22-0264 |
| | WQC#: | 22-114 |
| | GWD/UIC#: | UIC--001650 |
| | RIPDES#: | RIR101247 |
| | OTHER: | _____ |

Applicant Name: KenDan, LLC

Project Name: Gooding Avenue Development

Plans and Analysis Reviewed: Plans and Reports received by DEM on 6/27/2022, with revised plans and analysis received on 5/25/2023.

Engineering Review conducted with Checklist rev. date: 2/20/2014.

Recommended Action: Adequate for Public Notice and Adequate for Approval with Condition.

Findings:

- 1) **Redevelopment Status:** The proposed project represents new development.
- 2) **Drainage and Water Quality Issues:** The submittal meets the pertinent requirements of the RIDEM Stormwater Management, Design and Installation Rule (250-RICR-150-10-8). Specifically:
 - **Re: Water Quality Standard:** The proposed design includes two (2) water quality treatment practices to provide water quality treatment for the proposed impervious area of proposed impervious areas proposed areas of rooftop and parking and access drives. These will consist of an infiltrating underground sand filter with proposed Isolator Row-TM pretreatment and an infiltrating surface sand filter with a sediment forebay as pretreatment. Together these will filter and infiltrate the water quality volume (one inch of runoff from contributing impervious areas) from the proposed project. The proposed design meets pertinent vertical separations to groundwater table and pertinent horizontal setbacks. Based on the above considerations the proposed design will meet the pertinent Water Quality Standard of the Stormwater Rules.
 - **Re: Recharge Standard:** The proposed design provides two (2) infiltrating sand filters. Together these infiltration practices will meet the pertinent Recharge Standard of the Stormwater Rules.
 - **Re: Channel Protection Standard:** The proposed project design includes an infiltrating subsurface sand filter, an infiltrating surface

sand filter, and two underground detention practices. Together these practices will provide a combination of infiltration and detention that will ensure that the discharge rate in the one-year storm event will be less than the allowable release rate required to ensure the 24-hour extended detention of the total runoff volume for the one-year storm event. Therefore, the submitted analysis shows that the proposed project design will meet Channel Protection Standard of the Stormwater Rules.

- **Re: Overbank Protection Standard:** The proposed design includes a proposed underground sand filter, a proposed surface sand filter, and two underground detention practices. The submitted analysis demonstrates that together these practices will serve to ensure that there will not be any increase in the peak runoff discharge rates in either the 10-year or the 100-year 24-hour Type III storm events. Therefore the proposed design meets the pertinent Overbank Protection Standard of the Stormwater Rules.
- The designer has addressed potential downstream flooding concerns by indicating that the submitted analysis shows that the total runoff volume of runoff to the receiving wetland will be decreased in the 1, 10 and 100-year 24-hour Type III storm events.

3) **Re: Soil Erosion and Sediment Control Issues:** The submittal includes an acceptable Soil Erosion and Sediment Control Plan.

4) **Floodplain and Floodway Issues:** The site of the proposed development is located inland of the FEMA-mapped 100-year floodplain.

Technical Justification(s): If the site plans for the proposed development include a BMP that does not fully comply with all the applicable design requirements of the RISDISM, then please note below:

