SOUTH WAYNE
DRAINAGE IMPROVEMENTS
FEASBILITY STUDY

APRIL 2022

REVISED: MAY 31, 2022

PREPARED FOR:

RADNOR TOWNSHIP
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WAYNE, PA 19087-5297

PREPARED BY:

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I. INTRODUCTION

Carroll Engineering Corporation (CEC) is pleased to present this report which examines the feasibility of various alternatives for improvements to the South Wayne portion of Radnor Township to improve periodic flooding which occurs after heavy rainfalls. This area is traversed by Ithan Creek which was historically a meandering stream with various ponds along Midland Avenue, Saint Davids Road, Pembroke Avenue, and Meadowbrook Avenue according to available maps dating back as far as 150 years. Since that time, there has been significant encroachment from residential development and the stream has been confined to a manmade channel which varies in geometry and composition from its headwaters in the vicinity of the Radnor Fire Company to Encke Park adjacent to the Radnor Township Building.

From the Radnor Middle School, a main storm sewer culvert is noted to run along the southern side of Midland Avenue, crossing beneath the Saint Katherine of Siena School and South Aberdeen Avenue, and continues between the rear yards of the residential properties between Midland Avenue and Saint Davids Road. These areas are noted to have limited stormwater management infrastructure in the roadways and experience continual flooding issues during heavy rainfalls. As Ithan Creek approaches Pembroke Avenue, it turns south and crosses Meadowbrook Avenue and Orchard Way before proceeding east again. The creek continues through two (2) culverts, one at Iven Avenue, and other at the entrance of the Radnor Township Building. From there, Ithan Creek proceeds along the southern side of Encke Park returning to a typical creek composition with a natural bottom and vegetated side slopes.

The purpose of this study is multi-faceted with the following being the main goals of this Phase:

1. Identify each geometrically unique portion of the stream/culvert and catalog the following:

    - Stream/culvert bed slope
    - Bottom width and/or culvert dimensions
    - Side slopes
    - Channel depth
    - Composition of the stream bottom
    - Manning's 'n' coefficient (relative roughness constant)

2. Identify the drainage area and flow rates for each design year storm for each geometrically unique portion of the stream/culvert.

3. Complete a Manning's calculation to demonstrate the theoretical capacity of each portion of the stream.

4. Identify which portions of the stream/culvert may be deficient based on the capacity calculations and provide approximate sizing required to convey the 100-yr storm.

5. Prepare a conceptual plan for storm sewer infrastructure along Midland Avenue and Saint Davids Road which shall connect to the main storm sewer culvert corridor.

6. Prepare a conceptual plan for a potential storm sewer bypass beginning in the vicinity of the Pembroke Avenue between its intersections with Midland and Saint Davids Road and running southeast to Encke Park.

II. UNIQUE STREAM / CUVERT SECTIONS:

CEC performed a comprehensive topographic survey of the Ithan Creek Corridor and the adjacent right-of-way(s) to identify physical features such as stream geometry, storm sewers, culvert, retaining walls, centerline and edge of roadways, driveways, utility poles, mailboxes, fence lines, and other utilities and prominent features visible on the surface or marked by utility owners.

Following the survey, CEC prepared an existing features plan set of the entire stream corridor which is included Appendix A of this report. The existing features plan includes an index sheet to indicate where each sheet of the plans is located for ease of viewing.

The "Ithan Creek Sections – Index Plan" included in Appendix B summarizes the thirteen (13) individual stream sections along Ithan Creek which were used as the basis of our evaluation. These sections represent the approximate geometry of the stream for that particular reach. It should be noted that there are a number of minor variations in the parameters presented below (i.e., geometry, slope, etc.) for each reach. The sections are intended to represent the "best fit" which have been summarized below for reference.

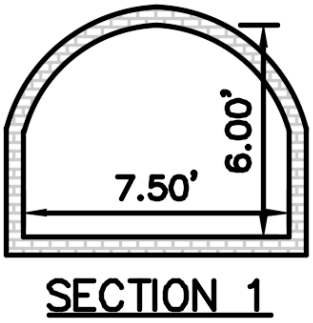
SECTION 1

Location:

This culvert section is located on the southern side of Midland Avenue between its intersection with Louella Lane and the Saint Katherine of Siena School.

Section Material & Geometry:

This section is composed of a 90- x 72-inch brick arch culvert (see graphic representation and photograph from a recent Township video inspection below).



SECTION 1

Section Capacity and Reach Geometry:

Length = 990 feet
Reach slope = 0.54% ±
Manning's n = 0.018
Theoretical Capacity = 339 CFS
Drainage Area = 192 acres
100-year peak flow rate = 548 CFS
50-year peak flow rate = 449 CFS
25-year peak flow rate = 358 CFS
10-year peak flow rate = 252 CFS
5-year peak flow rate = 181 CFS
2-year peak flow rate = 98.6 CFS

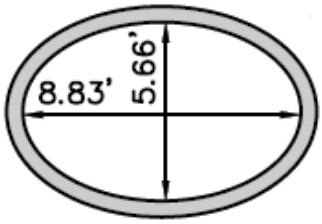
Observations/Recommendations:

A video inspection of this closed conduit was recently commissioned by the Township which demonstrated that this reach is in relatively good condition despite its old age (installation date unknown). Additionally, the theoretical carrying capacity falls somewhere between a 10- and 25-year peak flow rate. There is a portion where the Saint Katherine of Sienna School is located directly over top of the culvert which is not typically considered "good practice" since loss of property and/or life could result from a potential collapse. This conduit is recommended for consideration of eventual replacement in part to remove the conflict with Saint Katherine's, to replace aging infrastructure, incorporate stormwater inlets along Midland Avenue in accordance with Sheets C-103 & C-104 in Appendix A of this report, and provide the added capacity to convey the 100-year peak flow rate. The aforementioned design plans in Appendix presently depict the largest available concrete elliptical pipe which still falls somewhat short of the 100-year peak flow rate (437 CFS vs 545 CFS). However, alternatives to use a larger box culvert was ruled out due to space limitations of adjacent existing utilities and the significant cost addition for a box culvert as opposed to elliptical pipe. A sketch of this proposed section is included below for reference and calculations are

provided in Appendix C which demonstrate the equivalent round pipe would nearly have capacity to convey the 50-year peak flow rate.

The Township may also elect to complete the replacement of the portion overlaid by Saint Katherine's only to reduce the overall project scope.

In any case, improvements to the open channel portion of the stream at the Saint Katherine's parcel would need to be completed concurrently to remove approximately 2½ feet of the stream bottom and the pedestrian bridge to provide adequate slope for the replacement culvert. These removals are depicted on the aforementioned Sheet C-103.



PROPOSED SECTION 1

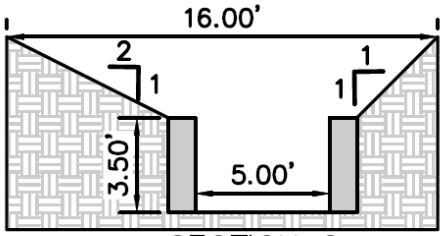
SECTION 2

Location:

This stream section is located on the southeastern portion of the Saint Katherine of Siena School parcel between the exit of Section 1 and an existing stone pedestrian bridge to the west of South Aberdeen Avenue.

Section Material & Geometry:

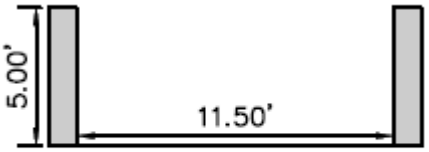
This section is an approximately 5 feet wide rectangular open channel with stone walls on either side having an approximate height of 3.5 feet. Above the stone walls, existing grade is sloped back until it reaches the elevation of the adjacent South Aberdeen Avenue roadway (see graphic representation below).



SECTION 2

Section Capacity and Reach Geometry:

Length = 82 feet
Reach slope = 0.90% ±
Manning's n = 0.017
Theoretical Capacity = 542 CFS
Drainage Area = 237 acres
100-year peak flow rate = 626 CFS
50-year peak flow rate = 513 CFS
25-year peak flow rate = 410 CFS
10-year peak flow rate = 289 CFS
5-year peak flow rate = 208 CFS
2-year peak flow rate = 114 CFS



PROPOSED SECTION 2
AND SECTION 3

Observations/Recommendations:

This portion of the stream is in good condition and the theoretical carrying capacity is relatively good which falls somewhere between a 50- and 100-year peak flow rate as noted above. However, this portion of the creek may be observed to surcharge during smaller storm events due to the presence of the downstream stone pedestrian bridge which forms a "choke point" for the stream. As you will note below, this pedestrian bridge has a theoretical capacity which falls between the 2-year and 5-year peak flow rate.

Also as previously noted in the Section 1 discussion above, the Midland Avenue storm sewer replacement plans on Sheet C-103 and C-104 in Appendix A of this report requires that this portion of the stream be lowered approximately 2½ feet to allow the proposed storm sewer to "daylight" at the existing stream. The channel section could also be maximized at that time to accommodate the 100-year peak flow rate. A graphic representation of the proposed channel is included above for reference and calculations are provided in Appendix C which demonstrate this channel cross-section would have sufficient capacity to convey the 100-year peak flow rate.

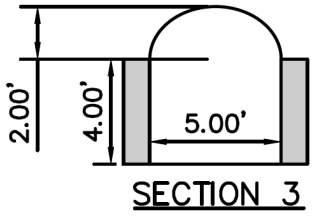
SECTION 3

Location:

This section is a stone masonry pedestrian bridge over the stream located on the eastern portion of the Saint Katherine of Siena School property. This is a decorative feature leading to a garden area near the intersection of Midland Avenue and South Aberdeen Avenue.

Section Material & Geometry:

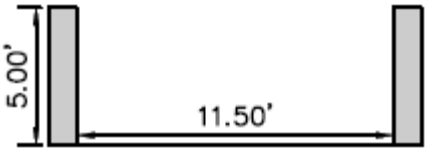
This creek section is a 5 feet wide culvert with a 2 feet stone arch above 4 feet stacked stone walls (see graphic representation and photograph below).



SECTION 3

Section Capacity and Reach Geometry:

Length = 9 feet
Reach slope = 0.35% ±
Manning's n = 0.017
Theoretical Capacity = 165 CFS
Drainage Area = 256 acres
100-year peak flow rate = 657 CFS
50-year peak flow rate = 539 CFS
25-year peak flow rate = 431 CFS
10-year peak flow rate = 305 CFS
5-year peak flow rate = 220 CFS
2-year peak flow rate = 121 CFS



PROPOSED SECTION 2
AND SECTION 3

Observations/Recommendations:

The pedestrian bridge has a theoretical capacity which falls between the 5-yr and 10-yr peak flow rate and is considered vastly undersized based on the tributary flows. As previously noted, this likely serves as a "choke point" for the flow which is tributary to this bridge. It is recommended that this bridge, which is assumed to have been installed for aesthetics rather than serving a particular function, be removed along with the abrupt drop in the channel just downstream to improve flow characteristics by removing this constriction.

Also as previously noted in the Section 1 & 2 discussion(s) above, the Midland Avenue storm sewer replacement plans on Sheet C-103 and C-104 in Appendix A of this report requires that that this structure be removed, and the stream be lowered approximately 2 ½ feet to allow the proposed storm sewer to "daylight" at the existing stream. The channel section could also be maximized at that time to accommodate the 100-year peak flow rate. A graphic representation of the proposed channel is included above for reference and calculations are provided in Appendix C which demonstrate this channel cross-section would have sufficient capacity to convey the 100-year peak flow rate.

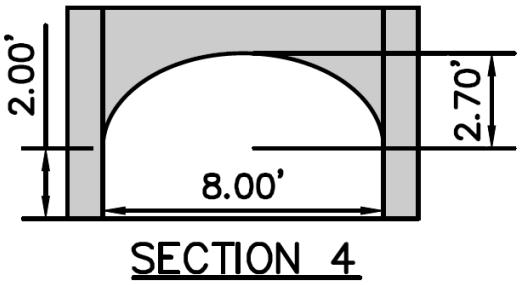
SECTION 4

Location:

This stream section is the culvert underneath South Aberdeen Avenue to the east of the Saint Katherine of Siena School.

Section Material & Geometry:

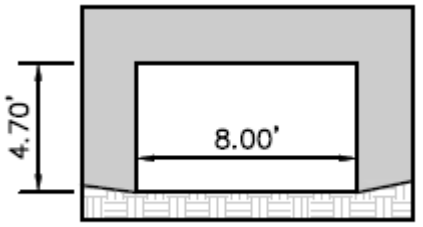
This section is an 8 feet wide culvert with a 2.7 feet stone arch above 2 feet stacked stone walls (see graphic representation and photograph below).



SECTION 4

Section Capacity and Reach Geometry:

Length = 63 feet
Reach slope = 1.52% ±
Manning's n = 0.017
Theoretical Capacity = 426 CFS
Drainage Area = 256 acres
100-year peak flow rate = 657 CFS
50-year peak flow rate = 539 CFS
25-yr peak flow rate = 431 CFS
10-yr peak flow rate = 305 CFS
5-yr peak flow rate = 220 CFS
2-yr peak flow rate = 121 CFS



PROPOSED SECTION 4

Observations/Recommendations:

The theoretical capacity of the stone culvert is nearly equivalent to the 25-year peak flow rate. Additionally, no operational issues are known to exist. As such, it is recommended that the Township continue to conduct periodic inspections to verify the integrity of the culvert is intact as is good practice.

This culvert may be subject to replacement in the future largely due to its assumed advanced age as part of the Township's general infrastructure replacement programs. The relative opening could be maximized at that time to adequately pass the 100-year peak flow rate. This culvert would be well suited for a CON/SPAN bridge or a box culvert. The graphic representation of the proposed box culvert is included above for reference and calculations are provided in Appendix C which demonstrate this culvert would have sufficient capacity to convey the 100-year peak flow rate.

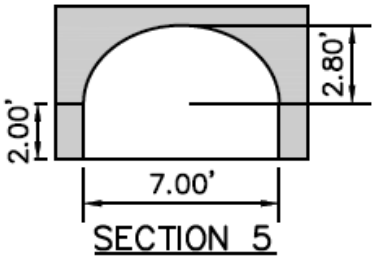
SECTION 5

Location:

This closed conduit is located below existing grade between South Aberdeen Avenue and Pembroke Avenue. It runs along the rear yards of residences having frontage on Midland Avenue and Saint David's Road.

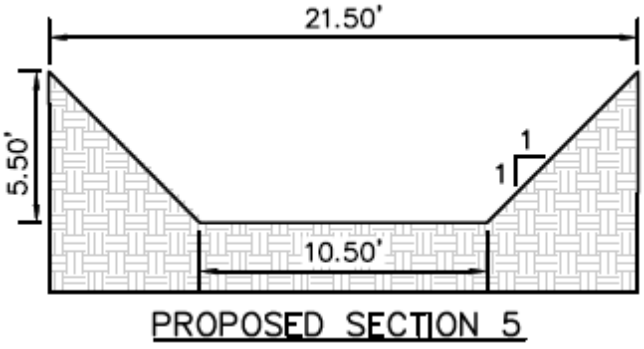
Section Material & Geometry:

This creek section is a 7 feet wide culvert with a 4.8 feet brick arch (see graphic representation and photograph below).



Section Capacity and Reach Geometry:

Length = 548 feet
Reach slope = 0.295% ±
Manning's n = 0.017
Theoretical Capacity = 164 CFS
Drainage Area = 262 acres
100-year peak flow rate = 668 CFS
50-year peak flow rate = 547 CFS
25-yr peak flow rate = 438 CFS
10-yr peak flow rate = 310 CFS
5-yr peak flow rate = 223 CFS
2-yr peak flow rate = 123 CFS



Observations/Recommendations:

The theoretical capacity of this closed conduit falls below the 5-year peak flow rate and is considered vastly undersized based on the tributary flows. This closed conduit likely serves as a substantial "choke point" due to its low theoretical capacity and the hydraulic losses of stormwater entering a closed conduit from an open channel. Furthermore, the existing grade above the conduit is somewhat higher than adjacent areas which is likely due to a coverage issue. This results in stormwater runoff entering the rear yards of residents along Midland and Saint Davids Avenue which cannot be conveyed by the conduit. There are also no intermediate inlets to accept additional runoff along this entire reach. Rather, stormwater flow must run to the east along the rear yards of residences until it meets the open channel portion of the stream.

Our recommendation would be to remove this closed conduit and replace it with an open channel having a bottom width of approximately 10½ feet, with 1:1 side slopes, and an approximate top width of 21½ feet. Calculations are provided in Appendix C which demonstrate this channel cross-section would have sufficient capacity to convey the 100-year

peak flow rate. Alternatives for smaller channels were not examined since it is not advisable to complete a replacement project for a channel not having sufficient capacity for the 100-year peak flow rate.

Typically, new channels would be designed to have 3:1 side slopes or less to minimize any bank erosion and allow for ease of maintenance. However, there a number of existing features which are in close proximity to the stream which preclude the channel from having more gradual side slopes and some that require modifications to accommodate the proposed channel. These existing features and/or impacts are as follows:

- **Garage at 313 Saint Davids Road (Parcel ID 36030190800)**
  The existing garage in the rear yard of this parcel is located within 10.3 feet of the existing closed conduit. The proposed open channel option would effectively move the edge of the stream 7.5 feet closer to this garage leaving approximately 3 feet of separation between the top of bank and northern side of the garage.

- **Garage / SWM Facility at 321 Saint Davids Road (Parcel ID 36030190600)**
  The existing garage in the rear yard of this parcel is located within 12 feet of the existing closed conduit. The proposed open channel option would effectively move the edge of the stream 7.5 feet closer to this garage leaving approximately 4½ feet of separation between the top of bank and northern side of the garage. Additionally, the private stormwater facility on this parcel would need to be modified to move the berm to the south by approximately 6 feet.

- **Fence at 301 Saint Davids Road (Parcel ID 36030191000)**
  An existing fence line at the rear of this parcel would need to be moved to the south approximately 6½ feet.

- **Fence at 305 Saint Davids Road (Parcel ID 36030190900)**
  An existing fence line at the rear of this parcel would need to be moved to the south approximately 4 feet.

- **Fence at 319 Saint Davids Road (Parcel ID 36030190700)**
  An existing fence line at the rear of this parcel would need to be moved to the south approximately 4 feet.

- **Shed & Fence at 318 Midland Avenue (Parcel ID 36030179600)**
  An existing fence line at the rear of this parcel would need to be moved to the north approximately 6 feet. Additionally, an existing shed at the southwestern corner of the parcel would need to be moved north by approximately 6 feet.

- **Utility Poles at the rear yards of residences along Saint Davids Road**
  A line of four (4) existing utility poles along the rear yards of the residences along Saint Davids Road would be located at the top of the southern bank of the proposed open channel stream section. These limit the overall width of the proposed stream which would be feasible at this location.

As a result of steeper side slopes being required, the proposed open channel would need to be installed with a robust bank liner which may consist of a variety of options including grouted riprap, reno mattress, green gabions, etc.

Additionally, the option to replace the closed conduit with open channel would require that each homeowner along Midland Avenue and Saint Davids Avenue (between South Aberdeen and Pembrooke Avenue) grant a permanent drainage easement to facilitate the work and allow the Township to maintain this reach of the stream in perpetuity. The acquisition of these easements will likely pose as a significant challenge to the Township.

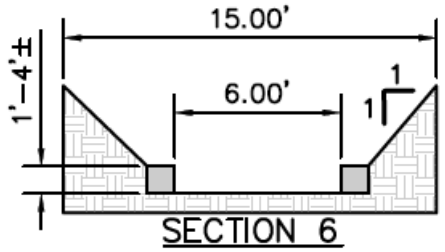
SECTION 6

Location:

This section of stream is located between the endwall of Section 5 southwest of the intersection of Midland Avenue and Pembroke Avenue and the headwall of the closed conduit running to the south along Pembroke Avenue.

Section Material & Geometry:

This creek section is a 6 feet wide trapezoidal open channel with 3:1 slopes on the sides atop a stone wall ranging in height from 1- to 4 feet (see graphic representation below).



Section Capacity and Reach Geometry:

Length = 130 feet
Reach slope = 1.100% ±
Manning's n = 0.017
Theoretical Capacity = 659 CFS
Drainage Area = 269 acres
100-year peak flow rate = 678 CFS
50-year peak flow rate = 556 CFS
25-yr peak flow rate = 445 CFS
10-yr peak flow rate = 315 CFS
5-yr peak flow rate = 227 CFS
2-yr peak flow rate = 125 CFS

Observations/Recommendations:

This portion of the stream is relatively good condition and the theoretical carrying capacity falls just below the 100-year peak flow rate as noted above. As such, no major modifications are recommended to this portion of the stream at this time. However, this portion of the creek may be observed to surcharge during smaller storm events due to the presence of the downstream closed conduit running to the south along Pembroke Avenue which forms a "choke point" for the stream. As you will note below, this Pembroke conduit has a theoretical capacity just above the 5-year peak flow rate.

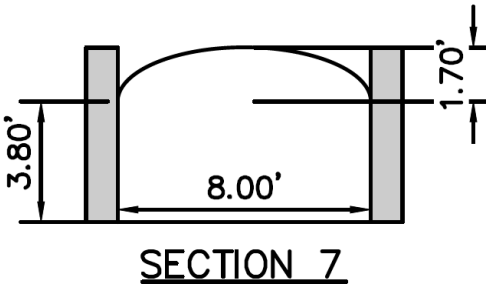
SECTION 7

Location:

This closed conduit is located beneath Pembroke Avenue which runs from its headwall to the southeast of the intersection of Midland Avenue and Pembroke Avenue and exits at approximately 200 feet southeast of the intersection of Pembroke Avenue and Saint Davids Road.

Section Material & Geometry:

This section is an 8 feet wide rectangular channel with 3.8 feet stone walls and a 1.7 feet stone arch (see graphic representation and photographs below).



SECTION 7

Section Capacity and Reach Geometry:

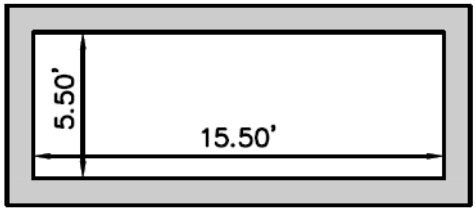
Length = 422 feet
Reach slope = 0.260% ±
Manning's n = 0.017
Theoretical Capacity = 234 CFS
Drainage Area = 359 acres
100-year peak flow rate = 813 CFS
50-year peak flow rate = 556 CFS
25-yr peak flow rate = 445 CFS
10-yr peak flow rate = 315 CFS
5-yr peak flow rate = 227 CFS
2-yr peak flow rate = 125 CFS

Observations/Recommendations:

As noted above, this closed conduit has a theoretical capacity just above 5-year peak flow rate and likely serves as a "choke point" for flow along the stream. This is also exacerbated by deposition in the stream at the exit of this closed conduit. This deposition of sediment and debris from years of erosion has effectively reduced the overall carrying capacity of the Pembroke Avenue closed conduit by about 1½ feet. This is further described under Section 8 below. A video inspection of this closed conduit was recently commissioned by the Township which demonstrated that this reach is in relatively good condition despite its old age (installation date unknown).

We recommend that this closed conduit be ultimately replaced with a larger concrete box culvert beneath Pembroke Avenue. Since the alignment of the stream is such that it runs along Pembroke Avenue, options for open channel flow are not feasible. The proposed box culvert would need to be approximately 15½ feet wide by 5½ feet in height to accommodate the 100-year peak flow rate. A graphic representation of the proposed culvert is included below for reference and calculations are provided in Appendix C which demonstrate this channel cross-section would have sufficient capacity to convey the 100-year peak flow rate.

A parallel bypass pipe for this alternative would also not be hydraulicly feasible since the largest elliptical concrete pipe available would still not provide adequate carrying capacity to convey the 100-year peak flow, less the capacity of the existing conduit. Additionally, there would be limited space to accommodate this alternative without the acquisition of private property.



PROPOSED SECTION 7

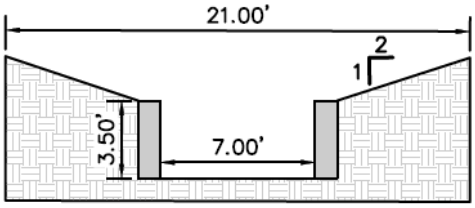
SECTION 8

Location:

This section of stream located between the endwall of the Pembroke Avenue conduit and the point where the stream crosses Meadowbrook Avenue.

Section Material & Geometry:

This section is a 7 feet wide rectangular open channel with 3.5 feet stone walls on the sides with 2:1 vegetated slopes above the walls (see graphic representation below).



SECTION 8

Section Capacity and Reach Geometry:

Length = 321 feet

Reach slope = 0.270% ±

Manning's n = 0.017

Theoretical Capacity = 441 CFS

Drainage Area = 359 acres

100-year peak flow rate = 813 CFS

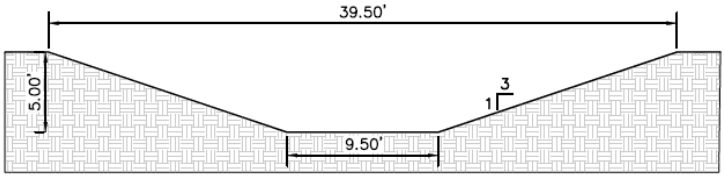
50-year peak flow rate = 668 CFS

25-yr peak flow rate = 536 CFS

10-yr peak flow rate = 380 CFS

5-yr peak flow rate = 275 CFS

2-yr peak flow rate = 153 CFS



PROPOSED SECTION 8

Observations/Recommendations:

As noted above, this open channel has a theoretical capacity which falls between the 10-year and 25-year peak flow rate. It was also noted that there is some deposition of sediment in the stream which effectively reduces the overall carrying capacity of the Pembroke Avenue closed conduit by about 1½ feet. As such, we recommend a short-term project to remove the sediment deposition along approximately 320 feet of the stream to allow the Pembroke Conduit to freely outfall and utilize its full carrying capacity.

Long term improvements to the stream may include removal of the stone walls to incorporate gradually sloped banks to increase overall capacity. However, these improvements may not be completely warranted since this area is encompassed by the 100-year floodplain as identified by FEMA. As such, these areas are likely to be inundated during the 100-year peak flow rate anyway. A graphic representation of the proposed channel is included above for reference and calculations are provided in Appendix C which demonstrate this channel cross-section would have sufficient capacity to convey the 100-year peak flow rate.

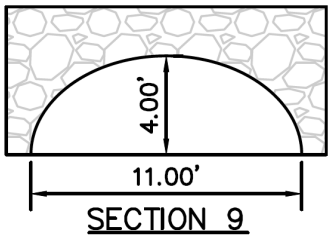
SECTION 9

Location:

This culvert is located beneath Meadowbrook Avenue.

Section Material & Geometry:

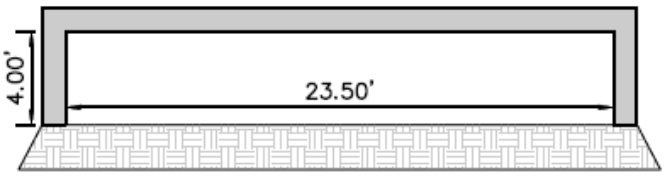
This culvert section is an 11 feet wide 4 feet tall stone arch culvert (see graphic representation and photograph below).



SECTION 9

Section Capacity and Reach Geometry:

Length = 33 feet
Measured Reach Slope: -0.1%
Mean Reach slope = 0.27% ±
Manning's n = 0.017
Theoretical Capacity = 165 CFS
Drainage Area = 390 acres
100-year peak flow rate = 858 CFS
50-year peak flow rate = 705 CFS
25-yr peak flow rate = 566 CFS
10-yr peak flow rate = 402 CFS
5-yr peak flow rate = 292 CFS
2-yr peak flow rate = 162 CFS



PROPOSED SECTION 9

Observations/Recommendations:

The theoretical capacity of this culvert is nearly equivalent to the 2-year peak flow rate and is considered vastly undersized based on the tributary flows. This culvert likely serves as a substantial "choke point" due to its low theoretical capacity and the hydraulic losses of stormwater entering a closed conduit from an open channel.

It is recommended that the Township continue to conduct periodic inspections to verify the integrity of the culvert is intact as is good practice. The Township should also plan to replace culvert in the future largely due to its assumed advanced age as part of the Township's general infrastructure replacement programs. The relative opening of the culvert could be maximized at that time to adequately pass the 100-year peak flow rate. This would result in the culvert being wider (approximately 23 to 24 feet) while maintaining its somewhat limited height at 4 feet. A graphic representation is included above for the proposed box culvert option and calculations are provided in Appendix C of this report which demonstrate the proposed section has sufficient capacity to convey the 100-year peak flow rate. This culvert would be well suited for a CON/SPAN bridge system or twin box culverts.

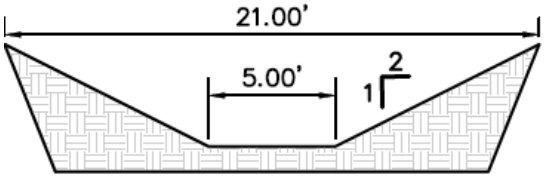
SECTION 10

Location:

This section of stream located between Meadowbrook Avenue and Orchard Way.

Section Material & Geometry:

This section is a 5 feet wide trapezoidal open channel with 2:1 vegetated slopes on the sides (see graphic representation below).



SECTION 10

Section Capacity and Reach Geometry:

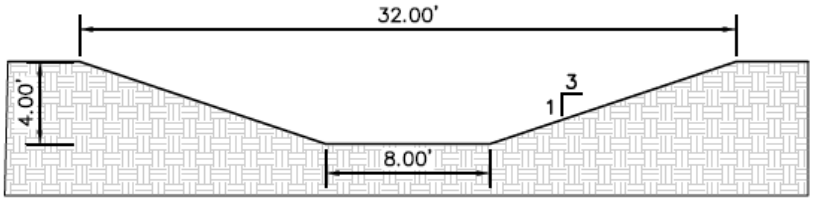
Length = 250 feet
Reach slope = 0.99% ±
Manning's n = 0.024
Theoretical Capacity = 554 CFS
Drainage Area = 397 acres
100-year peak flow rate = 867 CFS
50-year peak flow rate = 712 CFS
25-yr peak flow rate = 572 CFS
10-yr peak flow rate = 406 CFS
5-yr peak flow rate = 295 CFS
2-yr peak flow rate = 164 CFS

Observations/Recommendations:

The theoretical capacity of this section falls between the 10-year and 25-year peak flow rate. This only considers flow to the approximate top of bank. In situ, excess flow would inundate the areas surrounding the open channel.

The Township could complete a project to increase the dimensions of the stream to have a bottom width of 8 feet, 3:1 side slopes, and approximately 32 feet top width to accommodate the 100-year peak flow rate and better confine flow to the channel only. However, these improvements may not be completely warranted since this area is encompassed by the 100-year floodplain as identified by FEMA. As such, the stream is likely to be inundated during the 100-year peak flow rate anyway. As such, no improvements are recommended at this time.

In any case, a graphic representation of the proposed channel is included below for reference and calculations are provided in Appendix C which demonstrate this channel cross-section would have sufficient capacity to convey the 100-year peak flow rate.



PROPOSED SECTION 10 AND 11

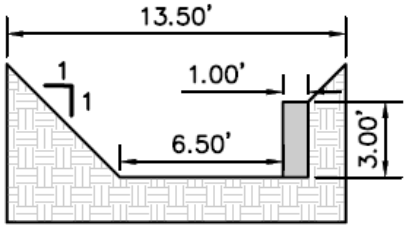
SECTION 11

Location:

This section of stream located between Meadowbrook Avenue and Orchard Way.

Section Material & Geometry:

This section is a 6.5 feet wide trapezoidal open channel with a 1:1 vegetated slopes on the western side and a 3 feet stone wall on the eastern side (see graphic representation below).



SECTION 11

Section Capacity and Reach Geometry:

Length = 210 feet
Reach slope = 0.99% ±
Manning's n = 0.024
Theoretical Capacity = 429 CFS
Drainage Area = 403 acres
100-year peak flow rate = 875 CFS
50-year peak flow rate = 720 CFS
25-yr peak flow rate = 578 CFS
10-yr peak flow rate = 411 CFS
5-yr peak flow rate = 298 CFS
2-yr peak flow rate = 166 CFS

Observations/Recommendations:

The theoretical capacity of this section falls between the 10-year and 25-year peak flow rate. This only considers flow to the approximate top of bank. In situ, excess flow would inundate the areas surrounding the open channel.

The Township could complete a project to increase the dimensions of the stream to accommodate the 100-year peak flow rate and better confine flow to the channel only. However, these improvements may not be completely warranted since this area is encompassed by the 100-year floodplain as identified by FEMA. As such, the stream is likely to be inundated during the 100-year peak flow rate anyway. As such, no improvements are recommended at this time.

In any case, a graphic representation of the proposed channel is included above in the Section 10 description for reference and calculations are provided in Appendix C which demonstrate this channel cross-section would have sufficient capacity to convey the 100-year peak flow rate.

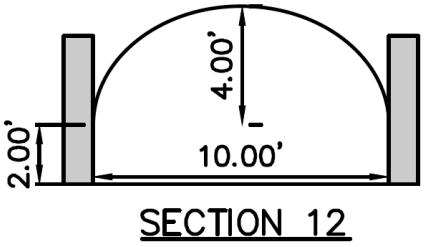
SECTION 12

Location:

This section is a brick and stone arch culvert beneath Orchard Way.

Section Material & Geometry:

This section is a 10 feet wide culvert with 2 feet walls and a 4 feet brick and stone arch (see graphic representation and photograph below).



SECTION 12

Section Capacity and Reach Geometry:

Length = 32 feet

Reach mean slope = 0.92% (mean slope of channel before and after)

Reach measured slope = -2.469%

Manning's n = 0.017

Theoretical Capacity = 579 CFS

Drainage Area = 409 acres

100-year peak flow rate = 884 CFS

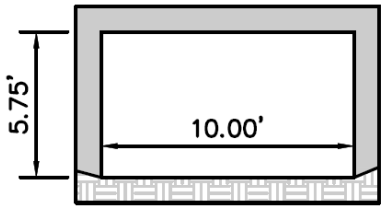
50-year peak flow rate = 727 CFS

25-yr peak flow rate = 584 CFS

10-yr peak flow rate = 415 CFS

5-yr peak flow rate = 301 CFS

2-yr peak flow rate = 168 CFS



PROPOSED SECTION 12

Observations/Recommendations:

The theoretical capacity of the stone culvert falls between the 10-year and 25-year peak flow rate. It is recommended that the Township continue to conduct periodic inspections to verify the integrity of the culvert is intact, as is good practice. The Township should also plan to replace culvert in the future largely due to its assumed advanced age as part of the Township's general infrastructure replacement programs. The relative opening could be maximized at that time to adequately pass the 100-year peak flow rate. The profile of Meadowbrook Drive may also require modifications to eliminate the hump at the culvert. This culvert would be well suited for a CON/SPAN bridge or similar system. The graphic representation of the proposed box culvert is included above for reference and calculations are provided in Appendix C which demonstrate this culvert would have sufficient capacity to convey the 100-year peak flow rate.

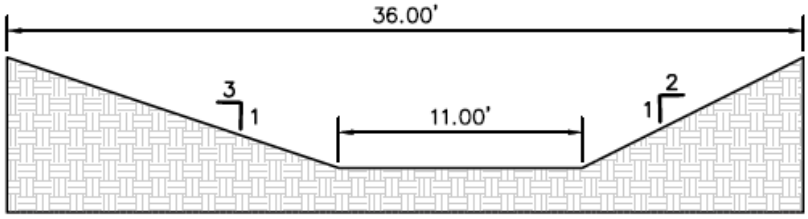
SECTION 13

Location:

This section of stream located between Orchard Way and Iven Avenue.

Section Material & Geometry:

This section is an approximately 10’ wide trapezoidal open channel with 1:1 vegetated slopes on the sides (see graphic representation below).



SECTION 13

Section Capacity and Reach Geometry:

Length = 1,323 feet
Reach slope = 0.62% ±
Manning’s n = 0.024
Theoretical Capacity = 1,216 CFS
Drainage Area = 524 acres
100-year peak flow rate = 1,040 CFS
50-year peak flow rate = 858 CFS
25-yr peak flow rate = 691 CFS
10-yr peak flow rate = 493 CFS
5-yr peak flow rate = 359 CFS
2-yr peak flow rate = 201 CFS

Observations/Recommendations:

The theoretical capacity of this section appears to be adequate for the 100-year peak flow rate. However, the surrounding areas may still be observed to periodically flood since this reach is encompassed by the 100-year floodplain as identified by FEMA. As such, no major modifications are recommended to this portion of the stream at this time.

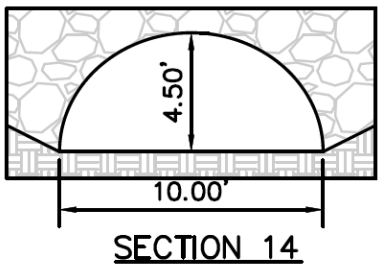
SECTION 14

Location:

This section is a stone arch culvert beneath Iven Avenue.

Section Material & Geometry:

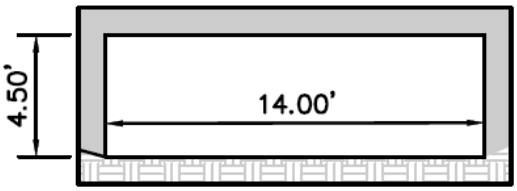
This section is a 10 feet wide culvert with 4½ feet stone arch (see graphic representation and photograph below).



SECTION 14

Section Capacity and Reach Geometry:

Length = 25 feet
Measured Reach Slope = -0.8%
Mean Reach slope = 1.1% ±
Manning's n = 0.017
Theoretical Capacity = 352 CFS
Drainage Area = 531 acres
100-year peak flow rate = 1,040 CFS
50-year peak flow rate = 858 CFS
25-yr peak flow rate = 691 CFS
10-yr peak flow rate = 493 CFS
5-yr peak flow rate = 359 CFS
2-yr peak flow rate = 201 CFS



PROPOSED SECTION 14

Observations/Recommendations:

The theoretical capacity of this culvert is nearly equivalent to the 5-year peak flow rate and is considered vastly undersized based on the tributary flows. This culvert likely serves as a substantial "choke point" due to its low theoretical capacity and the hydraulic losses of stormwater entering a closed conduit from an open channel. It was also noted that there is some deposition of sediment in the stream which effectively reduces the overall carrying capacity of the Iven Avenue closed conduit by about 1 foot. As such, we recommend a short-term project to remove the sediment deposition along approximately 60 feet of the stream to allow the Iven Avenue culvert to freely outfall and utilize its full carrying capacity. This would be an advantageous time to also to remove any sediment in the adjacent corrugated metal pipe beneath the Township Building entrance drive (Section 15).

It is recommended the Township replace this culvert in the future to increase the opening size to adequately pass the 100-year peak flow rate and reduce any flooding upstream due to this constriction. This would result in the culvert being wider (approximately 14 feet) while maintaining its somewhat limited height at 4½ feet. A graphic representation is included above for the proposed box culvert option and calculations are provided in Appendix C of this

report which demonstrate the proposed section has sufficient capacity to convey the 100-year peak flow rate. This culvert would be well suited for a CON/SPAN bridge or similar system.

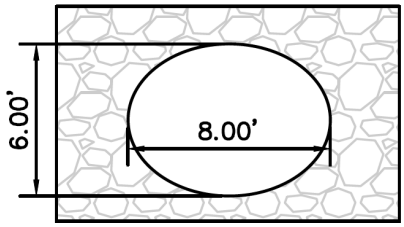
SECTION 15

Location:

This section is a corrugated metal culvert beneath the Township Building Entrance Drive.

Section Material & Geometry:

This section is an 8 feet by 6 feet corrugated metal pipe (see graphic representation and photograph below).



SECTION 15

Section Capacity and Reach Geometry:

Length = 33 feet
Mean Reach slope = 1.0% ±
Manning's n = 0.019
Theoretical Capacity = 393 CFS
Drainage Area = 531 acres
100-year peak flow rate = 1,040 CFS
50-year peak flow rate = 858 CFS
25-yr peak flow rate = 691 CFS
10-yr peak flow rate = 493 CFS
5-yr peak flow rate = 359 CFS
2-yr peak flow rate = 201 CFS

Observations/Recommendations:

The theoretical capacity of this culvert is nearly equivalent to the 5-year peak flow rate and is considered vastly undersized based on the tributary flows. This culvert likely serves as a substantial "choke point" due to its low theoretical capacity and the hydraulic losses of stormwater entering a closed conduit from an open channel.

It is recommended the Township replace this culvert in the future to increase the opening size to adequately pass the 100-year peak flow rate and reduce any flooding upstream due to this constriction. This would result in the culvert being wider (approximately 14 feet) which is similar to what would be required at the culvert crossing Iven Avenue directly upstream. A graphic representation is included under Section 14 above for the proposed box culvert option and calculations are provided in Appendix C of this report which demonstrate the proposed section has sufficient capacity to convey the 100-year peak flow rate. This culvert would be well suited for a CON/SPAN bridge or similar system.

III. CONCEPTUAL STORM SEWER IMPROVEMENTS:

CEC performed an evaluation of Midland Avenue between its intersection with Louella Avenue and Pembroke Avenue and provided plans for conceptual storm sewer improvements in Appendix A of this report. This was also completed for Saint Davids Road between its intersection with South Aberdeen Avenue and Pembroke Avenue. These two (2) roadways were previously identified by municipal personnel as being susceptible to flooding as there was little to no storm sewer present on either roadway.

Stormwater improvements along Midland Avenue were broken into two (2) separate portions. The first of which is located between the intersection of Midland Avenue and South Aberdeen Avenue and the intersection of Midland Avenue and Pembroke Avenue. Sheets C-101 and C-102 in Appendix A depict the improvements along this portion of Midland Avenue which proposes a series of stormwater inlets on the north and south side of the roadway which ultimately discharge to the open channel portion of the stream before it enters the Pembroke Avenue closed conduit. Inlets were spaced at approximately 100 feet and two (2) existing city inlets as well as one (1) stormwater manhole are proposed to be replaced at the intersection of Midland Avenue and Pembroke Avenue. This stormwater system provides a means for conveying runoff from the roadway to the receiving watercourse and does not result in any additional impervious surfaces.

The second portion of Midland Avenue considered is located between its intersections with Louella Avenue and South Aberdeen Avenue. Sheets C-103 and C-104 of Appendix A depict the existing brick culvert along Midland Avenue being replaced with the largest elliptical concrete pipe available which is equivalent to an 84-inch diameter round pipe. This is likely the largest size pipe that can be accommodated in this area due to existing cover available and the adjacent existing utilities. This alternative proposes to modify the existing alignment to remove the portion beneath the Saint Katherines of Sienna School and outfall to the existing open channel on the eastern portion of this parcel. This requires that the existing pedestrian bridge be removed, and the stream lowered by approximately 2½ feet. Inlets were spaced at approximately 100 feet on the north and south side of Midland Avenue with three (3) existing city inlets being replaced.

The conceptual stormwater for Saint Davids Road is included on Sheet C-105 in the Appendix A of this report. The alignment runs west to east with inlets spaced at approximately 100 feet on the north and south side of the roadway and ultimately discharges into the Pembroke conduit where a tie-in will be required.

IV. EVALUATION OF STORM SEWER BYPASS:

CEC performed an evaluation of a potential storm sewer bypass beginning in the vicinity of the Pembroke Avenue between its intersections with Midland and Saint Davids Road and running east to Encke Park. Survey data was obtained in various areas in Encke Park which was used to determine if there was sufficient slope to accommodate a gravity bypass line. Multiple alignments were examined which the bypass could follow as well as two (2) separate locations for the intake. The alternatives considered were as follows:

1. **Primary Stormwater Bypass Route –** This alignment begins southwest of the intersection of Midland Avenue and Pembroke Avenue where the stream enters the Pembroke closed conduit. From there the bypass would follow the Pembroke Avenue roadway south, proceed east along Saint Davids Road, and continue south along Orchard Way / Meadowbrook Circle. An easement would be required from the resident adjacent from the Township Building Entrance to accommodate the bypass between Meadowbrook Circle and Iven Avenue. Lastly the pipe would proceed to the area designated for a potential future basin in the "Driving Range" portion of Encke Park.

2. **Alternate 1: Stormwater Bypass Route –** This alignment begins southwest of the intersection of Midland Avenue and Pembroke Avenue where the stream enters the Pembroke closed conduit. From there the bypass would follow the Pembroke Avenue roadway south, proceed east along Saint Davids Road, and continue south along Saint Davids Court. An easement would be required from the Radnor Crossing Apartment accommodate the bypass between Saint Davids Court and Iven Avenue. Lastly the pipe would proceed to the area designated for a potential future basin in the "Driving Range" portion of Encke Park.

3. **Alternate 2: Stormwater Bypass Route –** This alignment follows largely the same alignment as the Primary Stormwater Bypass Route noted above with the exception that the location of the intake is moved to an alternate location at Saint Katherines of Sienna School Property.

4. **Alternate 3: Stormwater Bypass Route –** This alignment is directly parallel to the existing stream alignment.

Each alternate was determined to **not be feasible** due to a variety of reasons listed below.

1. The Pembroke closed conduit has capacity for approximately 234 CFS which is deficient by approximately 579 CFS. As such, the proposed gravity bypass would need to exceed the largest elliptical concrete pipe available. For purposes of simplicity, the various bypass profiles in Appendix F depict an 84-inch pipe.

2. Coverage is an insurmountable issue for each bypass alternative. This ranges from coverage being far too great with the deepest excavations ranging from 92 feet and 26 feet for the primary bypass and alternate 1 respectively. Additionally, the gravity bypass has insufficient cover for each alternative as you approach Encke Park leaving large swaths of the pipe exposed. Incorporating additional fill to provide coverage over the pipe would be prohibited since it would result in the placement of fill in the 100-year flood plain areas as identified by FEMA.