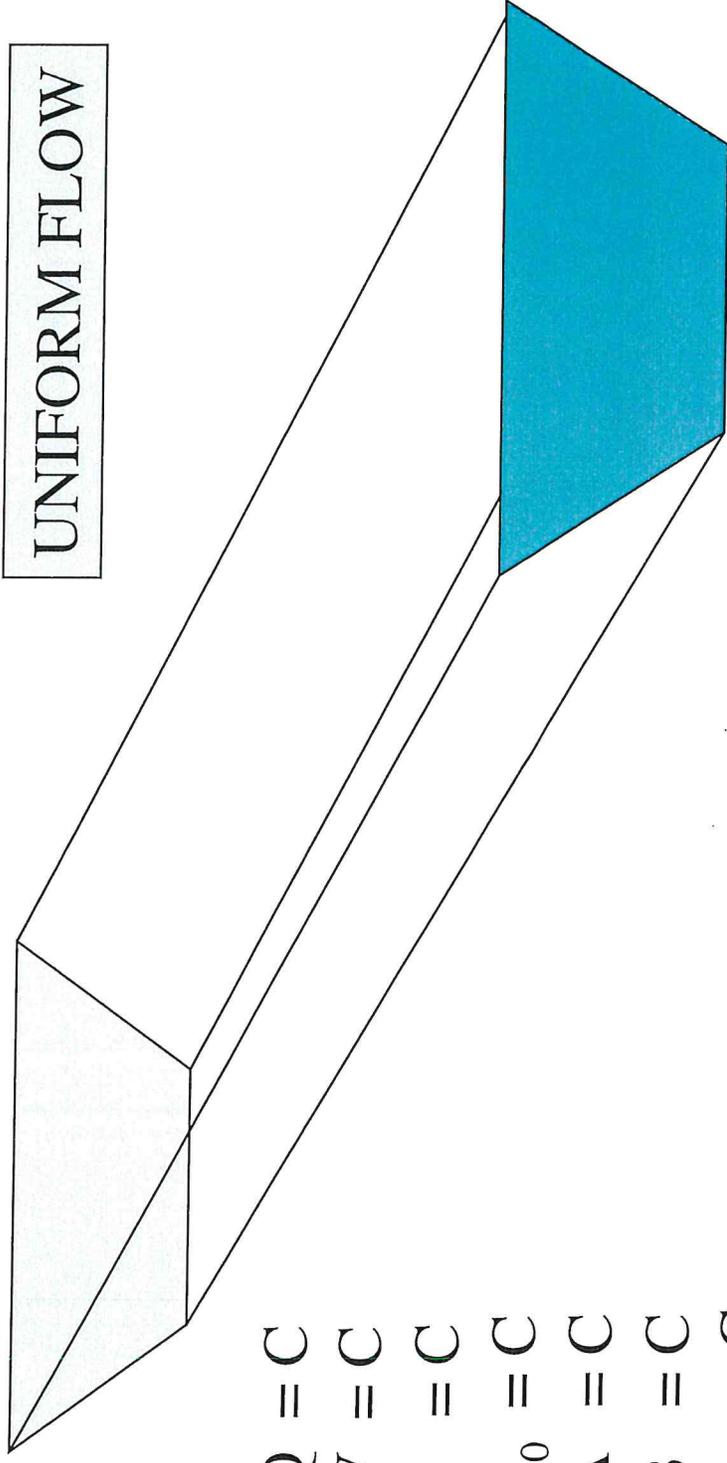
- NA

Permit Conditions:

- 1) The long-term operation and maintenance plan shall be strictly followed. The long-term operation and maintenance plan shall be that entitled "Operation & Maintenance Plan, Gooding Avenue Development, Located in Bristol, Rhode Island; Applicant: Kendan, LLC", dated 1-23-2018, Revised 4-06-2021, dated received 6/27/2022, prepared by DiPrete Engineering.

Graphic Representation Uniform and Non Uniform Flow

Normal depth implies that flow rate, velocity, depth, bottom slope, area, top width, and roughness remain constant within a **prismatic** channel as shown below