3. Although there is technically sufficient fall for the gravity bypass, the receiving regional detention basin would presumably fill with stormwater and create submerged outfall for the gravity bypass. This would limit the hydraulic capacity of the gravity bypass therefore negating its ability to sufficiently bypass flow.

4. Appendix F: also depicts a pressure pipe alternative for each alignment as well. However, this was simply provided for anecdotal reasons as the flow required to be pumped (579 CFS or **260,000 gallons per minute**) would result in a pump station **Six-Times larger** than the largest regional wastewater Pumping Station known to this office (Totem Road Pump Station) having an approximate capacity of 42,000 gallons per minute. A pump station of this size with associated force main would be on the order of $30 million.

5. A joint permit for the installation of a stormwater gravity bypass would not be able to be obtained due to regulations governing improvement to Waters of the Commonwealth. These DEP regulations typically discourage confining streams to closed conduits, and rather, encourage improvements to existing watercourses which provide added capacity/cross-sectional area and return them to their natural state (i.e., open channels, gradual vegetated banks, etc.).

6. Costs would also be prohibitively expensive for a parallel gravity bypass of the stream with the 3,600 linear feet of 84-inch diameter gravity estimated at approximately $3.6 million to construct.

APPENDIX A: EXISTING FEATURES AND CONCEPTUAL STORM SEWER PLANS

SOUTH WAYNE DRAINAGE IMPROVEMENTS FEASIBILITY STUDY

SITUATED IN:

RADNOR TOWNSHIP
DELAWARE COUNTY, PENNSYLVANIA

PREPARED FOR:

RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA 19087-5297

PREPARED BY:

Carroll Engineering Corporation

949 Easton Road
Warrington, PA 18976
Phone: 215-343-5700
Fax: 215-343-0875

630 Freedom Business Center,
Third Floor
King of Prussia, PA 19406
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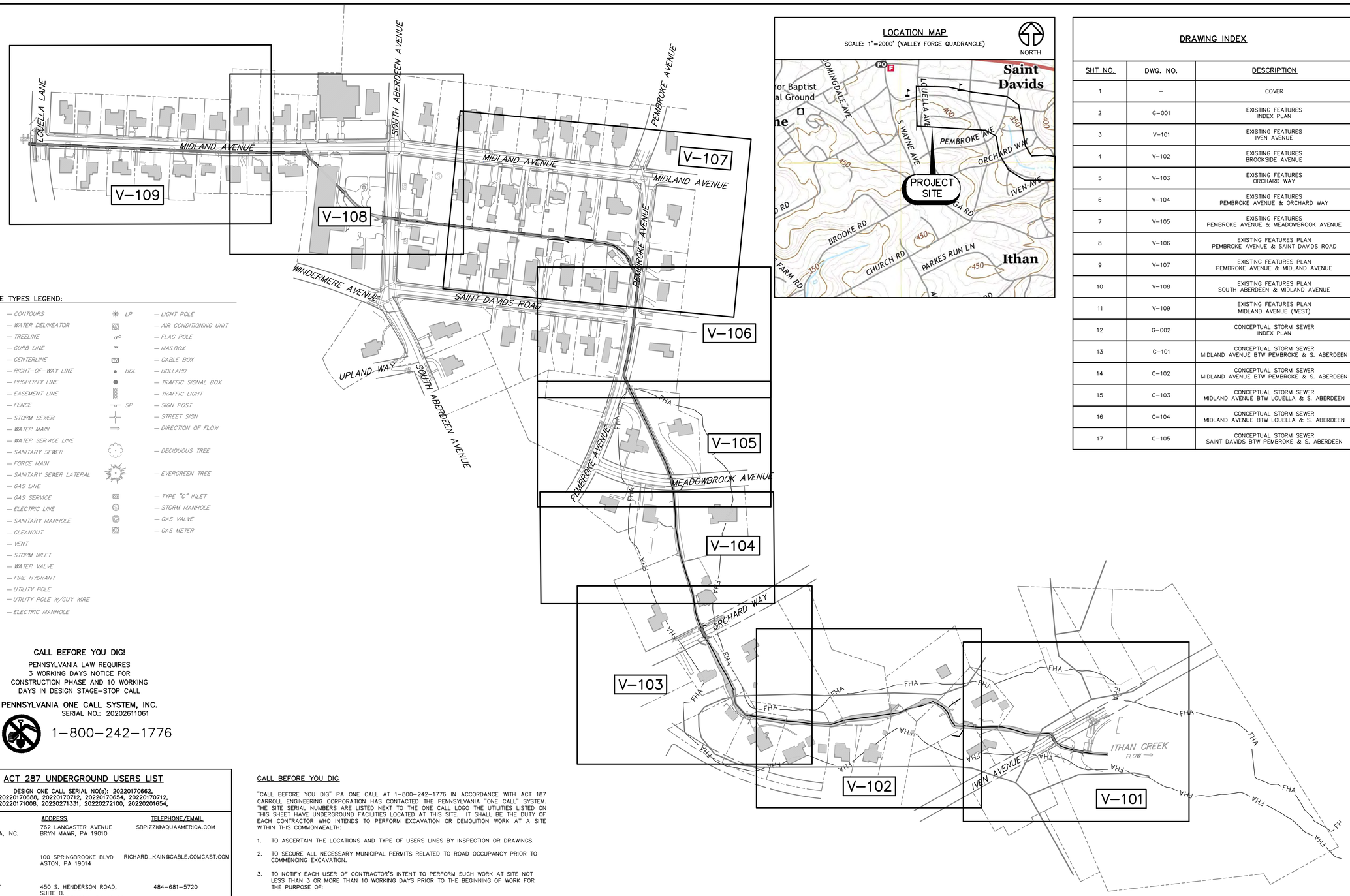
Fax: 908-874-5762

433 Lancaster Avenue,
Suite 200
Malvern, PA 19355
Phone: 610-489-5100

www.carrollengineering.com

DRAWER NUMBER ---

CADD FILE 2119900002



LOCATION MAP

SCALE: 1"=2000' (VALLEY FORGE QUADRANGLE)

NORTH

DRAWING INDEX

SHT NO.	DWG. NO.	DESCRIPTION
1	–	COVER
2	G–001	EXISTING FEATURES INDEX PLAN
3	V–101	EXISTING FEATURES IVEN AVENUE
4	V–102	EXISTING FEATURES BROOKSIDE AVENUE
5	V–103	EXISTING FEATURES ORCHARD WAY
6	V–104	EXISTING FEATURES PEMBROKE AVENUE & ORCHARD WAY
7	V–105	EXISTING FEATURES PEMBROKE AVENUE & MEADOWBROOK AVENUE
8	V–106	EXISTING FEATURES PLAN PEMBROKE AVENUE & SAINT DAVIDS ROAD
9	V–107	EXISTING FEATURES PLAN PEMBROKE AVENUE & MIDLAND AVENUE
10	V–108	EXISTING FEATURES PLAN SOUTH ABERDEEN & MIDLAND AVENUE
11	V–109	EXISTING FEATURES PLAN MIDLAND AVENUE (WEST)
12	G–002	CONCEPTUAL STORM SEWER INDEX PLAN
13	C–101	CONCEPTUAL STORM SEWER MIDLAND AVENUE BTW PEMBROKE & S. ABERDEEN
14	C–102	CONCEPTUAL STORM SEWER MIDLAND AVENUE BTW PEMBROKE & S. ABERDEEN
15	C–103	CONCEPTUAL STORM SEWER MIDLAND AVENUE BTW LOUELLA & S. ABERDEEN
16	C–104	CONCEPTUAL STORM SEWER MIDLAND AVENUE BTW LOUELLA & S. ABERDEEN
17	C–105	CONCEPTUAL STORM SEWER SAINT DAVIDS BTW PEMBROKE & S. ABERDEEN

SYMBOLS / LINE TYPES LEGEND:

320	— CONTOURS
W	— WATER DELINEATOR
	— TREELINE
	— CURB LINE
	— CENTERLINE
	— RIGHT–OF–WAY LINE
	— PROPERTY LINE
	— EASEMENT LINE
	— FENCE
ST	— STORM SEWER
W	— WATER MAIN
WS	— WATER SERVICE LINE
S	— SANITARY SEWER
FM	— FORCE MAIN
SLAT	— SANITARY SEWER LATERAL
G	— GAS LINE
GS	— GAS SERVICE
E	— ELECTRIC LINE
	— SANITARY MANHOLE
C/O	— CLEANOUT
V	— VENT
	— STORM INLET
WV	— WATER VALVE
FH	— FIRE HYDRANT
UP	— UTILITY POLE
	— UTILITY POLE W/GUY WIRE
E	— ELECTRIC MANHOLE
LP	— LIGHT POLE
	— AIR CONDITIONING UNIT
	— FLAG POLE
MB	— MAILBOX
CB	— CABLE BOX
BOL	— BOLLARD
	— TRAFFIC SIGNAL BOX
	— TRAFFIC LIGHT
SP	— SIGN POST
	— STREET SIGN
	— DIRECTION OF FLOW
	— DECIDUOUS TREE
	— EVERGREEN TREE
	— TYPE "C" INLET
	— STORM MANHOLE
GV	— GAS VALVE
GM	— GAS METER

CALL BEFORE YOU DIG!

PENNSYLVANIA LAW REQUIRES
3 WORKING DAYS NOTICE FOR
CONSTRUCTION PHASE AND 10 WORKING
DAYS IN DESIGN STAGE–STOP CALL

PENNSYLVANIA ONE CALL SYSTEM, INC.
SERIAL NO.: 20202611061

1–800–242–1776

ACT 287 UNDERGROUND USERS LIST

DESIGN ONE CALL SERIAL NO(s): 20220170662, 20220170688, 20220170712, 20220170654, 20220170712, 20220171008, 20220271331, 20220272100, 20220201654,

USER	ADDRESS	TELEPHONE/EMAIL
AQUA PENNSYLVANIA, INC.	762 LANCASTER AVENUE BRYN MAWR, PA 19010	SBPIZZI@AQUAAMERICA.COM
COMCAST	100 SPRINGBROOKE BLVD ASTON, PA 19014	RICHARD_KAIN@CABLE.COMCAST.COM
PECO ENERGY	450 S. HENDERSON ROAD, SUITE B. KING OF PRUSSIA, PA 19406	484–681–5720
VERIZON PA, INC.	15 MONTGOMERY AVENUE, FLOOR 2 PITTSBURGH, PA 15212	412–359–2000
RADNOR TOWNSHIP	301 IVEN AVENUE WAYNE, PA 19087	SMCNELIS@RADNOR.ORG

PA ONE CALL SYSTEM 1–800–242–1776

LOCATIONS OF EXISTING UTILITIES SHOWN HEREON HAVE BEEN DEVELOPED FROM EXISTING RECORDS AND/OR ABOVE–GROUND OBSERVATIONS AT THE SITE. COMPLETENESS OR ACCURACY OF LOCATION CANNOT BE GUARANTEED. ALL CONTRACTORS AND OTHER PERSONS UTILIZING THIS PLAN AND THE INFORMATION CONTAINED HEREON ARE CAUTIONED TO COMPLY WITH THE REQUIREMENTS OF PENNSYLVANIA ACT 287, AS AMENDED, TITLED "EXCAVATION AND DEMOLITION WORK PROTECTION OF UNDERGROUND UTILITIES." EACH INDIVIDUAL USING THIS PLAN MUST VERIFY THE DEPTH AND LOCATION OF ALL UNDERGROUND FACILITIES BEFORE STARTING WORK.

CALL BEFORE YOU DIG

"CALL BEFORE YOU DIG" PA ONE CALL AT 1–800–242–1776 IN ACCORDANCE WITH ACT 187 CARROLL ENGINEERING CORPORATION HAS CONTACTED THE PENNSYLVANIA "ONE CALL" SYSTEM. THE SITE SERIAL NUMBERS ARE LISTED NEXT TO THE ONE CALL LOGO THE UTILITIES LISTED ON THIS SHEET HAVE UNDERGROUND FACILITIES LOCATED AT THIS SITE. IT SHALL BE THE DUTY OF EACH CONTRACTOR WHO INTENDS TO PERFORM EXCAVATION OR DEMOLITION WORK AT A SITE WITHIN THIS COMMONWEALTH:

1. TO ASCERTAIN THE LOCATIONS AND TYPE OF USERS LINES BY INSPECTION OR DRAWINGS.
2. TO SECURE ALL NECESSARY MUNICIPAL PERMITS RELATED TO ROAD OCCUPANCY PRIOR TO COMMENCING EXCAVATION.
3. TO NOTIFY EACH USER OF CONTRACTOR'S INTENT TO PERFORM SUCH WORK AT SITE NOT LESS THAN 3 OR MORE THAN 10 WORKING DAYS PRIOR TO THE BEGINNING OF WORK FOR THE PURPOSE OF:

   I. REQUEST THE UTILITY TO FIELD LOCATE ITS LINES.
   II. INITIATE COOPERATION WHICH WILL AVOID DAMAGE.
   III. REQUEST PROCEDURES WHICH WILL AVOID DAMAGE.

   A CONTRACTOR SHALL BE DEEMED TO HAVE GIVEN NOTICE IF THE CONTRACTOR CALLS "ONE–CALL", SYSTEM AT 1–800–242–1776 CONCERNING THIS SITE.
4. TO INFORM EACH OPERATOR EMPLOYED BY THE CONTRACTOR AT THE SITE OF SUCH WORK OF THE INFORMATION OBTAINED.
5. TO REPORT IMMEDIATELY TO THE OCCUPANTS OF THE PREMISES AS TO ANY EMERGENCY THAT THE CONTRACTOR MAY CREATE OR DISCOVER AT OR NEAR SUCH PREMISES.
6. TO REPORT IMMEDIATELY TO THE USER ANY BREAK OR LEAK ON ITS LINES OR ANY DENT, GOUGE, GROOVE OR OTHER DAMAGE TO SUCH LINES OR TO THEIR COATING OR CATHODIC PROTECTION, MADE OR DISCOVERED IN THE COURSE OF THE EXCAVATION OR DEMOLITION WORK.
7. TO TAKE ALL REASONABLE STEPS NECESSARY TO AVOID INJURY OR OTHERWISE INTERFERE WITH ALL LINES WHERE POSITIONS HAVE BEEN PROVIDED TO THE CONTRACTOR BY USERS.
8. TO EMPLOY PRUDENT TECHNIQUES, WHICH MAY INCLUDE HAND–DUG TEST HOLES, TO ASCERTAIN THE PRECISE POSITION OF SUCH FACILITIES.

GRAPHIC SCALE

150 0 75 150 300 600

(IN FEET)
1 inch = 150 ft.

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Fax: 908-874-5762

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Phone: 610-489-5100

www.carrollengineering.com

EXISTING FEATURES INDEX PLAN

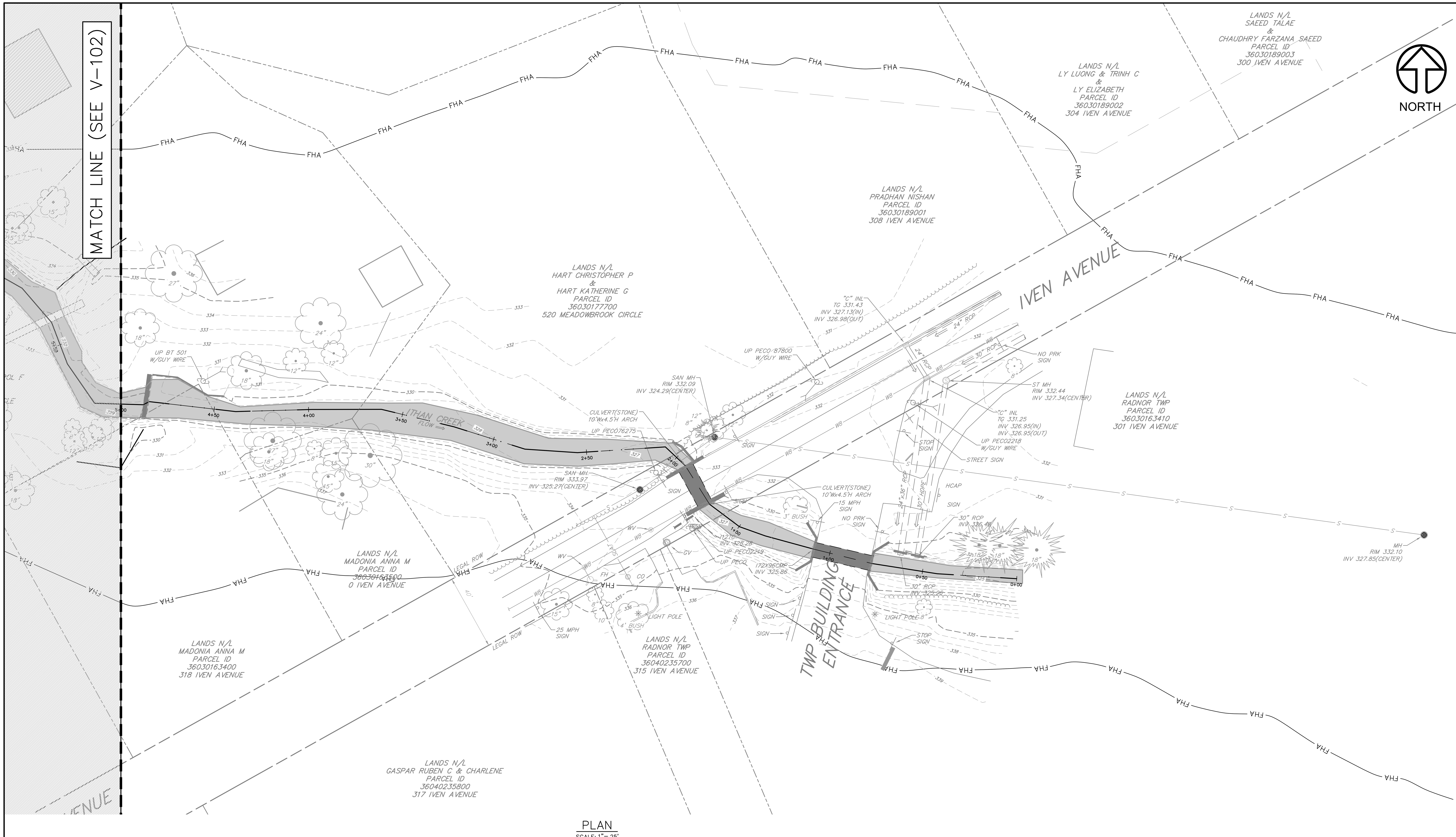
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY
SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087–5297

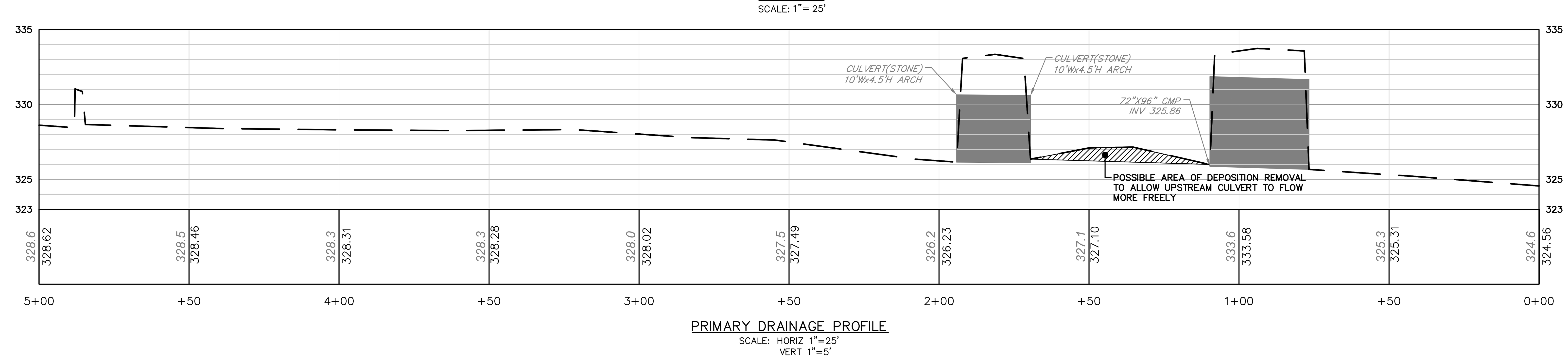
NO.	DATE	DESCRIPTION	INITIALS

DATE	4–1–2022
CADD FILE	2119900002
JOB NO	21–1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=150'
DRAWER NUMBER	–
SHEET	2 OF 17 SHEETS

DRAWING NUMBER
G–001

\\cec-file\Users\mstoltz\Desktop\2119900002.dwg Apr 19, 2022 4:13pm cpeterson Ent:


MATCH LINE (SEE V-102)
NORTH
IVEN AVENUE
ITHAN CREEK
FLOW
TWP BUILDING ENTRANCE
LANDS N/L
SAEED TALAE
&
CHAUDHRY FARZANA SAEED
PARCEL ID
36030189003
300 IVEN AVENUE
LANDS N/L
LY LUONG & TRINH C
&
LY ELIZABETH
PARCEL ID
36030189002
304 IVEN AVENUE
LANDS N/L
PRADHAN NISHAN
PARCEL ID
36030189001
308 IVEN AVENUE
LANDS N/L
HART CHRISTOPHER P
&
HART KATHERINE G
PARCEL ID
36030177700
520 MEADOWBROOK CIRCLE
LANDS N/L
RADNOR TWP
PARCEL ID
36030163410
301 IVEN AVENUE
LANDS N/L
MADONIA ANNA M
PARCEL ID
0 IVEN AVENUE
LANDS N/L
MADONIA ANNA M
PARCEL ID
36030163400
318 IVEN AVENUE
LANDS N/L
RADNOR TWP
PARCEL ID
36040235700
315 IVEN AVENUE
LANDS N/L
GASPAR RUBEN C & CHARLENE
PARCEL ID
36040235800
317 IVEN AVENUE
UP BT 501 W/GUY WIRE
SAN MH RIM 332.09 INV 324.29(CENTER)
SAN MH RIM 333.97 INV 325.27(CENTER)
CULVERT(STONE) 10'Wx4.5'H ARCH
UP PECO76275
UP PECO 87800 W/GUY WIRE
"C" INL TG 331.43 INV 327.13(IN) INV 326.98(OUT)
ST MH RIM 332.44 INV 327.34(CENTER)
"C" INL TG 331.25 INV 326.95(IN) INV 326.95(OUT)
UP PECO2218 W/GUY WIRE
STREET SIGN
NO PRK SIGN
STOP SIGN
HCAP
15 MPH SIGN
NO PRK SIGN
30" RCP
72"X96" CMP INV 325.86
UP PECO2219
LIGHT POLE
25 MPH SIGN
4' BUSH
3' BUSH
MH RIM 332.10 INV 327.85(CENTER)
LEGAL ROW
FHA
PLAN
SCALE: 1"= 25'


CULVERT(STONE) 10'Wx4.5'H ARCH
CULVERT(STONE) 10'Wx4.5'H ARCH
72"X96" CMP INV 325.86
POSSIBLE AREA OF DEPOSITION REMOVAL TO ALLOW UPSTREAM CULVERT TO FLOW MORE FREELY
335
330
325
323
328.6 328.62
328.5 328.46
328.3 328.31
328.3 328.28
328.0 328.02
327.5 327.49
326.2 326.23
327.1 327.10
333.6 333.58
325.3 325.31
324.6 324.56
5+00
+50
4+00
+50
3+00
+50
2+00
+50
1+00
+50
0+00
PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

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433 Lancaster Avenue, Suite 200 Malvern, PA 19355 Phone: 610-489-5100
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EXISTING FEATURES PLAN
IVEN AVENUE

SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASBILITY STUDY
SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	3 OF 17 SHEETS

DRAWING NUMBER
V-101

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 25 ft.