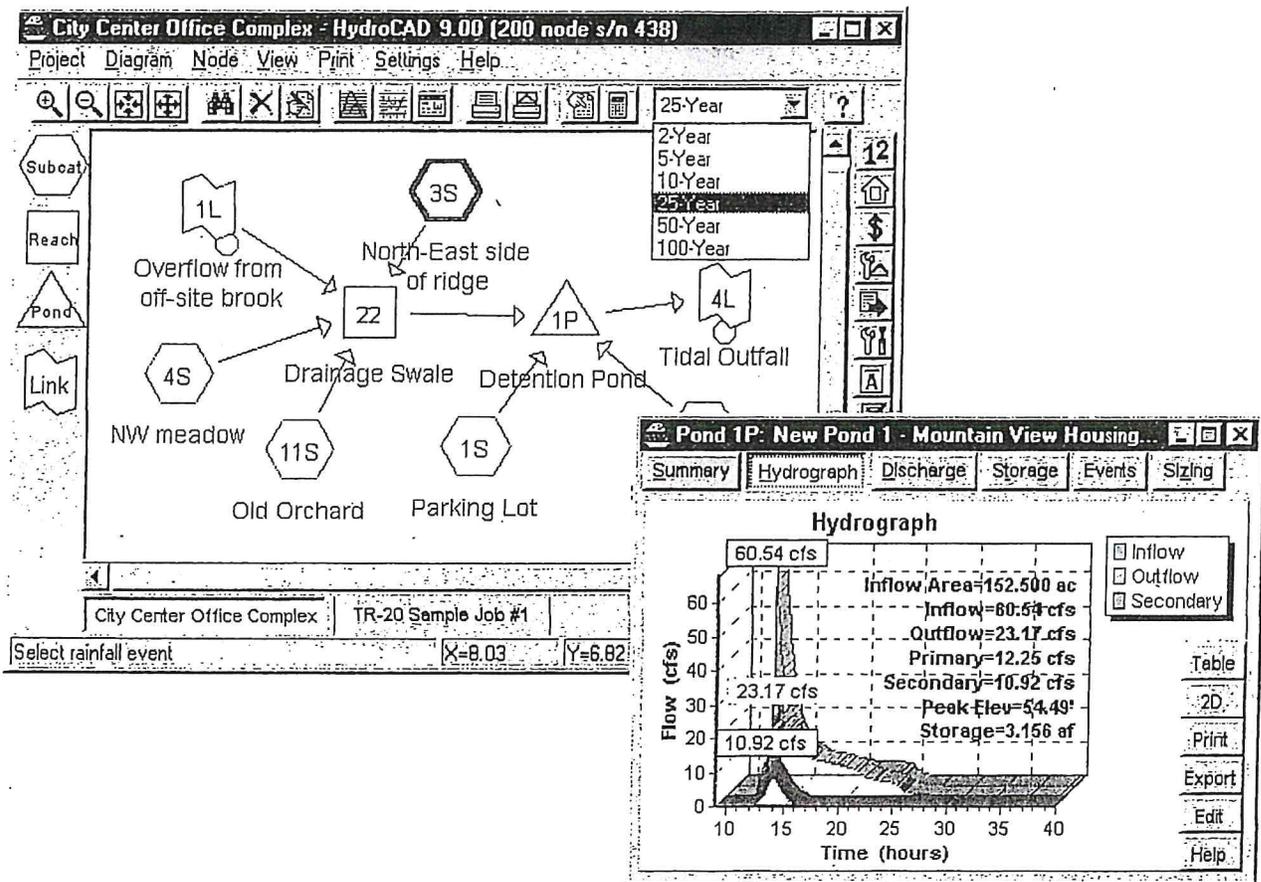
$$\begin{aligned} Q &= C \\ V &= C \\ y &= C \\ S_0 &= C \\ A &= C \\ B &= C \\ n &= C \end{aligned}$$

Non-Uniform Open Channel Flow

With natural or man-made channels, the shape, size, and slope may vary along the stream length, x . In addition, velocity and flow rate may also vary with x . Non-uniform flow can be best approximated using a numerical method called the Standard Step Method.

HydroCAD®

Stormwater Modeling System



Owner's Manual

Version 9

HydroCAD Software Solutions LLC

The Routing Diagram

The routing diagram shows the individual *nodes* that make up each project. The nodes are usually connected by arrows that indicate how their outflows are routed. Multiple inflows are summed automatically as required.¹

Based on the routing diagram, HydroCAD is able to determine the correct sequence of calculations, and then calculate the flows throughout the project. Routing calculations are automatically updated as required. You can manipulate the diagram display with the main scroll bars, the tool bar, the main menu, the palette, and the mouse.

Watershed components

Each drainage system is represented by a network of the following types of *nodes*:

- **Subcatchment:** A relatively homogenous area of land that typically drains into a reach or pond. Each subcatchment generates a *runoff hydrograph*. A subcatchment may also be used to account for the rain falling directly on the surface of a pond. A subcatchment *cannot* be used to route an inflow hydrograph. Instead, use a subcatchment to calculate the runoff and a separate reach to perform the routing.
- **Pond:** A pond, swamp, dam, catch basin, manhole, drywell, or other impoundment that fills with water from one or more sources and empties in a manner determined by a weir, culvert, or other outlet device(s). The outflow of each pond is determined by a *hydrograph routing* calculation which attenuates and delays the peak flow. A pond may empty into a reach or into another pond. An optional *secondary* outflow may be used to *divert* the discharge from specific outlet devices and route them separately. A *discarded* outflow is also available for outflows that are not subject to further routing, such as exfiltration.
- **Catch Basin:** A special type of pond that provides an insignificant amount of storage, but otherwise has all the properties and capabilities of a pond. Since a catch basin has no storage capability, it cannot detain or attenuate its inflow. However, the routing calculations will determine the water surface level (headwater) at each point in time.
- **Reach:** A uniform stream, channel, or pipe that conveys water from one point to another and operates under *open channel flow*.² A reach may also be used to route an upstream hydrograph through a subcatchment.³ The outflow of each reach is determined by a hydrograph routing calculation. This generally delays and attenuates the peak flow. A reach may be routed into a pond or into another reach.
- **Link:** A link may be used to 1) enter a hydrograph generated outside HydroCAD, 2) interconnect several routing diagrams, 3) scale a hydrograph, 4) split a hydrograph into two components for independent routing, or 5) define a fixed or tidal tailwater elevation.

¹ To sum multiple flows without performing a hydrograph routing, use an undescribed reach, pond, or link.

² To model a pipe under other flow conditions, including headwater and tailwater effects, use a *catch basin or pond with a culvert outlet*. This applies to most culverted road crossings, manholes, and other impoundments that feed a pipe.

³ When a reach drains a subcatchment *along its length*, it may be best modeled as a component of the subcatchment's calculation, rather than as an independent reach.

This technique is based on the assumption that the total flow is equal to the sum of the flows for the individual segments. If applied to a section with a constant Manning's value, the result is *not* the same as the original Manning's value.

Subdivision by Segment

$$Q = \sum Q_i \quad \text{Eq. 27}$$

Q=Total flow for cross-section [ft³/sec] or [m³/sec]
Q_i=Flow for segment i (see Eq.23) [ft³/sec] or [m³/sec]

This technique produces exactly the same flow as the Lotter method, described above. It differs only in the calculation procedure, in which the total flow is the sum of the flows calculated separately for each segment, without the use of a composite Manning's value.

Subdivision by Manning's Value

$$Q = \sum Q_n \quad \text{Eq. 28}$$

Q=Total flow for cross-section [ft³/sec] or [m³/sec]
Q_n=Flow for consecutive segments with same Manning's value

This technique subdivides the channel only when there is a change (break) in the Manning's value. This produces more consistent results than subdivision by segment, in that the resulting flow is independent of the number of points along the cross section. When all segments have the same Manning's value, the flow is identical to the traditional solution for a constant Manning's value. This technique is similar (although not identical) to the current procedure used in HEC-RAS.

Other Procedures

If another technique is used to calculate flow through a complex cross-section, the rating curve can be calculated separately and entered into HydroCAD using option 1, above. However, using a defined geometry or cross-section allows direct evaluation of the channel at any depth, without having to interpolate between a (smaller) number of user-defined stages.