C:\Users\cpeterson.CORP\appdata\local\temp\AcPublish_25496\2119900002.dwg Jun 01, 2022 3:40pm cpeterson Xref:

MATCH LINE (SEE V-103)

MATCH LINE (SEE V-101)

NORTH

LANDS N/L
WAMBOLD JUDSON J
PARCEL ID
36030185500
312 ORCHARD WAY

LANDS N/L
REBANE KIRK A
&
REBANE BERNADETTE
PARCEL ID
36030178100
523 MEADOWBROOK CIRCLE

LANDS N/L
FETTER KENNETH A & CAROL F
PARCEL ID
36030177600
524 MEADOWBROOK CIRCLE

LANDS N/L
DANIEL M. TAKEFMAN
& ANGELA K. SHEN
PARCEL ID
36030155001
515 BROOKSIDE AVENUE

LANDS N/L
REIMEL THEODORE L III
&
REIMEL JOANNA L
PARCEL ID
36030155200
525 BROOKSIDE AVENUE

LANDS N/L
HILL JUSTIN J
&
HILL ERIN C
PARCEL ID
36030155300
529 BROOKSIDE AVENUE

LANDS N/L
BALL CHARLES E
PARCEL ID
36030155400
531 BROOKSIDE AVENUE

LANDS N/L
RISI KRISTIN M
PARCEL ID
36030155500
533 BROOKSIDE AVENUE

LANDS N/L
HOBSON THOMAS A
&
HOBSON MOIRA S
PARCEL ID
36030155600
535 BROOKSIDE AVENUE

LANDS N/L
MADONIA ANNA
PARCEL ID
36030103400
318 IVEN AVENUE

ITHAN CREEK
FLOW

UP PECO 3285
W/GUY WIRE

UP
W/GUY WIRE

UP BT 500

UP BT 501
W/GUY WIRE

FFE
342.67

GFE
338.21

FFE
342.68

FFE
342.70

BFE
338.64

BROOKSIDE AVENUE

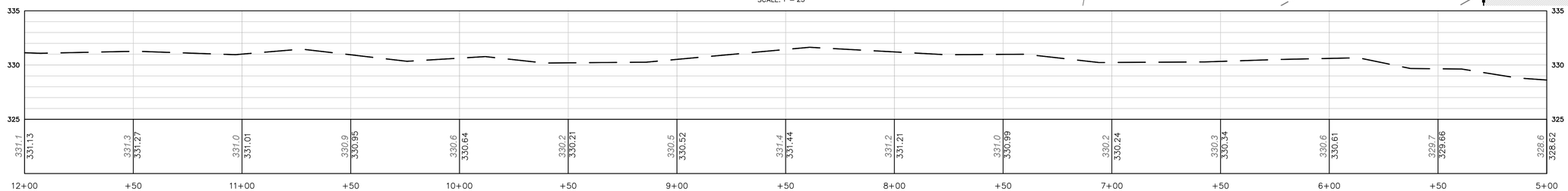
IVEN AVENUE

GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

PLAN
SCALE: 1"= 25'



PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

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EXISTING FEATURES PLAN
BROOKSIDE AVENUE

SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION
		INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	4 OF 17 SHEETS

DRAWING NUMBER
V-102

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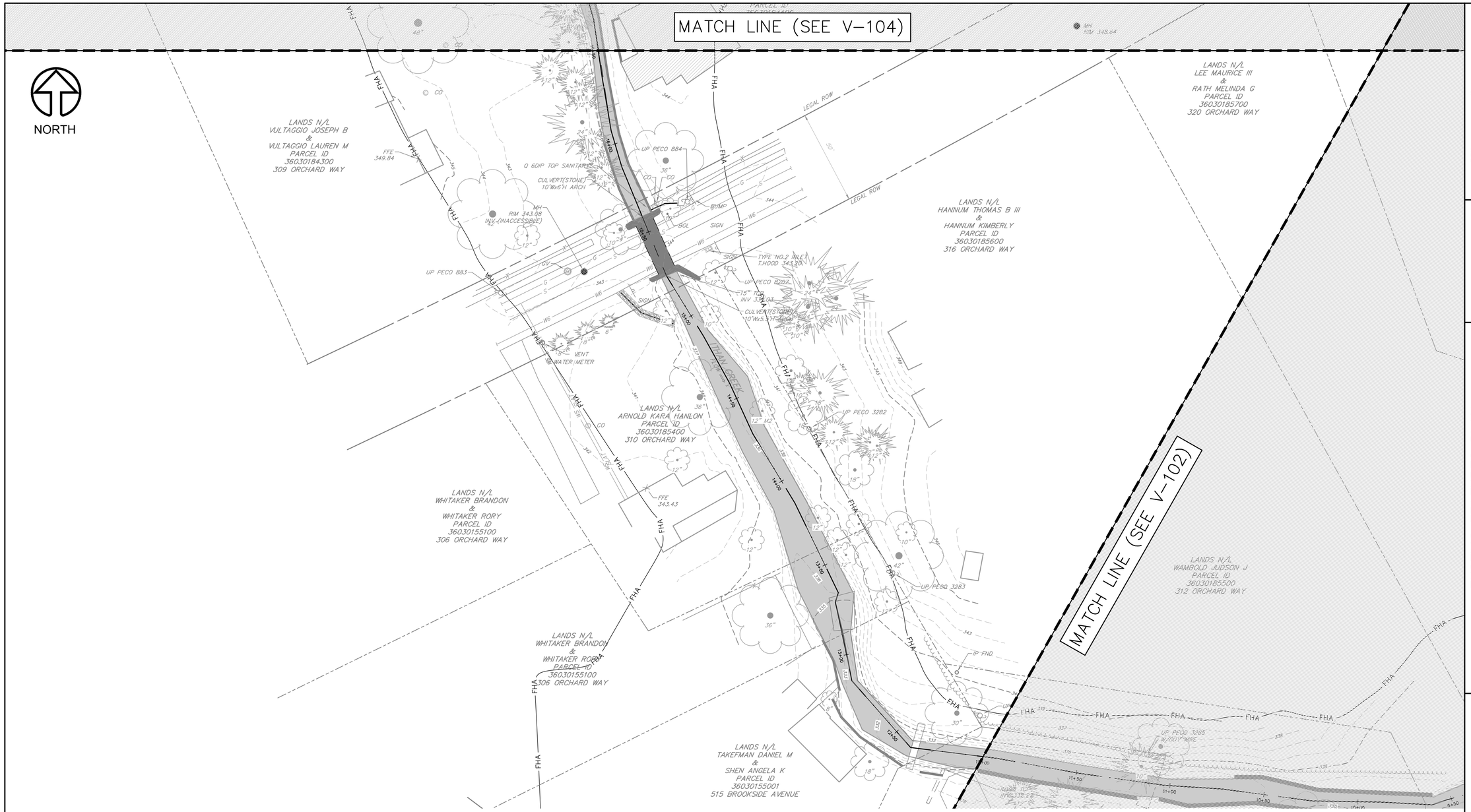
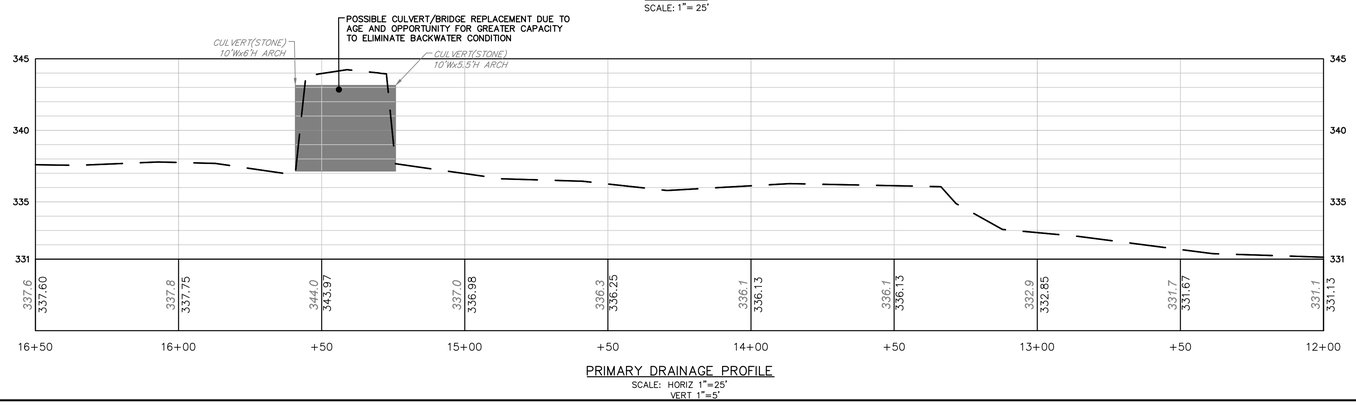


PLAN
SCALE: 1"= 25'



PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 25 ft.

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EXSTING FEATURES PLAN
ORCHARD WAY

SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	5 OF 17 SHEETS

DRAWING NUMBER
V-103

MATCH LINE (SEE V–104)

MATCH LINE (SEE V–103)

NORTH

MEADOWBROOK AVENUE

PEMBROKE AVENUE

LANDS N/L
RENEHAN JOHN B JR & PATRICIA
PARCEL ID
36030176901
400 MEADOWBROOK AVENUE

LANDS N/L
HAUCK KHAREN
&
HAUCK CHRISTOPHER
PARCEL ID
36030177000
410 MEADOWBROOK AVENUE

LANDS N/L
BUCKLEY MORTIMER J III
&
NORRIS ELIZABETH A
PARCEL ID
36030176400
420 MEADOWBROOK AVENUE

LANDS N/L
ZISMAN MICHAEL D
&
GAMBLE LINDA J
PARCEL ID
36030184400
311 ORCHARD WAY

CULVERT (STONE)
11'Wx4'H ARCH

SIM. 345.72
INV. 341.92±
(INACCESSIBLE)

18" TCP
INV 341.78

Q DRAIN 20
TG 349.64

FFE
352.60

FFE
345.60

UP BT 230

UP BT 229
W/GUY WIRE

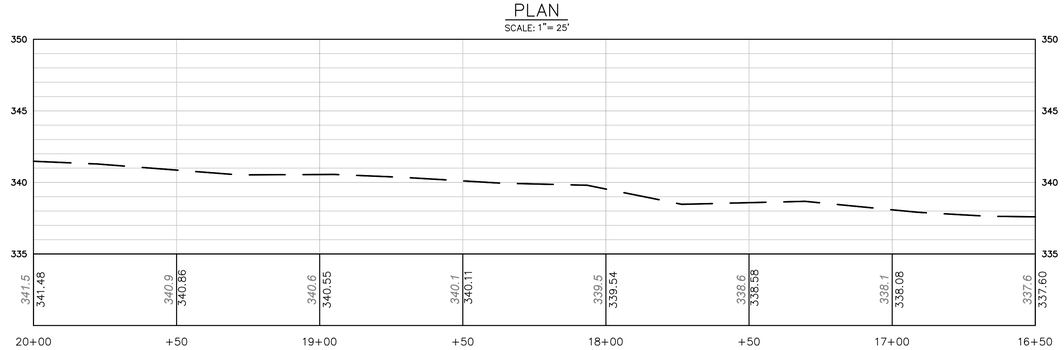
UP PECO 82" DIA

MH
RIM 348.64

MH
RIM 350.56

RIM 350.73

PLAN
SCALE: 1"= 25'



PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 25 ft.

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EXISTING FEATURES PLAN
MEADOWBROOK AVENUE & ORCHARD WAY
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087–5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4–1–2022
CADD FILE	2119900002
JOB NO	21–1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	–
SHEET	6 OF 17 SHEETS

DRAWING NUMBER
V–104

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MATCH LINE (SEE V–106)

MATCH LINE (SEE V–104)

NORTH

LANDS N/L
FARBER JOHN & SUSAN R
PARCEL ID
36030186200
239 PEMBROKE AVENUE

LANDS N/L
FARBER JOHN & SUSAN R
PARCEL ID
36030186200
239 PEMBROKE AVENUE

LANDS N/L
FUREY LOUISE FROEHLICH
PARCEL ID
36030186300
233 PEMBROKE AVENUE

LANDS N/L
HALLOWELL MARK B & PATRICIA A
PARCEL ID
36030176B00
403 MEADOWBROOK AVENUE

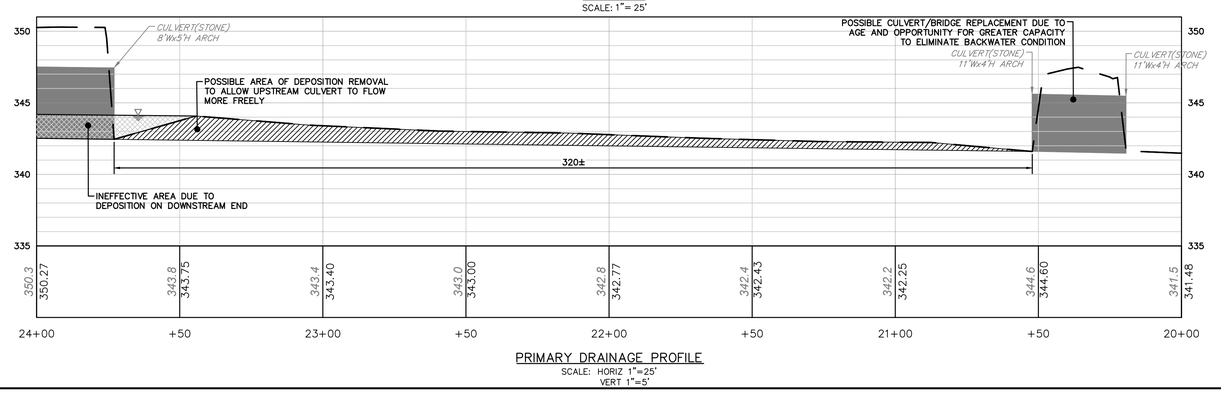
LANDS N/L
FEIN MARC S
&
FEIN JULIE A
PARCEL ID
36030176B01
407 MEADOWBROOK AVENUE

LANDS N/L
WICKHAM SUSAN READ
&
ROSS THOMAS H
PARCEL ID
36030176900
409 MEADOWBROOK AVENUE

PEMBROKE AVENUE

MEADOWBROOK AVENUE

PLAN
SCALE: 1"= 25'



PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 25 ft.

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EXISTING FEATURES PLAN
PEMBROKE AVENUE & MEADOWBROOK AVENUE
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087–5297

NO.	DATE	DESCRIPTION
		INITIALS

DATE	4–1–2022
CADD FILE	2119900002
JOB NO	21–1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	–
SHEET	7 OF 17 SHEETS

DRAWING NUMBER
V–105

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MATCH LINE (SEE V–107)

MATCH LINE (SEE V–105)

LANDS N/L
GIBBONS GEORGE E
&
MARZIANO MICHELE L
PARCEL ID
36030190700
319 SAINT DAVIDS ROAD

LANDS N/L
WHITMORE WILLIAM C JR
&
WHITMORE JEANNE L
PARCEL ID
36030190600
321 SAINT DAVIDS ROAD

LANDS N/L
GEYELIN SUSAN H
PARCEL ID
36030190500
323 SAINT DAVIDS ROAD

LANDS N/L
MORTENSEN BRADLEY J
&
AGNEW CATHERINE H
PARCEL ID
36030190400
325 SAINT DAVIDS ROAD

LANDS N/L
FRAZIER KIRSTEN S
PARCEL ID
36030187202
250 PEMBROKE AVENUE

LANDS N/L
ELORTEGUI NAPOLEON T
&
GEORGINA C
PARCEL ID
36030187201
254 PEMBROKE AVENUE

LANDS N/L
HURLEY JOHN G
&
ELLEN C
PARCEL ID
36030192500
316 SAINT DAVIDS ROAD

LANDS N/L
SUBAK MICHAEL
&
SUBAK BRIDGET
PARCEL ID
36030192300
326 SAINT DAVIDS ROAD

LANDS N/L
ZWEIG JOSHUA
&
AUSLANDER REBECCA
PARCEL ID
36030192400
328 SAINT DAVIDS ROAD

LANDS N/L
MOORE JEFFREY D
&
MICKELONIS KATHLEEN A
PARCEL ID
36030192200
330 SAINT DAVIDS ROAD

LANDS N/L
MOORE GORDON P
&
BERGER SHELLEY L
PARCEL ID
36030186100
249 PEMBROKE AVENUE

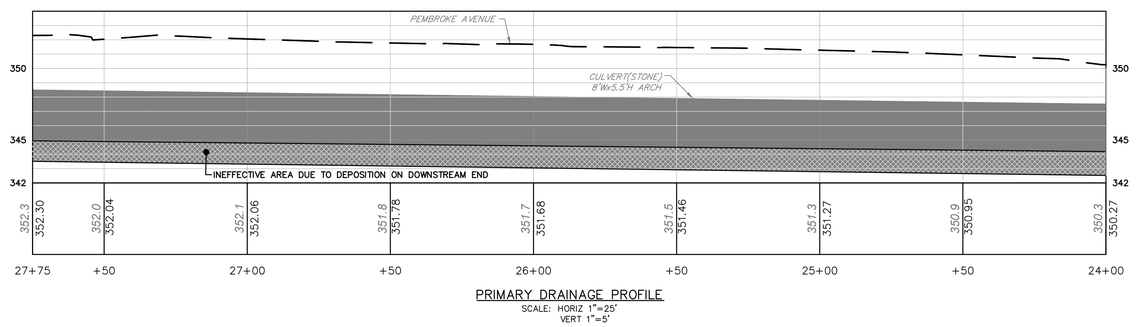
LANDS N/L
ARNOLD KARA HANLON
PARCEL ID
36030192100
400 SAINT DAVIDS ROAD

SAINT DAVIDS ROAD

PEMBROKE AVENUE

NORTH

PLAN
SCALE: 1"= 25'



PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 25 ft.

Carroll Engineering Corporation
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EXISTING FEATURES PLAN
PEMBROKE AVENUE & SAINT DAVIDS ROAD
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087–5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4–1–2022
CADD FILE	2119900002
JOB NO	21–1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	–
SHEET	8 OF 17 SHEETS

DRAWING NUMBER
V–106

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MATCH LINE (SEE V-108)

LANDS N/L
FINLEY DANIEL & MARITA
PARCEL ID
360301819000
309 MIDLAND AVENUE

LANDS N/L
STERGE MARYLOUISE A
PARCEL ID
360301820000
311 MIDLAND AVENUE

LANDS N/L
BARKER SEAN JEFFREY
&
LAKE E MOIRA
PARCEL ID
360301821000
317 MIDLAND AVENUE

LANDS N/L
DOONER JANE E
PARCEL ID
360301822000
321 MIDLAND AVENUE

LANDS N/L
STEFANSKI MATTHEW J
&
STEFANSKI MARY R
PARCEL ID
360301823000
323 MIDLAND AVENUE

LANDS N/L
BARTON JAMES
&
BARTON KATHLEEN H
PARCEL ID
360301824000
327 MIDLAND AVENUE

LANDS N/L
ZIELINSKI MICHAEL A
&
ZIELINSKI DANIELLE H
PARCEL ID
360301825000
401 MIDLAND AVENUE

MIDLAND AVENUE

PEMBROKE AVENUE

NORTH

LANDS N/L
OTT LOUIS V III
&
OTT DIANA N
PARCEL ID
360301793000
308 MIDLAND AVENUE

LANDS N/L
RIEMER KATHERINE
&
MCBRIDE MICHAEL
PARCEL ID
360301794000
310 MIDLAND AVENUE

LANDS N/L
AYRES WARREN W
&
SUSAN W
PARCEL ID
360301795000
314 MIDLAND AVENUE

LANDS N/L
DUNCAN MICHAEL
&
DUNCAN LAUREN
PARCEL ID
360301796000
318 MIDLAND AVENUE

LANDS N/L
NOONE MICHAEL
&
NOONE BRENDA A
PARCEL ID
360301797000
320 MIDLAND AVENUE

LANDS N/L
LEHANE WILLIAM
&
CYNTHIA M
PARCEL ID
360301798000
324 MIDLAND AVENUE

LANDS N/L
SEMISCH WAYNE M
&
SEMISCH TARA L
PARCEL ID
360301799000
328 MIDLAND AVENUE

LANDS N/L
MILLER STEPHEN ERIC JR
&
BRENNAN NORA ELIZABETH
PARCEL ID
360301800000
402 MIDLAND AVENUE

LANDS N/L
DOUGLASS C JR
&
SUSAN S
PARCEL ID
360301910000
NT DAVIDS ROAD

LANDS N/L
GREGITIS JOHN & ROSE MARY
PARCEL ID
360301909000
309 SAINT DAVIDS ROAD

LANDS N/L
IACONE JOSEPH
PARCEL ID
360301908000
313 SAINT DAVIDS ROAD

LANDS N/L
GIBBONS GEORGE E
&
MARZIANO MICHELE L
PARCEL ID
360301907000
319 SAINT DAVIDS ROAD

LANDS N/L
WHITMORE WILLIAM C JR
&
WHITMORE JEANNE L
PARCEL ID
360301906000
321 SAINT DAVIDS ROAD

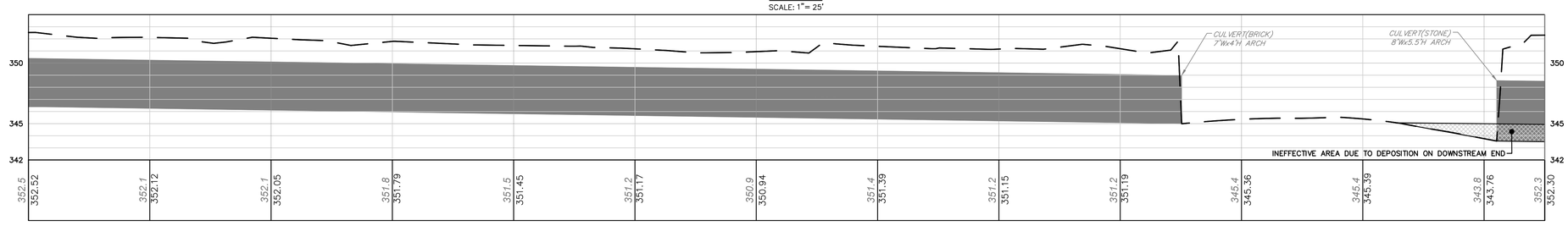
LANDS N/L
GEYELIN SUSAN H
PARCEL ID
360301905000
323 SAINT DAVIDS ROAD

LANDS N/L
MORTENSEN BRADLEY J
&
AGNEW CATHERINE H
PARCEL ID
360301904000
325 SAINT DAVIDS ROAD

LANDS N/L
FRAZIER KIRSTEN S
PARCEL ID
360301872002
250 PEMBROKE AVENUE

MATCH LINE (SEE V-106)

PLAN
SCALE: 1"= 25'



PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 25 ft.

Carroll Engineering Corporation
CORPORATE OFFICE
949 . EASTON . ROAD
WARRINGTON, . PA . 18976
PHONE: 215.343.5700
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Fax: 908-874-5762

433 Lancaster Avenue, Suite 200
Malvern, PA 19355
Phone: 610-489-5100

www.carrollengineering.com

EXISTING FEATURES PLAN
PEMBROKE AVENUE & MIDLAND AVENUE
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IWEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION
		INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	9 OF 17 SHEETS

DRAWING NUMBER
V-107

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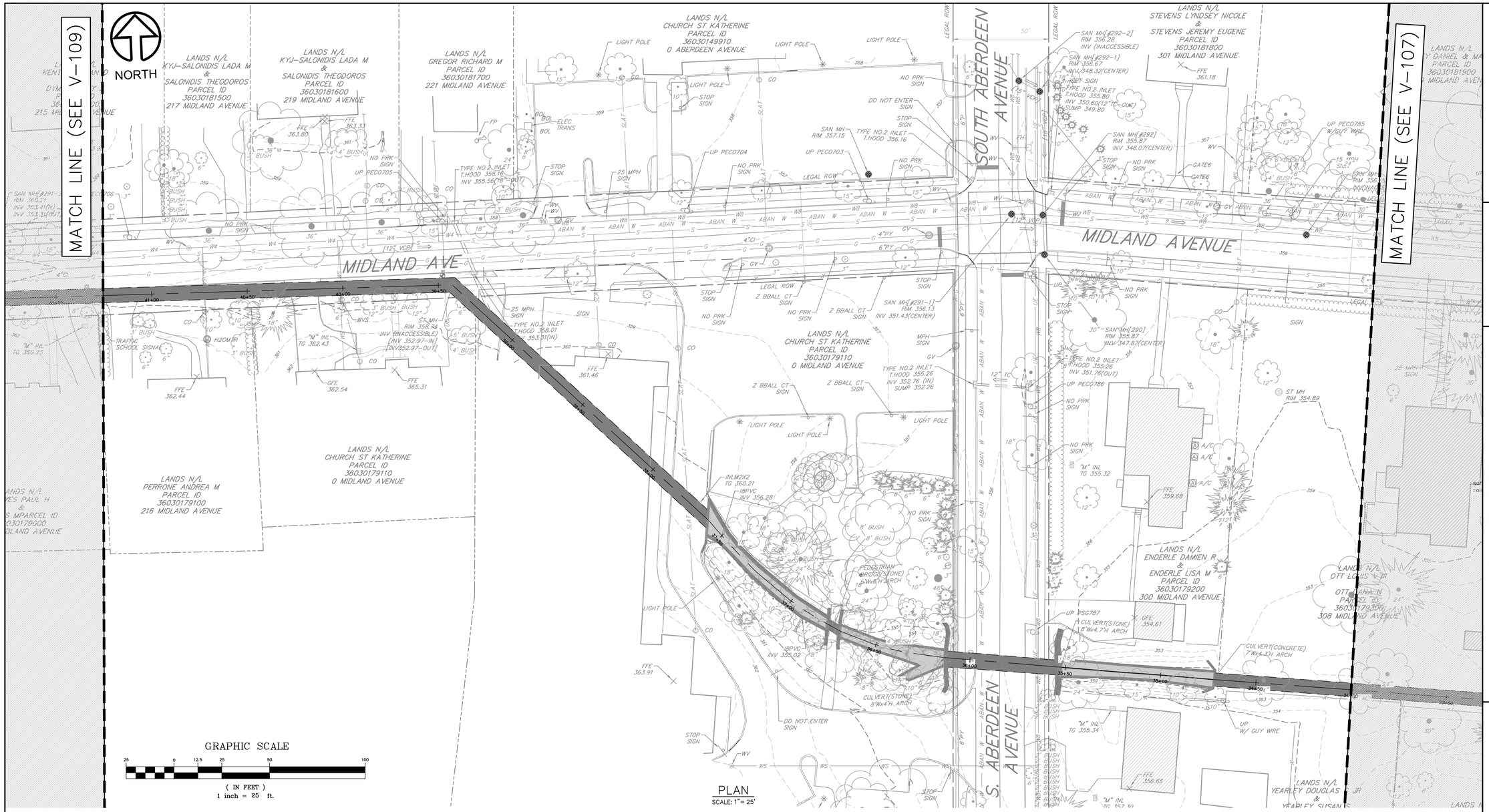
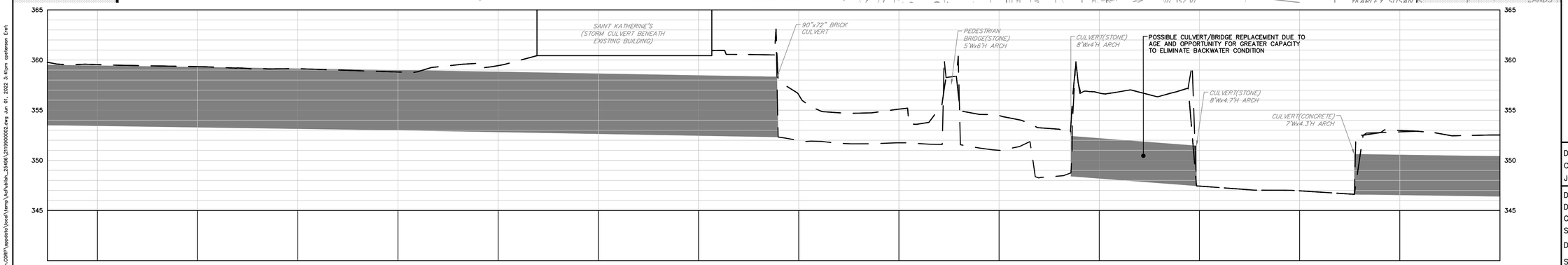


GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

PLAN
SCALE: 1"= 25'



PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

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WARRINGTON, . PA . 18976
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Fax: 908-874-5762

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Malvern, PA 19355
Phone: 610-489-5100

www.carrollengineering.com

EXISTING FEATURES PLAN
SOUTH ABERDEEN AVENUE & MIDLAND AVENUE
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY
SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	10 OF 17 SHEETS

DRAWING NUMBER
V-108

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NORTH

LOUELLA LANE

LANDS N/L
SAGE THERESA
&
WEISS MARK K
PARCEL ID
36030180700
201 MIDLAND AVENUE

LANDS N/L
CLARK GINA BONACCI TRUSTEE
PARCEL ID
36030180800
203 MIDLAND AVENUE

LANDS N/L
CONNOR NATHANIEL W
&
CONNOR ELIZABETH
PARCEL ID
36030180900
205 MIDLAND AVENUE

LANDS N/L
GAGLIARDI CHRISTOPHER P
&
CAROLINE A
PARCEL ID
36030181000
207 MIDLAND AVENUE

LANDS N/L
DESAI RONAK G
&
DESAI SANDHYA K
PARCEL ID
36030181100
209 MIDLAND AVENUE

LANDS N/L
RYAN TERENCE R
&
RYAN VICTORIA R
PARCEL ID
36030181200
211 MIDLAND AVENUE

LANDS N/L
BOOKBINDER SAMUEL C IV
&
BOOKBINDER EILEEN W
PARCEL ID
36030181300
213 MIDLAND AVENUE

LANDS N/L
KENT BRENDAN D
&
DYMOND AMY
PARCEL ID
36030181400
215 MIDLAND AVENUE

MIDLAND AVENUE

MATCH LINE (SEE V-108)

LANDS N/L
METZGER SUE MCFARLAND
&
METZGER LOUIS JOSEPH
PARCEL ID
36030178300
200 MIDLAND AVENUE

LANDS N/L
STERN SUSAN E
PARCEL ID
36030178400
202 MIDLAND AVENUE

LANDS N/L
EHART JOHANNA
PARCEL ID
36030178500
204 MIDLAND AVENUE

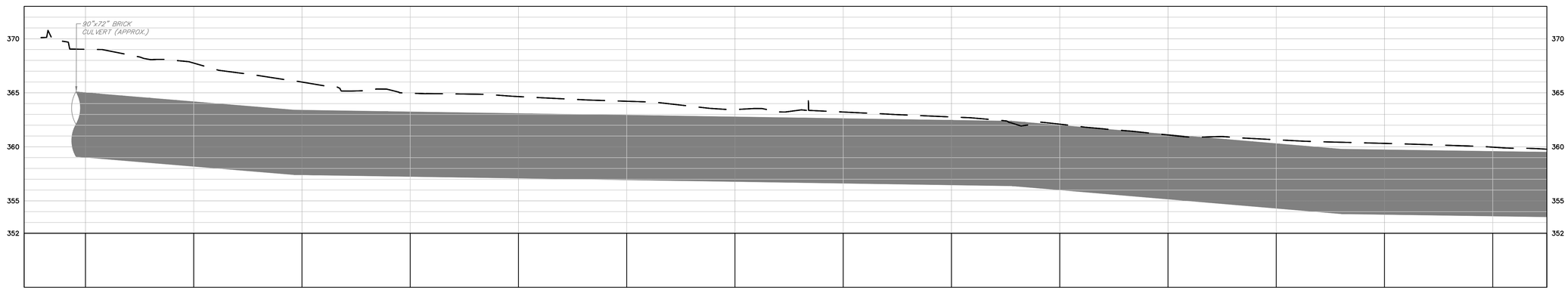
LANDS N/L
KIM YOUNG S
&
KWANG J
PARCEL ID
36030178700
208 MIDLAND AVENUE

LANDS N/L
SAVINI DANIEL J
PARCEL ID
36030178800
210 MIDLAND AVENUE

LANDS N/L
WOOD WILLIAM H
&
REBECCA W
PARCEL ID
36030178900
212 MIDLAND AVENUE

LANDS N/L
HAYES PAUL H
&
AGNES MPARCEL ID
36030179000
214 MIDLAND AVENUE

PLAN
SCALE: 1"= 25'



PRIMARY DRAINAGE PROFILE
SCALE: HORIZ 1"=25'
VERT 1"=5'

GRAPHIC SCALE
25 0 12.5 25 50 100
(IN FEET)
1 inch = 25 ft.

C:\Users\cpeterson.CORP\appdata\local\temp\AcPublish_25496\2119900002.dwg Jun 01, 2022 5:41pm cpeterson Eref:

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433 Lancaster Avenue, Suite 200 Malvern, PA 19355 Phone: 610-489-5100
www.carrollengineering.com

EXISTING FEATURES PLAN
MIDLAND AVENUE (WEST)

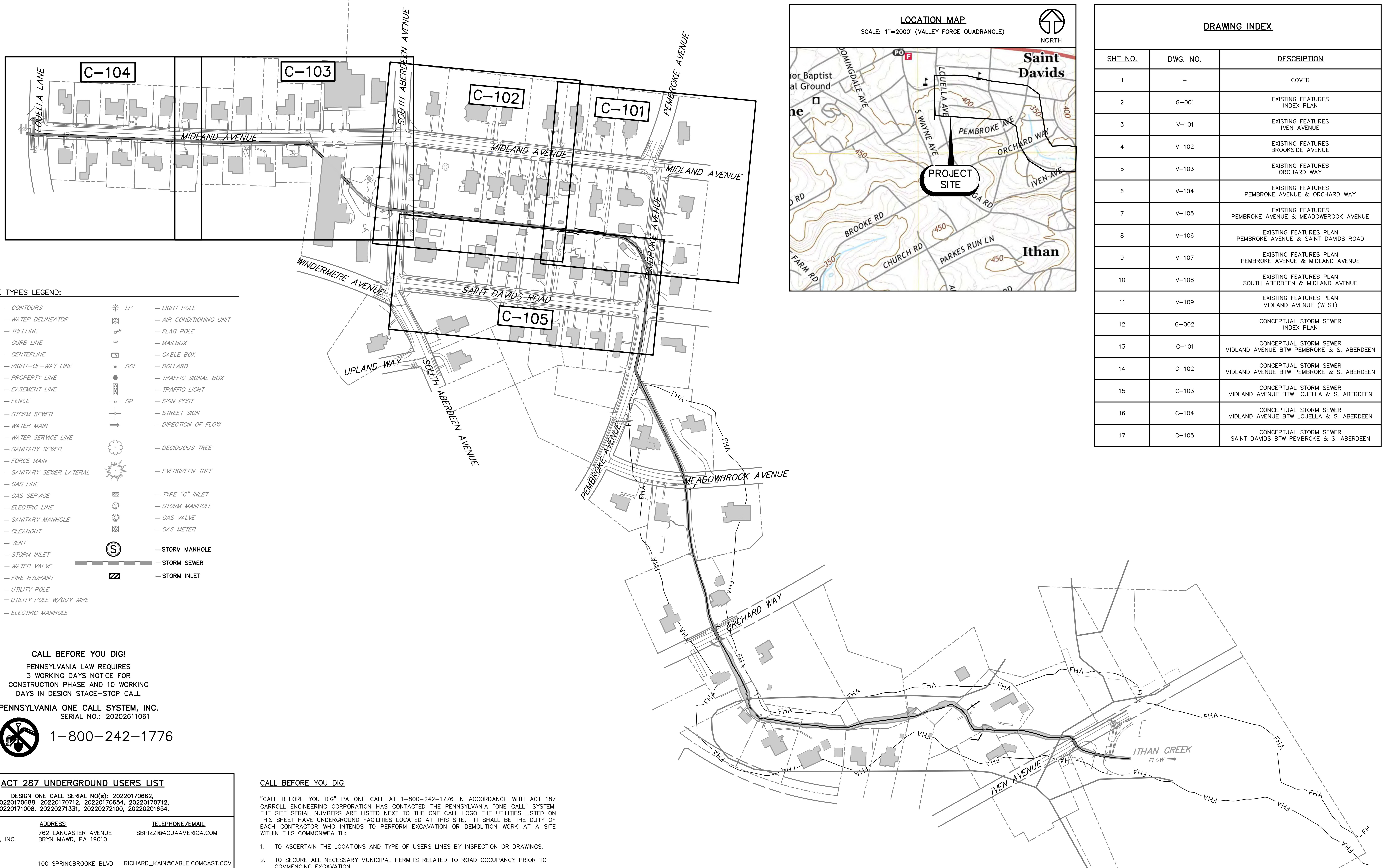
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	11 OF 17 SHEETS

DRAWING NUMBER
V-109



DRAWING INDEX

SHT NO.	DWG. NO.	DESCRIPTION
1	–	COVER
2	G-001	EXISTING FEATURES INDEX PLAN
3	V-101	EXISTING FEATURES IVEN AVENUE
4	V-102	EXISTING FEATURES BROOKSIDE AVENUE
5	V-103	EXISTING FEATURES ORCHARD WAY
6	V-104	EXISTING FEATURES PEMBROKE AVENUE & ORCHARD WAY
7	V-105	EXISTING FEATURES PEMBROKE AVENUE & MEADOWBROOK AVENUE
8	V-106	EXISTING FEATURES PLAN PEMBROKE AVENUE & SAINT DAVIDS ROAD
9	V-107	EXISTING FEATURES PLAN PEMBROKE AVENUE & MIDLAND AVENUE
10	V-108	EXISTING FEATURES PLAN SOUTH ABERDEEN & MIDLAND AVENUE
11	V-109	EXISTING FEATURES PLAN MIDLAND AVENUE (WEST)
12	G-002	CONCEPTUAL STORM SEWER INDEX PLAN
13	C-101	CONCEPTUAL STORM SEWER MIDLAND AVENUE BTW PEMBROKE & S. ABERDEEN
14	C-102	CONCEPTUAL STORM SEWER MIDLAND AVENUE BTW PEMBROKE & S. ABERDEEN
15	C-103	CONCEPTUAL STORM SEWER MIDLAND AVENUE BTW LOUELLA & S. ABERDEEN
16	C-104	CONCEPTUAL STORM SEWER MIDLAND AVENUE BTW LOUELLA & S. ABERDEEN
17	C-105	CONCEPTUAL STORM SEWER SAINT DAVIDS BTW PEMBROKE & S. ABERDEEN

SYMBOLS / LINE TYPES LEGEND:

320 — CONTOURS	LP — LIGHT POLE
— WATER DELINEATOR	— AIR CONDITIONING UNIT
— TREELINE	— FLAG POLE
— CURB LINE	— MAILBOX
— CENTERLINE	— CABLE BOX
— RIGHT-OF-WAY LINE	BOL — BOLLARD
— PROPERTY LINE	— TRAFFIC SIGNAL BOX
— EASEMENT LINE	— TRAFFIC LIGHT
— FENCE	SP — SIGN POST
— STORM SEWER	— STREET SIGN
W — WATER MAIN	— DIRECTION OF FLOW
WS — WATER SERVICE LINE	
— SANITARY SEWER	— DECIDUOUS TREE
FM — FORCE MAIN	
SLAT — SANITARY SEWER LATERAL	— EVERGREEN TREE
G — GAS LINE	
GS — GAS SERVICE	— TYPE "C" INLET
E — ELECTRIC LINE	— STORM MANHOLE
— SANITARY MANHOLE	— GAS VALVE
C/O — CLEANOUT	— GAS METER
— VENT	— STORM MANHOLE
— STORM INLET	— STORM SEWER
WV — WATER VALVE	— STORM INLET
FH — FIRE HYDRANT	
UP — UTILITY POLE	
— UTILITY POLE W/GUY WIRE	
— ELECTRIC MANHOLE	

CALL BEFORE YOU DIG!

PENNSYLVANIA LAW REQUIRES
3 WORKING DAYS NOTICE FOR
CONSTRUCTION PHASE AND 10 WORKING
DAYS IN DESIGN STAGE-STOP CALL

PENNSYLVANIA ONE CALL SYSTEM, INC.
SERIAL NO.: 20202611061

1-800-242-1776

ACT 287 UNDERGROUND USERS LIST

DESIGN ONE CALL SERIAL NO(s): 20220170662, 20220170688, 20220170712, 20220170654, 20220170712, 20220171008, 20220271331, 20220272100, 20220201654,

USER	ADDRESS	TELEPHONE/EMAIL
AQUA PENNSYLVANIA, INC.	762 LANCASTER AVENUE BRYN MAWR, PA 19010	SBPIZZI@AQUAAMERICA.COM
COMCAST	100 SPRINGBROOKE BLVD ASTON, PA 19014	RICHARD_KAIN@CABLE.COMCAST.COM
PECO ENERGY	450 S. HENDERSON ROAD, SUITE B. KING OF PRUSSIA, PA 19406	484-681-5720
VERIZON PA, INC.	15 MONTGOMERY AVENUE, FLOOR 2 PITTSBURGH, PA 15212	412-359-2000
RADNOR TOWNSHIP	301 IVEN AVENUE WAYNE, PA 19087	SMCNELIS@RADNOR.ORG

PA ONE CALL SYSTEM 1-800-242-1776

LOCATIONS OF EXISTING UTILITIES SHOWN HEREON HAVE BEEN DEVELOPED FROM EXISTING RECORDS AND/OR ABOVE-GROUND OBSERVATIONS AT THE SITE. COMPLETENESS OR ACCURACY OF LOCATION CANNOT BE GUARANTEED. ALL CONTRACTORS AND OTHER PERSONS UTILIZING THIS PLAN AND THE INFORMATION CONTAINED HEREON ARE CAUTIONED TO COMPLY WITH THE REQUIREMENTS OF PENNSYLVANIA ACT 287, AS AMENDED, TITLED "EXCAVATION AND DEMOLITION WORK PROTECTION OF UNDERGROUND UTILITIES." EACH INDIVIDUAL USING THIS PLAN MUST VERIFY THE DEPTH AND LOCATION OF ALL UNDERGROUND FACILITIES BEFORE STARTING WORK.

CALL BEFORE YOU DIG

"CALL BEFORE YOU DIG" PA ONE CALL AT 1-800-242-1776 IN ACCORDANCE WITH ACT 187 CARROLL ENGINEERING CORPORATION HAS CONTACTED THE PENNSYLVANIA "ONE CALL" SYSTEM. THE SITE SERIAL NUMBERS ARE LISTED NEXT TO THE ONE CALL LOGO THE UTILITIES LISTED ON THIS SHEET HAVE UNDERGROUND FACILITIES LOCATED AT THIS SITE. IT SHALL BE THE DUTY OF EACH CONTRACTOR WHO INTENDS TO PERFORM EXCAVATION OR DEMOLITION WORK AT A SITE WITHIN THIS COMMONWEALTH:

1. TO ASCERTAIN THE LOCATIONS AND TYPE OF USERS LINES BY INSPECTION OR DRAWINGS.
2. TO SECURE ALL NECESSARY MUNICIPAL PERMITS RELATED TO ROAD OCCUPANCY PRIOR TO COMMENCING EXCAVATION.
3. TO NOTIFY EACH USER OF CONTRACTOR'S INTENT TO PERFORM SUCH WORK AT SITE NOT LESS THAN 3 OR MORE THAN 10 WORKING DAYS PRIOR TO THE BEGINNING OF WORK FOR THE PURPOSE OF:

   I. REQUEST THE UTILITY TO FIELD LOCATE ITS LINES.
   II. INITIATE COOPERATION WHICH WILL AVOID DAMAGE.
   III. REQUEST PROCEDURES WHICH WILL AVOID DAMAGE.

   A CONTRACTOR SHALL BE DEEMED TO HAVE GIVEN NOTICE IF THE CONTRACTOR CALLS "ONE-CALL", SYSTEM AT 1-800-242-1776 CONCERNING THIS SITE.
4. TO INFORM EACH OPERATOR EMPLOYED BY THE CONTRACTOR AT THE SITE OF SUCH WORK OF THE INFORMATION OBTAINED.
5. TO REPORT IMMEDIATELY TO THE OCCUPANTS OF THE PREMISES AS TO ANY EMERGENCY THAT THE CONTRACTOR MAY CREATE OR DISCOVER AT OR NEAR SUCH PREMISES.
6. TO REPORT IMMEDIATELY TO THE USER ANY BREAK OR LEAK ON ITS LINES OR ANY DENT, GOUGE, GROOVE OR OTHER DAMAGE TO SUCH LINES OR TO THEIR COATING OR CATHODIC PROTECTION, MADE OR DISCOVERED IN THE COURSE OF THE EXCAVATION OR DEMOLITION WORK.
7. TO TAKE ALL REASONABLE STEPS NECESSARY TO AVOID INJURY OR OTHERWISE INTERFERE WITH ALL LINES WHERE POSITIONS HAVE BEEN PROVIDED TO THE CONTRACTOR BY USERS.
8. TO EMPLOY PRUDENT TECHNIQUES, WHICH MAY INCLUDE HAND-DUG TEST HOLES, TO ASCERTAIN THE PRECISE POSITION OF SUCH FACILITIES.