Reach Routing Limitations

The preceding stage-discharge calculations are based solely on Manning's equation, and do *not* consider possible inlet, outlet, or tailwater effects. If a complete analysis is desired for a pipe, including entrance losses and possible tailwater effects, it should be modeled as a pond with a culvert outlet. If a detailed water surface profile is required for a channel, you should use a program specifically designed for that purpose.²⁵

²⁵ Water surface profiles are usually calculated under constant flow conditions rather than with

Primary Comparison

| Time (hours) | Reach 11. (cfs) | Reach 111. (cfs) | Time (hours) | Reach 11. (cfs) | Reach 111. (cfs) | Time (hours) | Reach 11. (cfs) | Reach 111. (cfs) |
|--------------|-----------------|------------------|--------------|-----------------|------------------|--------------|-----------------|------------------|
| 0.00 | 0.00 | 0.00 | 27.00 | 3.51 | 3.67 | 54.00 | 0.00 | 0.02 |
| 0.50 | 0.00 | 0.00 | 27.50 | 2.49 | 2.66 | 54.50 | 0.00 | 0.02 |
| 1.00 | 0.00 | 0.00 | 28.00 | 1.83 | 1.99 | 55.00 | 0.00 | 0.02 |
| 1.50 | 0.00 | 0.00 | 28.50 | 1.36 | 1.52 | 55.50 | 0.00 | 0.02 |
| 2.00 | 0.00 | 0.00 | 29.00 | 1.05 | 1.19 | 56.00 | 0.00 | 0.02 |
| 2.50 | 0.00 | 0.00 | 29.50 | 0.81 | 0.96 | 56.50 | 0.00 | 0.02 |
| 3.00 | 0.00 | 0.00 | 30.00 | 0.63 | 0.78 | 57.00 | 0.00 | 0.02 |
| 3.50 | 0.00 | 0.00 | 30.50 | 0.51 | 0.65 | 57.50 | 0.00 | 0.02 |
| 4.00 | 0.00 | 0.00 | 31.00 | 0.42 | 0.55 | 58.00 | 0.00 | 0.02 |
| 4.50 | 0.00 | 0.00 | 31.50 | 0.34 | 0.48 | 58.50 | 0.00 | 0.02 |
| 5.00 | 0.01 | 0.01 | 32.00 | 0.28 | 0.42 | 59.00 | 0.00 | 0.02 |
| 5.50 | 0.20 | 0.20 | 32.50 | 0.23 | 0.37 | 59.50 | 0.00 | 0.02 |
| 6.00 | 0.92 | 0.92 | 33.00 | 0.19 | 0.33 | 60.00 | 0.00 | 0.02 |
| 6.50 | 2.32 | 2.32 | 33.50 | 0.16 | 0.29 | 60.50 | 0.00 | 0.02 |
| 7.00 | 4.57 | 4.57 | 34.00 | 0.14 | 0.26 | 61.00 | 0.00 | 0.02 |
| 7.50 | 7.83 | 7.80 | 34.50 | 0.12 | 0.24 | 61.50 | 0.00 | 0.02 |
| 8.00 | 12.22 | 12.17 | 35.00 | 0.11 | 0.22 | 62.00 | 0.00 | 0.02 |
| 8.50 | 17.74 | 17.67 | 35.50 | 0.09 | 0.20 | 62.50 | 0.00 | 0.02 |
| 9.00 | 25.02 | 24.91 | 36.00 | 0.08 | 0.19 | 63.00 | 0.00 | 0.02 |
| 9.50 | 35.06 | 34.89 | 36.50 | 0.07 | 0.18 | 63.50 | 0.00 | 0.02 |