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949 . EASTON . ROAD
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105 Raider Boulevard, Suite 206
Hillsborough, NJ 08844
Phone: 908-874-7500
Fax: 908-874-5762

433 Lancaster Avenue, Suite 200
Malvern, PA 19355
Phone: 610-489-5100

www.carrollengineering.com

CONCEPTUAL STORM SEWER INDEX PLAN

SOUTH WAYNE DRAINAGE IMPROVEMENTS FEASBILITY STUDY
SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=150'
DRAWER NUMBER	–
SHEET 12	OF 17 SHEETS

DRAWING NUMBER
G-002

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WARRINGTON, . PA . 18976
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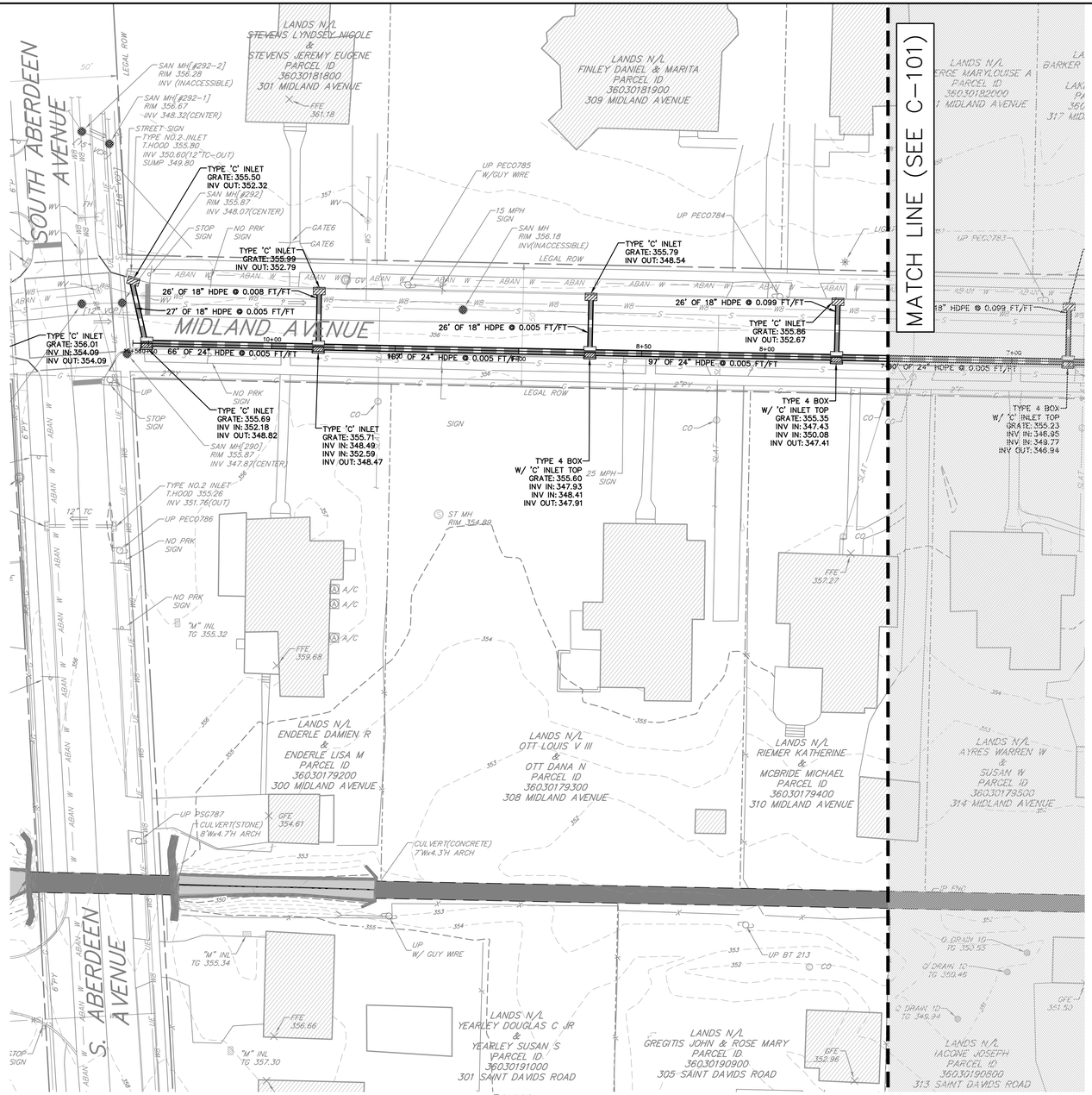
CONCEPTUAL STORM SEWER PLAN
MIDLAND AVENUE BTW PEMBROKE & S. ABERDEEN
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION
		INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	–
SHEET	13 OF 17 SHEETS

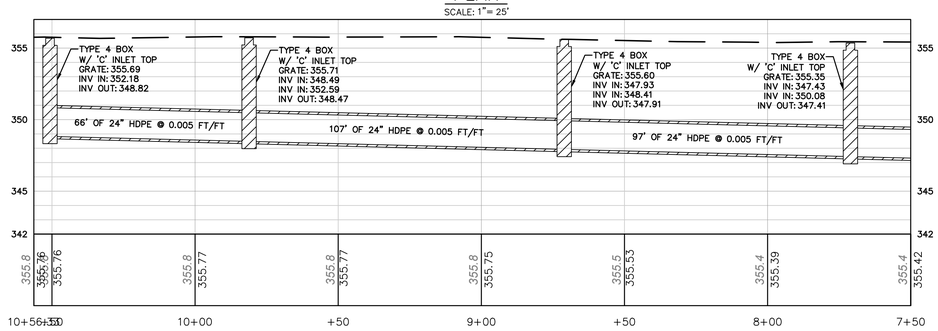
DRAWING NUMBER
C-101



NORTH

PLAN

SCALE: 1"= 25'



GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

Carroll Engineering Corporation

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Phone: 610-489-5100

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CONCEPTUAL STORM SEWER PLAN
MIDLAND AVENUE BTW PEMBROKE & S. ABERDEEN
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IWEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	14 OF 17 SHEETS

DRAWING NUMBER
C-102

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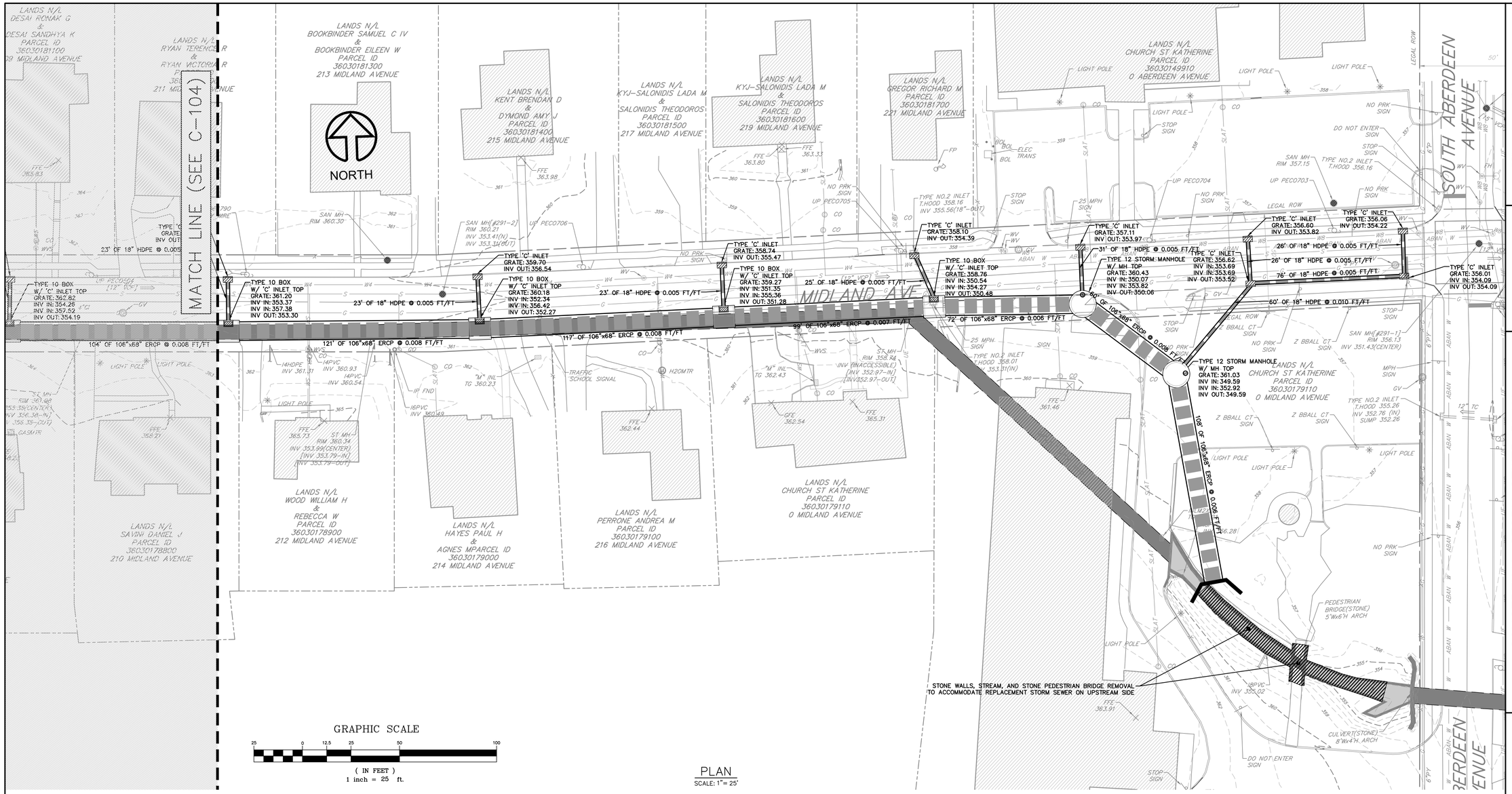
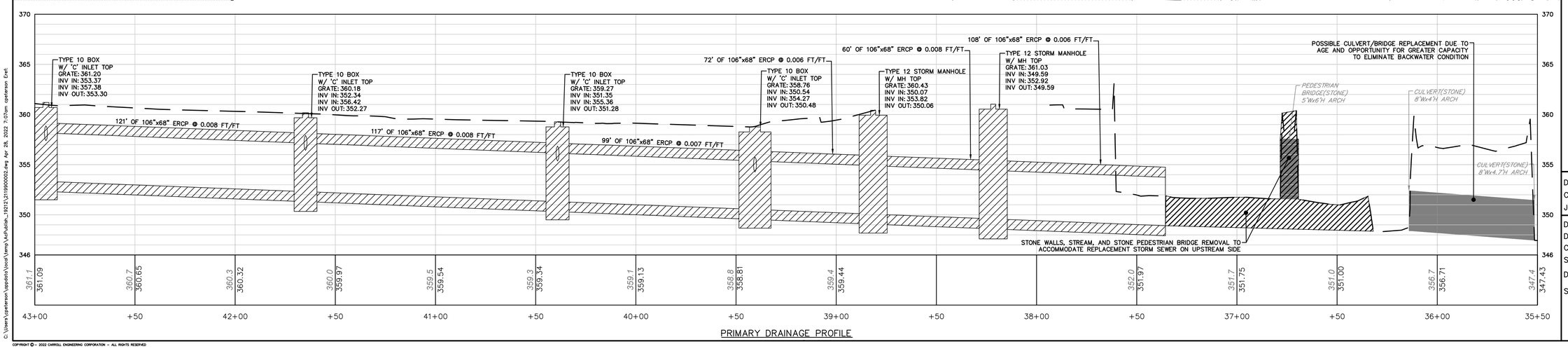


GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

PLAN
SCALE: 1" = 25'



PRIMARY DRAINAGE PROFILE

Carroll Engineering Corporation
CORPORATE OFFICE
949 . EASTON . ROAD
WARRINGTON, . PA . 18976
PHONE: 215.343.5700
FAX: 215.343.0875

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Hillsborough, NJ 08844
Phone: 908-874-7500
Fax: 908-874-5762

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Malvern, PA 19355
Phone: 610-489-5100

www.carrollengineering.com

CONCEPTUAL STORM SEWER PLAN
MIDLAND AVENUE BTW LOUELLA & S. ABERDEEN
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	15 OF 17 SHEETS

DRAWING NUMBER
C-103

C:\Users\cpeterson\appdata\local\temp\AcPublish_19212\2119900002.dwg Apr 28, 2022 7:07pm cpeterson Eref:

NORTH

LOUELLA LANE

LANDS N/L
TOWNSHIP OF RADNOR
PARCEL ID
36030195810
0 WINDERMERE AVENUE

LANDS N/L
SAGE THERESA
&
WEISS MARK K
PARCEL ID
36030180700
201 MIDLAND AVENUE

LANDS N/L
CLARK GINA BONACCI TRUSTEE
PARCEL ID
36030180800
203 MIDLAND AVENUE

LANDS N/L
CONNOR NATHANIEL W
&
CONNOR ELIZABETH
PARCEL ID
36030180900
205 MIDLAND AVENUE

LANDS N/L
GAGLIARDI CHRISTOPHER P
&
CAROLINE A
PARCEL ID
36030181000
207 MIDLAND AVENUE

LANDS N/L
DESAI RONAK G
&
DESAI SANDHYA K
PARCEL ID
36030181100
209 MIDLAND AVENUE

LANDS N/L
RYAN TERENCE R
&
RYAN VICTORIA R
PARCEL ID
36030181200
211 MIDLAND AVE

LANDS N/L
BOOKBINDER SAMUEL C IV
&
BOOKBINDER EILEEN W
PARCEL ID
36030181300
213 MIDLAND AVENUE

MIDLAND AVENUE

MATCH LINE (SEE C-103)

"M" INL
TG 369.67
INV 364.97(36" HDPE-IN)
INV 364.97(36" HDPE-OUT)

SAN MH
RIM 369.16
INV 387.76(IN)
INV 387.66(OUT)

"M" INL
TG 368.63
INV 365.43(A-IN)
INV 365.38(B-IN)
INV 365.33(C-IN)
INV 365.13(OUT)

"M" INL
TG 368.01
INV 365.61(OUT)

NO PRK SIGN

STOP SIGN

15 MPH SIGN

25 MPH SIGN

LIGHT POLE

UP PSC706

SAN MH[#291-4]
RIM 363.44
INV 356.69(CENTER)

UP PECO504
[12" VCP]

SAN MH
RIM 362.30

TYPE 'C' INLET
GRATE: 365.10
INV OUT: 359.77
23' OF 18" HDPE @ 0.010 FT/FT

TYPE 'C' INLET
GRATE: 363.33
INV OUT: 358.77
23' OF 18" HDPE @ 0.010 FT/FT

TYPE 'C' INLET
GRATE: 361.85
INV OUT: 357.75
23' OF 18" HDPE @ 0.010 FT/FT

TYPE 'C' INLET
GRATE: 360.69
INV OUT: 357.49
23' OF 18" HDPE @ 0.005 FT/FT

TYPE 'C' INLET
GRATE: 367.73
INV OUT: 360.54
22' OF 18" HDPE @ 0.009 FT/FT

91' OF 106"x68" ERCP @ 0.022 FT/FT

116' OF 106"x68" ERCP @ 0.008 FT/FT

121' OF 106"x68" ERCP @ 0.008 FT/FT

104' OF 106"x68" ERCP @ 0.008 FT/FT

TYPE 10 BOX
W/ 'C' INLET TOP
GRATE: 362.82
INV IN: 354.26
INV IN: 357.52
INV OUT: 354.19

TYPE 10 BOX
W/ 'C' INLET TOP
GRATE: 367.85
INV IN: 360.33
INV OUT: 358.31

TYPE 10 BOX
W/ 'C' INLET TOP
GRATE: 365.34
INV IN: 356.29
INV IN: 359.54
INV OUT: 356.21

TYPE 10 BOX
W/ 'C' INLET TOP
GRATE: 364.13
INV IN: 355.29
INV IN: 358.54
INV OUT: 355.22

STREET SIGN

"W" INL
TG 369.92
INV 368.62(WEIR)
INV 365.42(18" RCP-IN)
INV 365.32(18" RCP OUT)

SAN MH[#291-22]
RIM 368.92
INV 359.82(CENTER)

18" CMP

"C" INL
TG 369.53
INV 365.03(18" CMP-IN)
INV 364.68(IN)
INV 364.73(OUT)

SAN MH
RIM 369.85
INV 363.25(CENTER)
[INV 363.51-IN]
[INV 363.42-IN]
[INV 363.28-OUT]

TYPE NO.2 INLET
T.HOOD 369.27
INV 366.47(12")

ST MH
RIM 366.04
INV (INACCESSIBLE)
[INV 357.4'-IN]
[INV 357.4'-OUT]

14PVC
INV 366.79

"M" INL
TG 364.52

14PVC
INV 363.62

ST MH
RIM 367.48
INV 355.38(CENTER)
[INV 356.38-IN]
[INV 356.38-OUT]

GASMTR

SUMP
INV 365.57

LANDS N/L
METZGER SUE MCFARLAND
&
METZGER LOUIS JOSEPH
PARCEL ID
36030178300
200 MIDLAND AVENUE

LANDS N/L
STERN SUSAN E
PARCEL ID
36030178400
202 MIDLAND AVENUE

LANDS N/L
EHART JOHANNA
PARCEL ID
36030178500
204 MIDLAND AVENUE

LANDS N/L
KIM YOUNG S
&
KWANG J
PARCEL ID
36030178700
208 MIDLAND AVENUE

LANDS N/L
SAVNI DANIEL J
PARCEL ID
36030178800
210 MIDLAND AVENUE

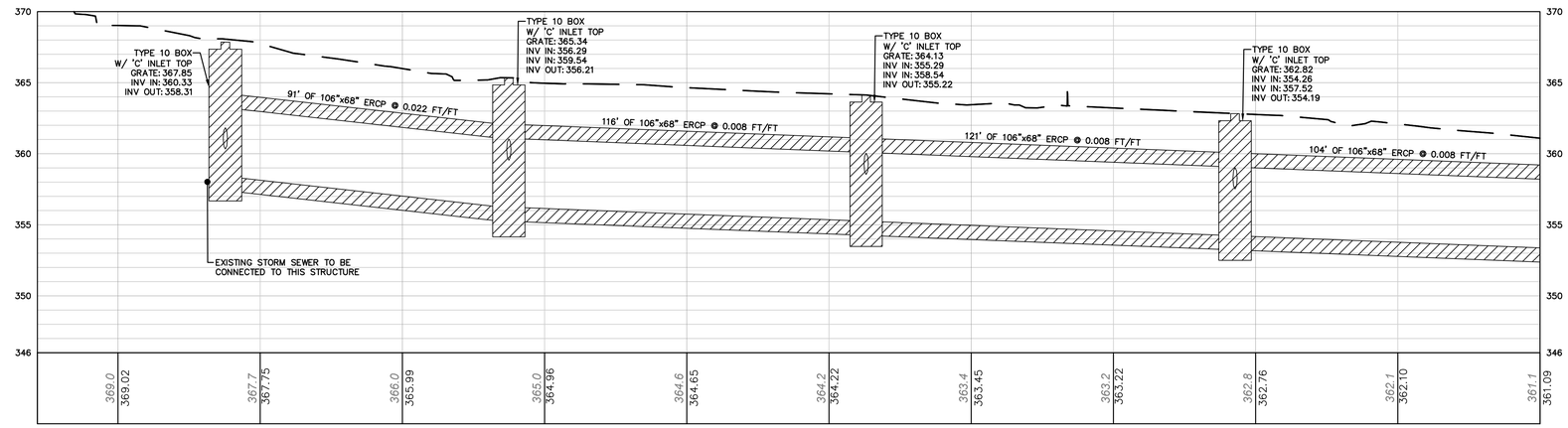
LANDS N/L
WOOD WILLIAM H
&
REBECCA W
PARCEL ID
36030178900
212 MIDLAND AVENUE

GRAPHIC SCALE

25 0 12.5 25 50 100

(IN FEET)
1 inch = 25 ft.