| 10.00 | 47.96 | 47.72 | 37.00 | 0.06 | 0.17 | 64.00 | 0.00 | 0.02 |
| 10.50 | 63.55 | 63.26 | 37.50 | 0.05 | 0.16 | 64.50 | 0.00 | 0.02 |
| 11.00 | 83.97 | 83.68 | 38.00 | 0.04 | 0.15 | 65.00 | 0.00 | 0.02 |
| 11.50 | 112.72 | 112.36 | 38.50 | 0.04 | 0.14 | 65.50 | 0.00 | 0.02 |
| 12.00 | 182.30 | 181.75 | 39.00 | 0.03 | 0.13 | 66.00 | 0.00 | 0.02 |
| 12.50 | 669.59 | 665.36 | 39.50 | 0.03 | 0.13 | 66.50 | 0.00 | 0.02 |
| 13.00 | 920.95 | 918.61 | 40.00 | 0.03 | 0.12 | 67.00 | 0.00 | 0.02 |
| 13.50 | 572.45 | 571.50 | 40.50 | 0.03 | 0.11 | 67.50 | 0.00 | 0.02 |
| 14.00 | 344.61 | 344.09 | 41.00 | 0.02 | 0.11 | 68.00 | 0.00 | 0.02 |
| 14.50 | 233.75 | 233.41 | 41.50 | 0.02 | 0.10 | 68.50 | 0.00 | 0.02 |
| 15.00 | 176.45 | 176.20 | 42.00 | 0.02 | 0.09 | 69.00 | 0.00 | 0.02 |
| 15.50 | 143.95 | 143.77 | 42.50 | 0.02 | 0.08 | 69.50 | 0.00 | 0.01 |
| 16.00 | 121.40 | 121.27 | 43.00 | 0.02 | 0.08 | 70.00 | 0.00 | 0.01 |
| 16.50 | 102.96 | 102.89 | 43.50 | 0.02 | 0.07 | 70.50 | 0.00 | 0.01 |
| 17.00 | 88.06 | 88.03 | 44.00 | 0.01 | 0.07 | 71.00 | 0.00 | 0.01 |
| 17.50 | 76.91 | 76.91 | 44.50 | 0.01 | 0.06 | 71.50 | 0.00 | 0.01 |
| 18.00 | 67.93 | 67.95 | 45.00 | 0.01 | 0.06 | 72.00 | 0.00 | 0.01 |
| 18.50 | 60.04 | 60.08 | 45.50 | 0.01 | | | | |
| 19.00 | 53.64 | 53.71 | 46.00 | 0.01 | | | | |
| 19.50 | 49.11 | 49.18 | 46.50 | 0.01 | | | | |
| 20.00 | 45.71 | 45.79 | 47.00 | 0.01 | | | | |
| 20.50 | 42.95 | 43.03 | 47.50 | 0.01 | | | | |
| 21.00 | 40.61 | 40.70 | 48.00 | 0.01 | | | | |
| 21.50 | 38.56 | 38.66 | 48.50 | 0.01 | | | | |
| 22.00 | 36.71 | 36.81 | 49.00 | 0.01 | | | | |
| 22.50 | 35.00 | 35.11 | 49.50 | 0.01 | | | | |
| 23.00 | 33.33 | 33.44 | 50.00 | 0.01 | | | | |
| 23.50 | 31.67 | 31.78 | 50.50 | 0.00 | | | | |
| 24.00 | 30.01 | 30.12 | 51.00 | 0.00 | | | | |
| 24.50 | 27.20 | 27.33 | 51.50 | 0.00 | | | | |
| 25.00 | 18.94 | 19.09 | 52.00 | 0.00 | | | | |
| 25.50 | 11.96 | 12.12 | 52.50 | 0.00 | | | | |
| 26.00 | 7.67 | 7.83 | 53.00 | 0.00 | 0.03 | | | |
| 26.50 | 5.10 | 5.26 | 53.50 | 0.00 | 0.03 | | | |

DiPrete using HydroCAD for 'Downstream Analysis'
 NO water surface elevations
 Flow Rate does not compare with HEC RAS anal
 At high school culvert
 Beta Study 337.53 cfs Elev. 66.96'
 Spinard Study 358.46 cfs Elev. 67.22