PLAN
SCALE: 1"= 25'



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CONCEPTUAL STORM SEWER PLAN
MIDLAND AVENUE BTW LOUELLA & S. ABERDEEN
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION	INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-
SHEET	16 OF 17 SHEETS

DRAWING NUMBER
C-104

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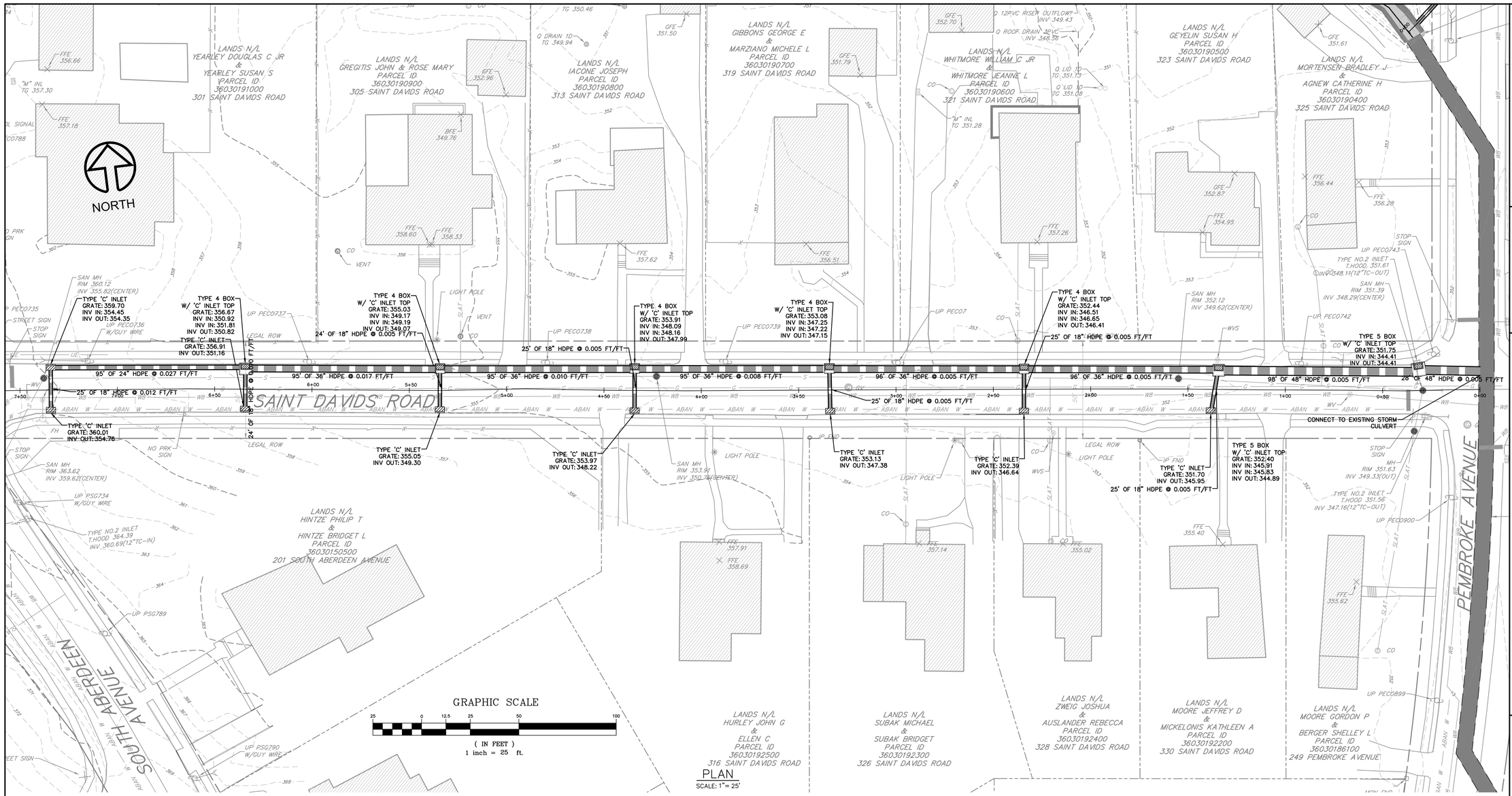

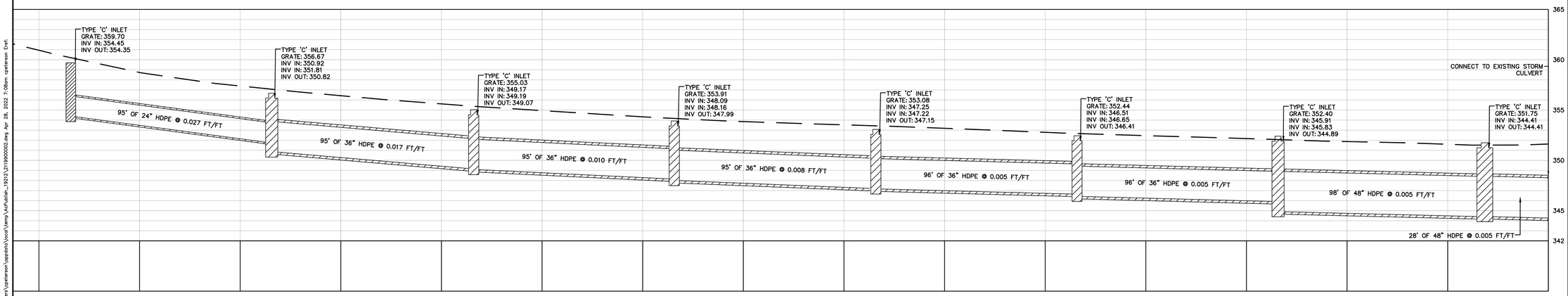

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Phone: 610-489-5100

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CONCEPTUAL STORM SEWER PLAN
SAINT DAVIDS BTW PEMBROKE & S. ABERDEEN
SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION
		INITIALS

DATE	4-1-2022
CADD FILE	2119900002
JOB NO	21-1990
DSG BY	CAP
DWN BY	TSB
CKD BY	CAP
SCALE	1"=25'
DRAWER NUMBER	-

SHEET 17 OF 17 SHEETS

DRAWING NUMBER
C-105

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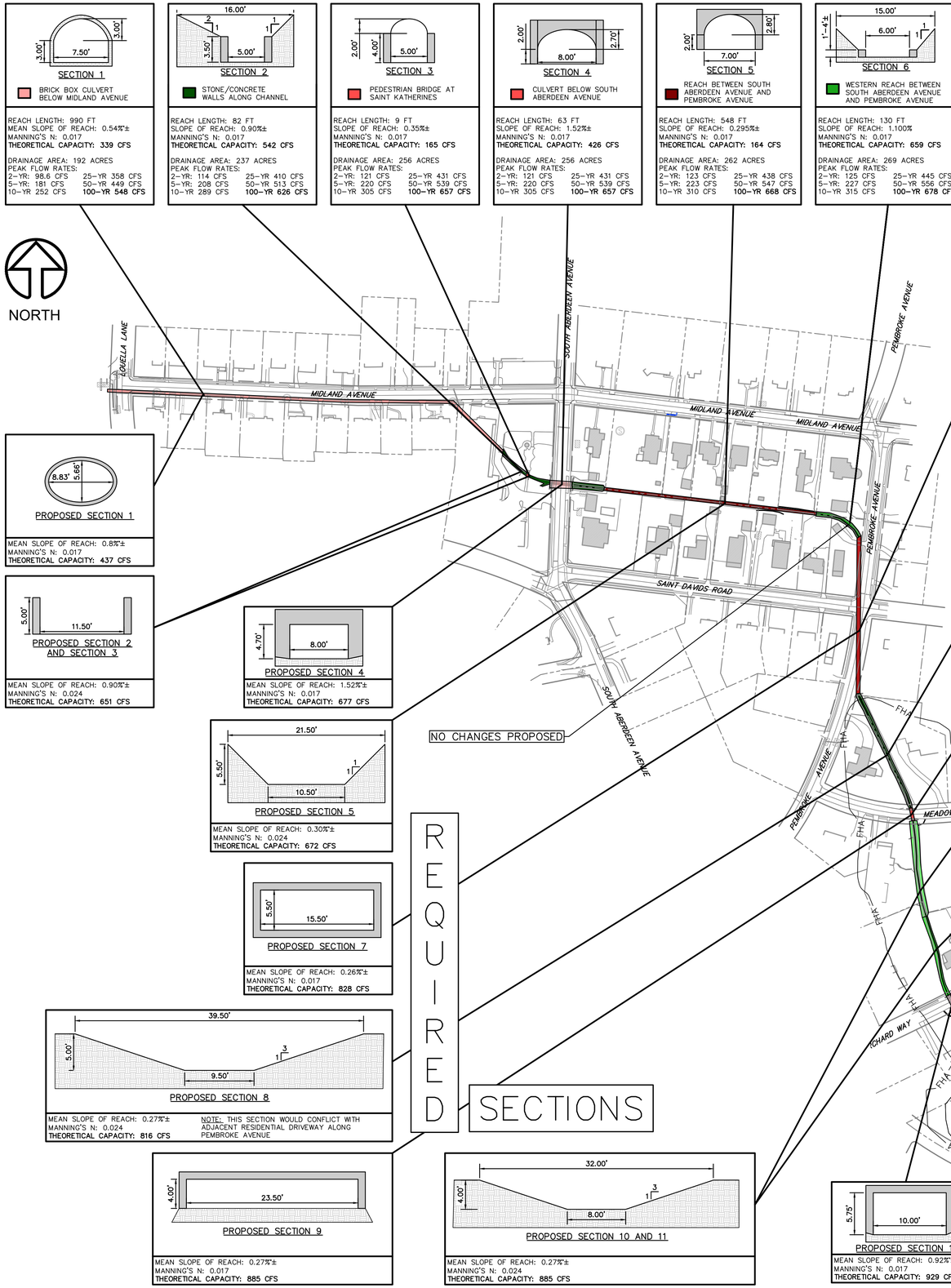
APPENDIX B: ITHAN CREEK SECTIONS – INDEX PLAN



SECTION 1

BRICK BOX CULVERT BELOW MIDLAND AVENUE

REACH LENGTH: 990 FT
MEAN SLOPE OF REACH: 0.54%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 339 CFS

DRAINAGE AREA: 192 ACRES
PEAK FLOW RATES:
2-YR: 98.6 CFS 25-YR 358 CFS
5-YR: 181 CFS 50-YR 449 CFS
10-YR 252 CFS **100-YR 548 CFS**

SECTION 2

STONE/CONCRETE WALLS ALONG CHANNEL

REACH LENGTH: 82 FT
SLOPE OF REACH: 0.90%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 542 CFS

DRAINAGE AREA: 237 ACRES
PEAK FLOW RATES:
2-YR: 114 CFS 25-YR 410 CFS
5-YR: 208 CFS 50-YR 513 CFS
10-YR 289 CFS **100-YR 626 CFS**

SECTION 3

PEDESTRIAN BRIDGE AT SAINT KATHERINES

REACH LENGTH: 9 FT
SLOPE OF REACH: 0.35%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 165 CFS

DRAINAGE AREA: 256 ACRES
PEAK FLOW RATES:
2-YR: 121 CFS 25-YR 431 CFS
5-YR: 220 CFS 50-YR 539 CFS
10-YR 305 CFS **100-YR 657 CFS**

SECTION 4

CULVERT BELOW SOUTH ABERDEEN AVENUE

REACH LENGTH: 63 FT
SLOPE OF REACH: 1.52%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 426 CFS

DRAINAGE AREA: 256 ACRES
PEAK FLOW RATES:
2-YR: 121 CFS 25-YR 431 CFS
5-YR: 220 CFS 50-YR 539 CFS
10-YR 305 CFS **100-YR 657 CFS**

SECTION 5

REACH BETWEEN SOUTH ABERDEEN AVENUE AND PEMBROKE AVENUE

REACH LENGTH: 548 FT
SLOPE OF REACH: 0.295%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 164 CFS

DRAINAGE AREA: 262 ACRES
PEAK FLOW RATES:
2-YR: 123 CFS 25-YR 438 CFS
5-YR: 223 CFS 50-YR 547 CFS
10-YR 310 CFS **100-YR 668 CFS**

SECTION 6

WESTERN REACH BETWEEN SOUTH ABERDEEN AVENUE AND PEMBROKE AVENUE

REACH LENGTH: 130 FT
SLOPE OF REACH: 1.100%
MANNING'S N: 0.017
THEORETICAL CAPACITY: 659 CFS

DRAINAGE AREA: 269 ACRES
PEAK FLOW RATES:
2-YR: 125 CFS 25-YR 445 CFS
5-YR: 227 CFS 50-YR 556 CFS
10-YR 315 CFS **100-YR 678 CFS**

SECTION 7

CULVERT UNDERNEATH PEMBROKE AVENUE

REACH LENGTH: 422 FT
MEAN SLOPE OF REACH: 0.26%
MANNING'S N: 0.017
THEORETICAL CAPACITY: 234 CFS

DRAINAGE AREA: 359 ACRES
PEAK FLOW RATES:
2-YR: 153 CFS 25-YR 536 CFS
5-YR: 275 CFS 50-YR 668 CFS
10-YR 380 CFS **100-YR 813 CFS**

SECTION 8

REACH BETWEEN PEMBROKE CONDUIT AND MEADOWBROOK

REACH LENGTH: 321 FT
MEAN SLOPE OF REACH: 0.27%
MANNING'S N: 0.017
THEORETICAL CAPACITY: 441 CFS

DRAINAGE AREA: 359 ACRES
PEAK FLOW RATES:
2-YR: 153 CFS 25-YR 536 CFS
5-YR: 275 CFS 50-YR 668 CFS
10-YR 380 CFS **100-YR 813 CFS**

SECTION 9

STONE ARCH CULVERT BELOW MEADOWBROOK AVENUE

REACH LENGTH: 33 FT
MEAN SLOPE OF REACH: 0.27%*
MANNING'S N: 0.017
THEORETICAL CAPACITY: 165 CFS

DRAINAGE AREA: 390 ACRES
PEAK FLOW RATES:
2-YR: 162 CFS 25-YR 566 CFS
5-YR: 292 CFS 50-YR 705 CFS
10-YR 402 CFS **100-YR 858 CFS**

SECTION 10

NORTHERN REACH BETWEEN MEADOWBROOK AVENUE AND ORCHARD WAY

REACH LENGTH: 250 FT
MEAN SLOPE OF REACH: 0.99%
MANNING'S N: 0.024
THEORETICAL CAPACITY: 554 CFS

DRAINAGE AREA: 397 ACRES
PEAK FLOW RATES:
2-YR: 164 CFS 25-YR 572 CFS
5-YR: 295 CFS 50-YR 712 CFS
10-YR 406 CFS **100-YR 867 CFS**

SECTION 11

SOUTHERN REACH BETWEEN MEADOWBROOK AVENUE AND ORCHARD WAY

REACH LENGTH: 210 FT
MEAN SLOPE OF REACH: 0.99%
MANNING'S N: 0.024
THEORETICAL CAPACITY: 429 CFS

DRAINAGE AREA: 403 ACRES
PEAK FLOW RATES:
2-YR: 166 CFS 25-YR 578 CFS
5-YR: 298 CFS 50-YR 720 CFS
10-YR 411 CFS **100-YR 875 CFS**

SECTION 12

STONE ARCH CULVERT UNDER ORCHARD WAY

MEASURED SLOPE OF REACH: −2.469%
REACH LENGTH: 32 FT

MEAN SLOPE OF REACH: 0.92%**
MANNING'S N: 0.017
THEORETICAL CAPACITY: 579 CFS

DRAINAGE AREA: 409 ACRES
PEAK FLOW RATES:
2-YR: 168 CFS 25-YR 584 CFS
5-YR: 301 CFS 50-YR 727 CFS
10-YR 415 CFS **100-YR 884 CFS**

SECTION 13

NORTHERN REACH BETWEEN ORCHARD WAY AND IVEN AVENUE

REACH LENGTH: 1,323 FT
MEAN SLOPE OF REACH: 0.62%
MANNING'S N: 0.024
THEORETICAL CAPACITY: 1,216 CFS

DRAINAGE AREA: 524 ACRES
PEAK FLOW RATES:
2-YR: 201 CFS 25-YR 691 CFS
5-YR: 359 CFS 50-YR 858 CFS
10-YR 493 CFS **100-YR 1040 CFS**

SECTION 14

STONE ARCH CULVERT UNDER IVEN AVENUE

MEASURED SLOPE OF REACH: −0.8%
REACH LENGTH: 25 FT

MEAN SLOPE OF REACH: 1.1%**
MANNING'S N: 0.017
THEORETICAL CAPACITY: 352 CFS

DRAINAGE AREA: 531 ACRES
PEAK FLOW RATES:
2-YR: 201 CFS 25-YR 691 CFS
5-YR: 359 CFS 50-YR 858 CFS
10-YR 493 CFS **100-YR 1040 CFS**

SECTION 15

CORRUGATED METAL PIPE UNDER TWP ENTRANCE

REACH LENGTH: 33 FT
MEAN SLOPE OF REACH: 1.0%
MANNING'S N: 0.019
THEORETICAL CAPACITY: 393 CFS

DRAINAGE AREA: 531 ACRES
PEAK FLOW RATES:
2-YR: 201 CFS 25-YR 691 CFS
5-YR: 359 CFS 50-YR 858 CFS
10-YR 493 CFS **100-YR 1040 CFS**

PROPOSED SECTION 1

MEAN SLOPE OF REACH: 0.8%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 437 CFS

PROPOSED SECTION 2 AND SECTION 3

MEAN SLOPE OF REACH: 0.90%±
MANNING'S N: 0.024
THEORETICAL CAPACITY: 651 CFS

PROPOSED SECTION 4

MEAN SLOPE OF REACH: 1.52%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 677 CFS

PROPOSED SECTION 5

MEAN SLOPE OF REACH: 0.30%±
MANNING'S N: 0.024
THEORETICAL CAPACITY: 672 CFS

PROPOSED SECTION 7

MEAN SLOPE OF REACH: 0.26%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 828 CFS

PROPOSED SECTION 8

MEAN SLOPE OF REACH: 0.27%±
MANNING'S N: 0.024
THEORETICAL CAPACITY: 816 CFS

NOTE: THIS SECTION WOULD CONFLICT WITH ADJACENT RESIDENTIAL DRIVEWAY ALONG PEMBROKE AVENUE

PROPOSED SECTION 9

MEAN SLOPE OF REACH: 0.27%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 885 CFS

PROPOSED SECTION 10 AND 11

MEAN SLOPE OF REACH: 0.27%±
MANNING'S N: 0.024
THEORETICAL CAPACITY: 885 CFS

PROPOSED SECTION 12

MEAN SLOPE OF REACH: 0.92%±
MANNING'S N: 0.017
THEORETICAL CAPACITY: 929 CFS

PROPOSED SECTION 14

SLOPE OF REACH: 1.0%
MANNING'S N: 0.017
THEORETICAL CAPACITY: 1,078 CFS

GRAPHIC SCALE
150 0 75 150 300 600
(IN FEET)
1 inch = 150 ft.

SECTION NOTES:

* STONE ARCH CULVERT AT MEADOWBROOK AVENUE HAS NEGATIVE SLOPE. AS SUCH, SLOPE OF THE UPSTREAM REACH IS USED FOR THEORETICAL CAPACITY.

** STONE ARCH CULVERT AT ORCHARD AND IVEN AVENUE HAVE NEGATIVE SLOPE. AS SUCH, THE AVERAGE OF THE UP AND DOWNSTREAM STREAM SLOPE IS USED FOR THEORETICAL CAPACITY.

GENERAL NOTES:

1. DRAINAGE AREA AND PEAK FLOW RATES OBTAINED FROM STREAMSTATS.USGS.GOV REPORTS.
2. PEAK FLOW RATES FOR SECTIONS BASED ON DRAINAGE CONDITIONS AT START OF REACH.
3. THEORETICAL CAPACITY CALCULATED USING MANNING'S EQUATION AND FULL FLOWING SECTIONS.
4. MANNING'S N VALUES OBTAINED FROM TABLES IN THE PUBLICATION (CHOW, 1959).
5. MEAN SLOPE OF REACH USED IN CALCULATION WHEN MEASURED SLOPE IS UNSUITABLE DUE TO CURRENT CONDITIONS.
6. "REQUIRED SECTIONS" OR PROPOSED SECTIONS WERE APPROXIMATELY SIZED TO CONVEY THE 100-YEAR FLOW RATE WITH THE EXCEPTION OF SECTION 1 WHERE SPACE LIMITS THE SIZE OF THE CONDUIT WHICH CAN BE USED WITHOUT MAJOR UTILITY RELOCATIONS.

SECTION RANKING

RANK	SECTION	CAPACITY	100-YR FLOW	DIFFERENCE
1	9	165 CFS	858 CFS	(693 CFS)
2	14	352 CFS	1,040 CFS	(688 CFS)
3	15	393 CFS	1,040 CFS	(647 CFS)
4	7	234 CFS	813 CFS	(579 CFS)
5	5	164 CFS	668 CFS	(504 CFS)
6	3	165 CFS	657 CFS	(492 CFS)
7	11	429 CFS	875 CFS	(446 CFS)
8	8	441 CFS	813 CFS	(372 CFS)
9	10	554 CFS	867 CFS	(313 CFS)
10	12	579 CFS	884 CFS	(305 CFS)
11	4	426 CFS	657 CFS	(231 CFS)
12	1	339 CFS	548 CFS	(209 CFS)
13	2	542 CFS	626 CFS	(84 CFS)
14	6	659 CFS	678 CFS	(19 CFS)
15	13	1,216 CFS	1,040 CFS	+176 CFS

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ITHAN CREEK SECTIONS INDEX PLAN

SOUTH WAYNE DRAINAGE IMPROVEMENTS FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP
PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVENUE
WAYNE, PENNSYLVANIA, 19087-5297

NO.	DATE	DESCRIPTION
1	5-31-22	SECTIONS 14 & 15 ADDED

CAP INITIALS

DATE 4-20-2022
CADD FILE 2119900007
JOB NO 21-1990

DSG BY CAP
DWN BY MEW
CKD BY CAP
SCALE 1"=150'
DRAWER NUMBER –
SHEET 1 OF 1 SHEETS

DRAWING NUMBER
G-001

APPENDIX C: MANNINGS CALCULATIONS

EXISTING SECTIONS

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 1 - Brick Arch Culvert

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.54
N-Value	= Composite

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 6.00
Q (cfs)	= 339.20
Area (sqft)	= 38.27
Velocity (ft/s)	= 8.86
Wetted Perim (ft)	= 23.68
Crit Depth, Yc (ft)	= 3.89
Top Width (ft)	= 0.00
EGL (ft)	= 7.22

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

(3.75, 106.00)-(2.00, 105.50, 0.017)-(1.33, 105.00, 0.017)-(0.78, 104.50, 0.017)-(0.50, 104.00, 0.017)-(7.50, 100.00, 0.017)-(7.50, 103.00, 0.017)
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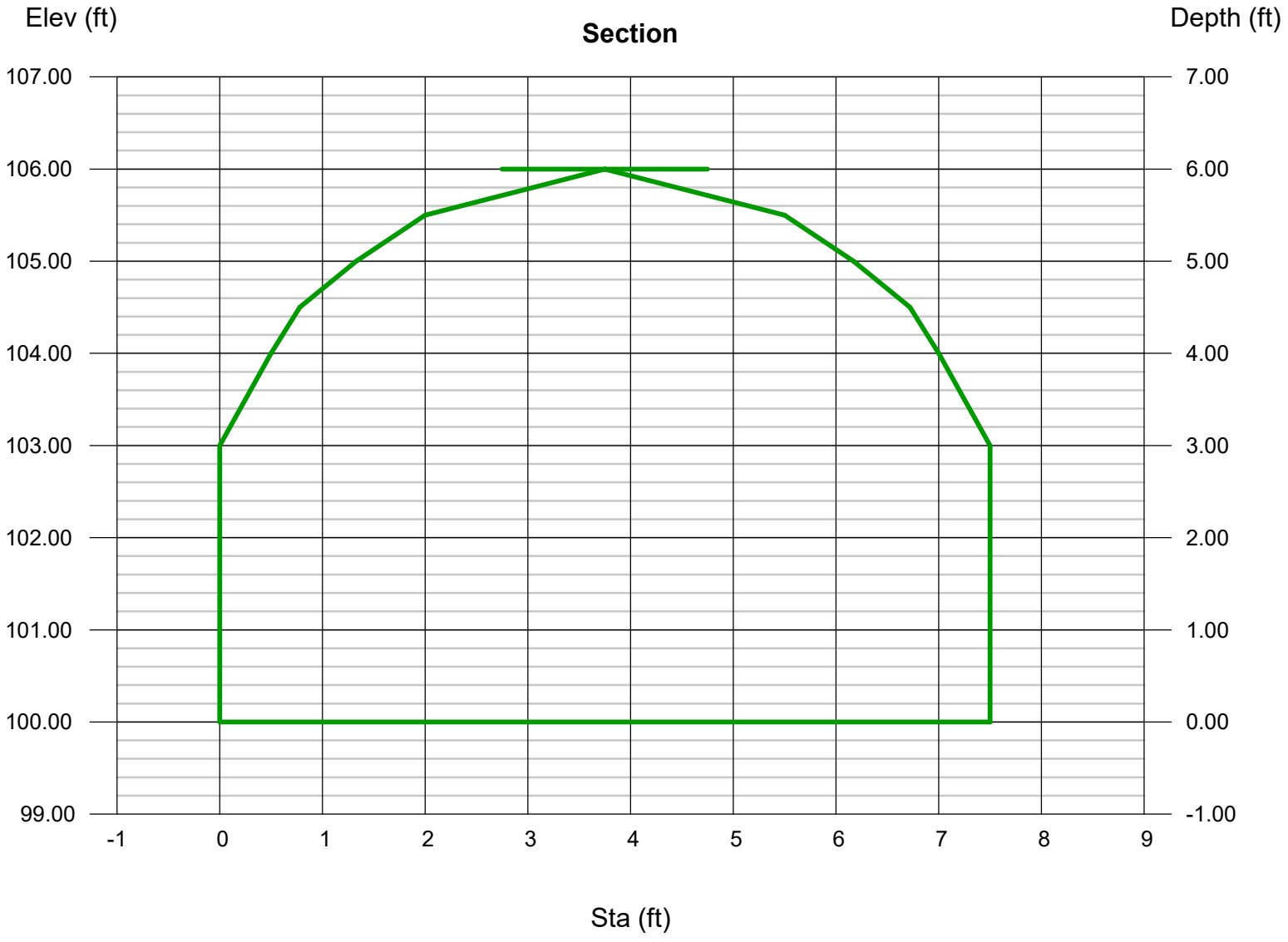


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 21 2022

Section 2 - Stone Wall Channel (Saint Katherines)

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.90
N-Value	= Composite

Calculations

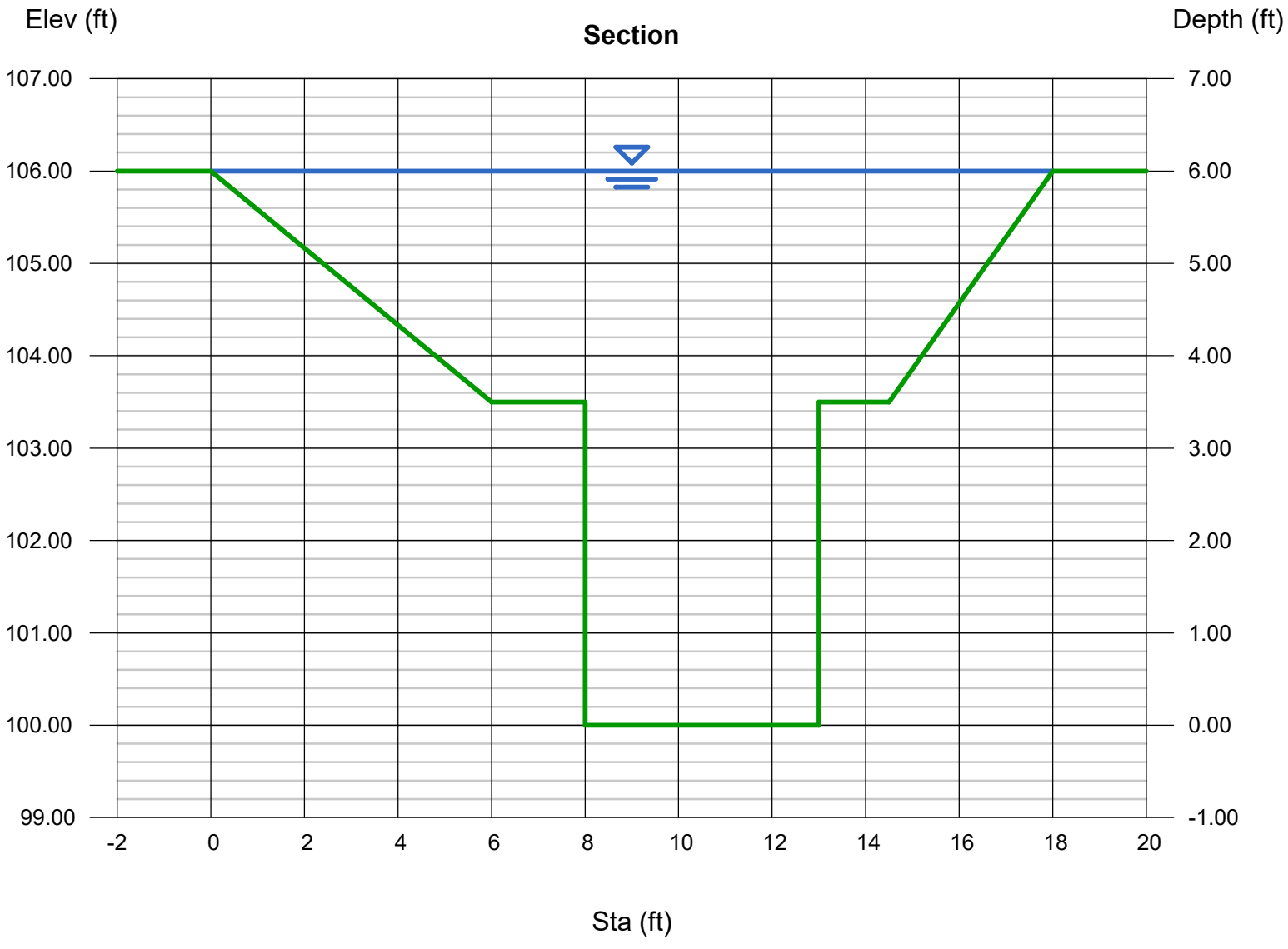
Compute by:	Q vs Depth
No. Increments	= 12

Highlighted

Depth (ft)	= 6.00
Q (cfs)	= 541.88
Area (sqft)	= 50.63
Velocity (ft/s)	= 10.70
Wetted Perim (ft)	= 26.30
Crit Depth, Yc (ft)	= 6.00
Top Width (ft)	= 18.00
EGL (ft)	= 7.78

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

(0.00, 106.00)-(6.00, 103.50, 0.024)-(8.00, 103.50, 0.017)-(8.00, 100.00, 0.017)-(13.00, 100.00, 0.017)-(13.00, 103.50, 0.017)-(14.50, 103.50, 0.024)
-(18.00, 106.00, 0.024)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 3 - Pedestrian Bridge

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.35
N-Value	= Composite

Calculations

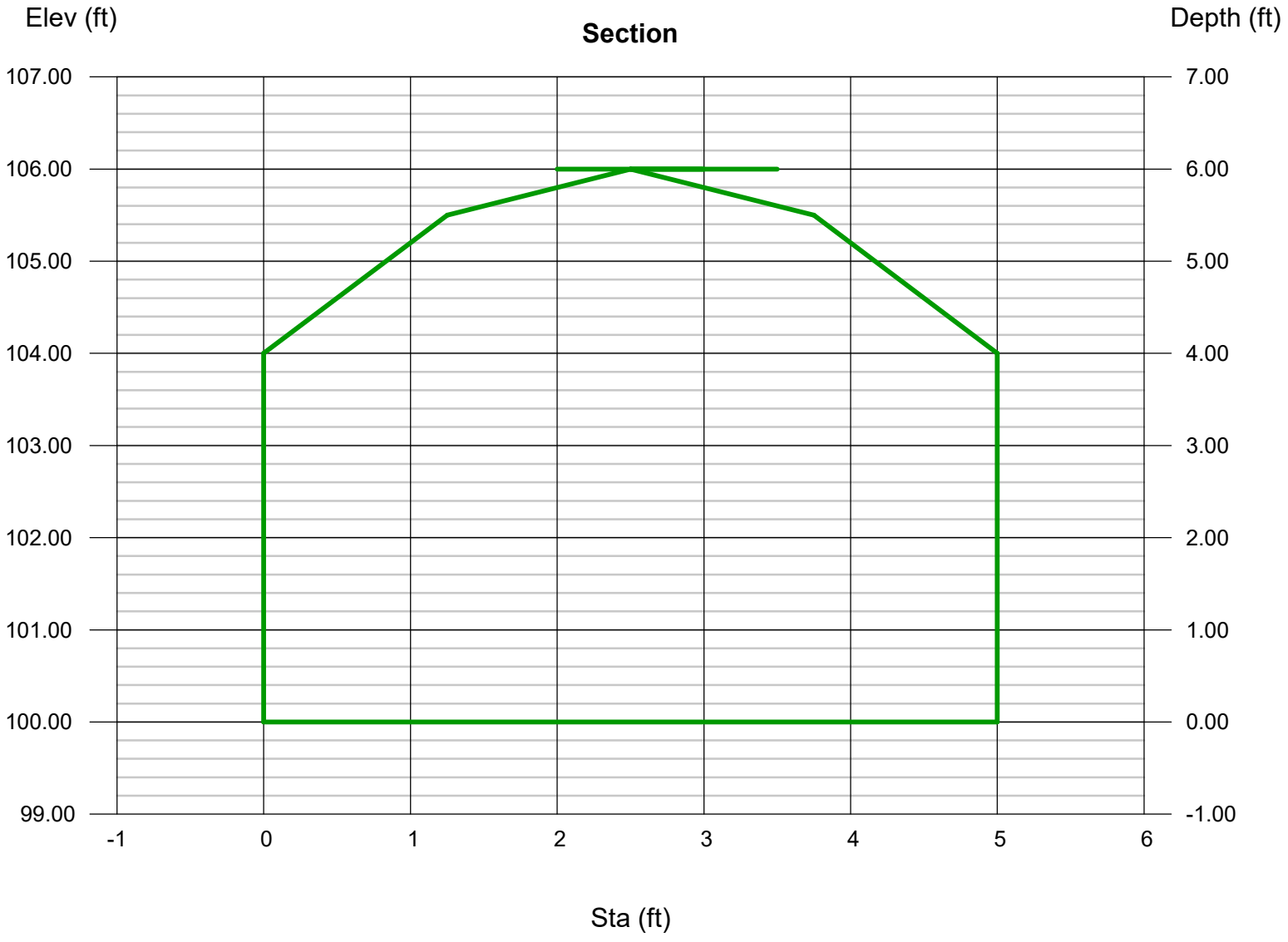
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 6.00
Q (cfs)	= 165.30
Area (sqft)	= 26.25
Velocity (ft/s)	= 6.30
Wetted Perim (ft)	= 19.60
Crit Depth, Yc (ft)	= 3.24
Top Width (ft)	= 0.00
EGL (ft)	= 6.62

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

(3.00, 106.00)-(2.50, 106.00, 0.017)-(1.25, 105.50, 0.017)-(5.00, 100.00, 0.017)-(5.00, 104.00, 0.017)-(3.75, 105.50, 0.017)-(2.50, 106.00, 0.017)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 28 2022

Section 4 - Aberdeen Bridge

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 1.52
N-Value	= Composite

Calculations

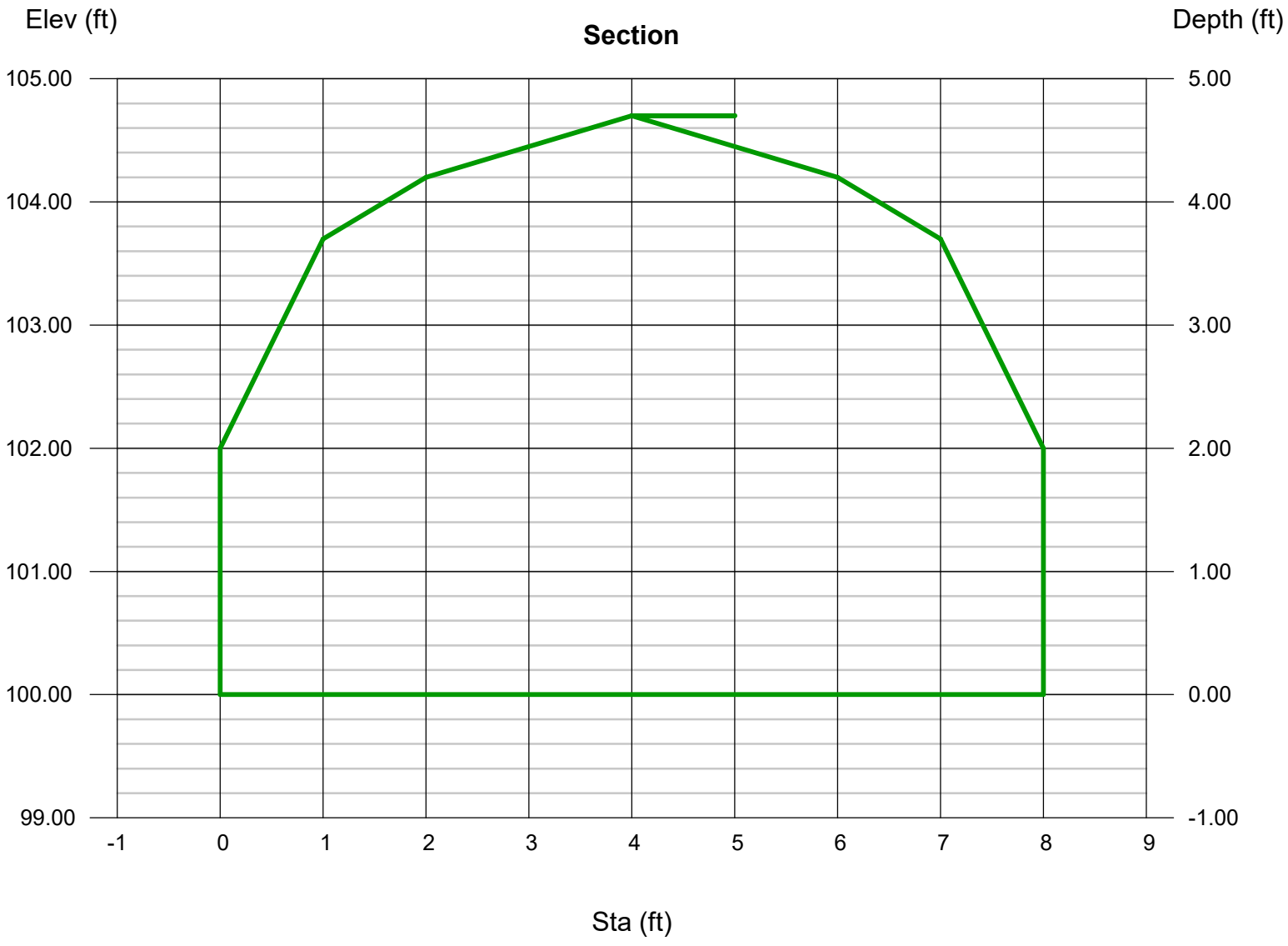
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.70
Q (cfs)	= 425.98
Area (sqft)	= 31.40
Velocity (ft/s)	= 13.57
Wetted Perim (ft)	= 22.30
Crit Depth, Yc (ft)	= 4.04
Top Width (ft)	= 0.00
EGL (ft)	= 7.56

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

(5.00, 104.70)-(4.00, 104.70, 0.017)-(2.00, 104.20, 0.017)-(1.00, 103.70, 0.017)-(8.00, 100.00, 0.017)-(8.00, 102.00, 0.017)-(7.00, 103.70, 0.017) -(6.00, 104.20, 0.017)-(4.00, 104.70, 0.017)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 28 2022

Section 5 - South Aberdeen Conduit

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.30
N-Value	= Composite

Calculations

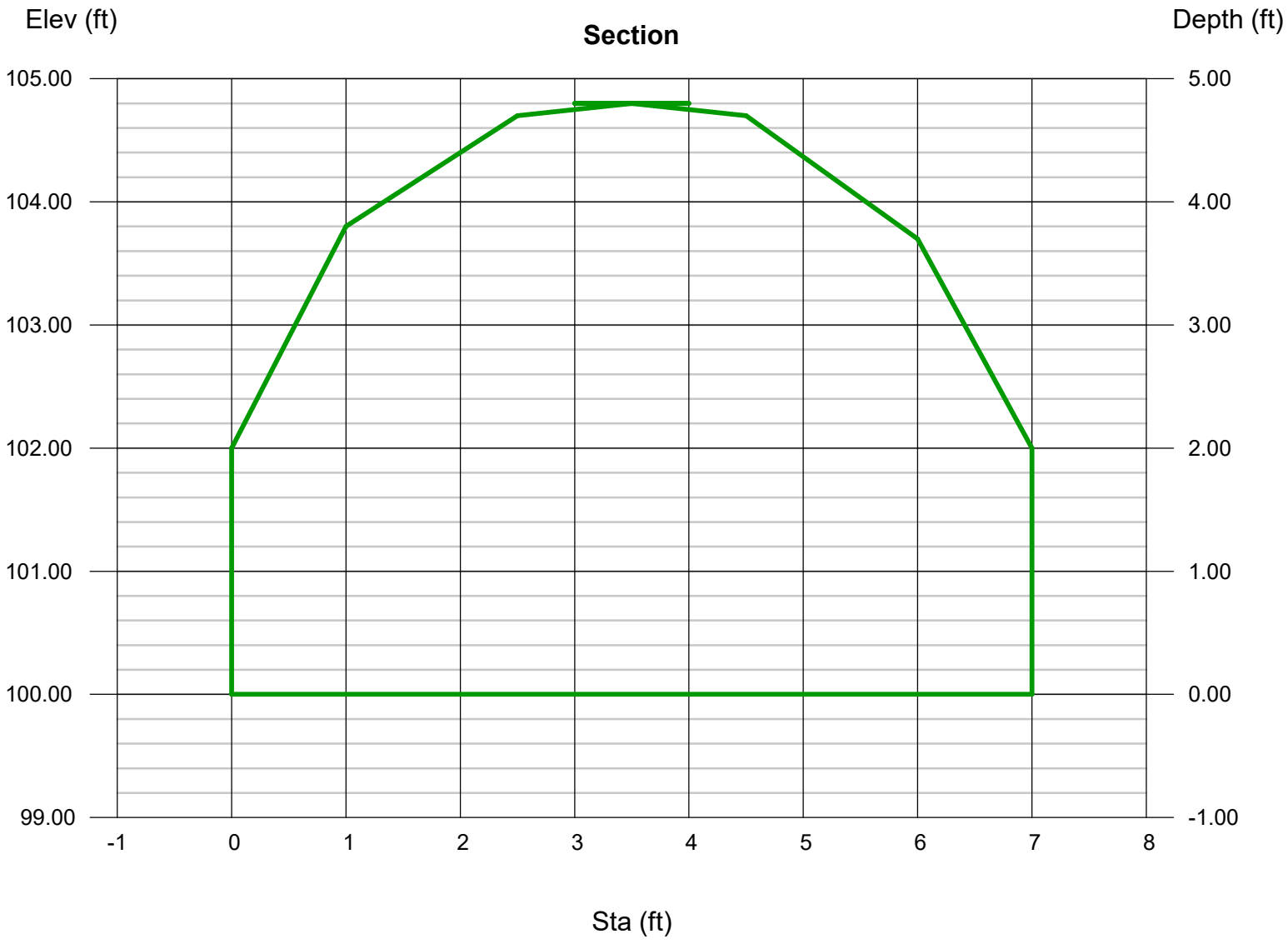
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.80
Q (cfs)	= 164.15
Area (sqft)	= 27.93
Velocity (ft/s)	= 5.88
Wetted Perim (ft)	= 20.59
Crit Depth, Yc (ft)	= 2.53
Top Width (ft)	= 0.00
EGL (ft)	= 5.34

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

(4.00, 104.80)-(3.50, 104.80, 0.017)-(2.50, 104.70, 0.017)-(1.00, 103.80, 0.017)-(7.00, 100.00, 0.017)-(7.00, 102.00, 0.017)-(6.00, 103.70, 0.017)
-(4.50, 104.70, 0.017)-(3.50, 104.80, 0.017)-(3.00, 104.80, 0.017)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 21 2022

Section 6 - Open Channel Before Pembroke Conduit

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 1.10
N-Value	= Composite

Calculations

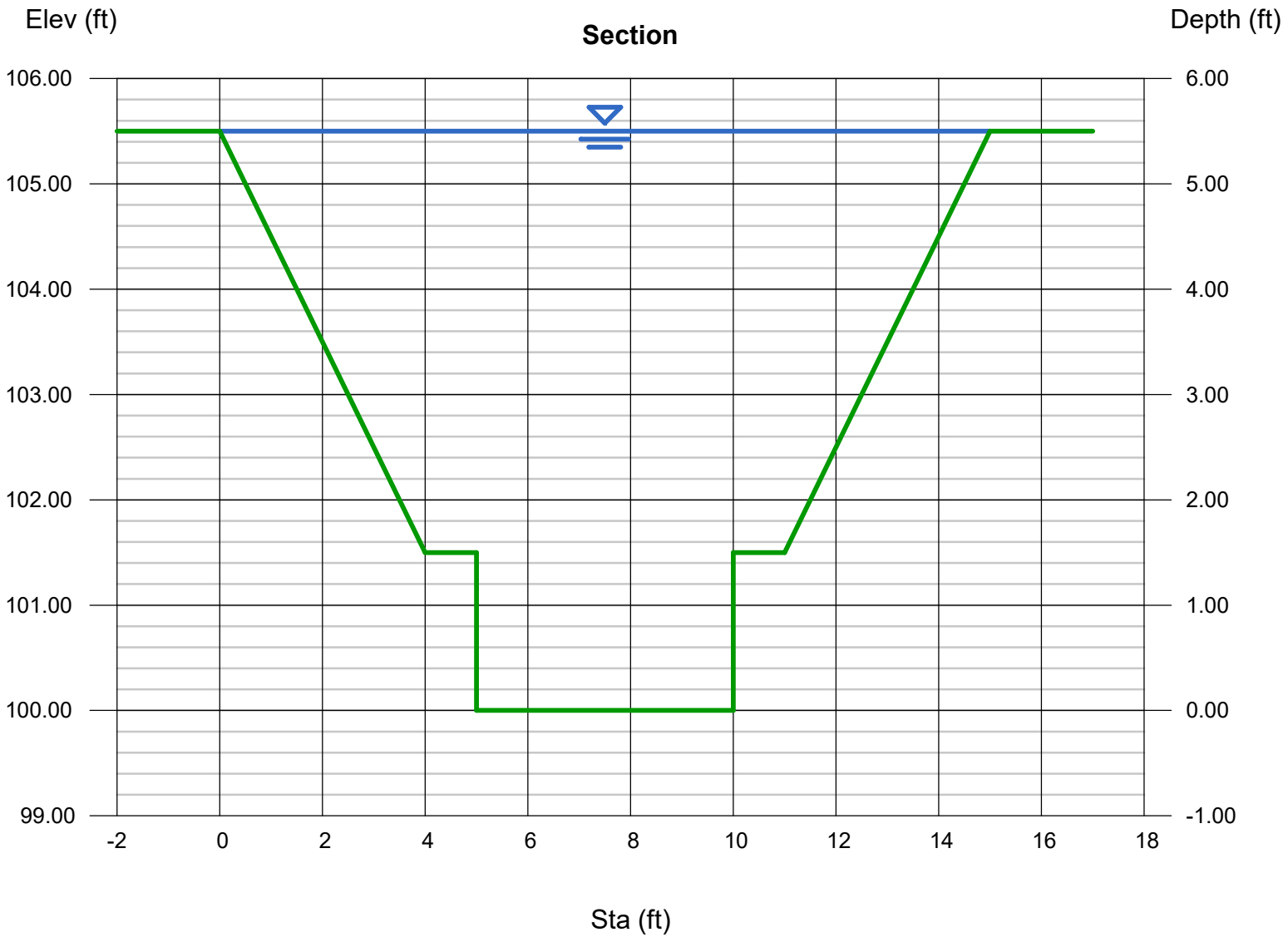
Compute by:	Q vs Depth
No. Increments	= 11

Highlighted

Depth (ft)	= 5.50
Q (cfs)	= 658.80
Area (sqft)	= 51.50
Velocity (ft/s)	= 12.79
Wetted Perim (ft)	= 21.31
Crit Depth, Yc (ft)	= 5.50
Top Width (ft)	= 15.00
EGL (ft)	= 8.04

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

(0.00, 105.50)-(4.00, 101.50, 0.024)-(5.00, 101.50, 0.024)-(5.00, 100.00, 0.017)-(10.00, 100.00, 0.017)-(10.00, 101.50, 0.024)-(11.00, 101.50, 0.024)-(15.00, 105.50, 0.024)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 28 2022

Section 7 - Pembroke Bridge

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.26
N-Value	= Composite

Calculations

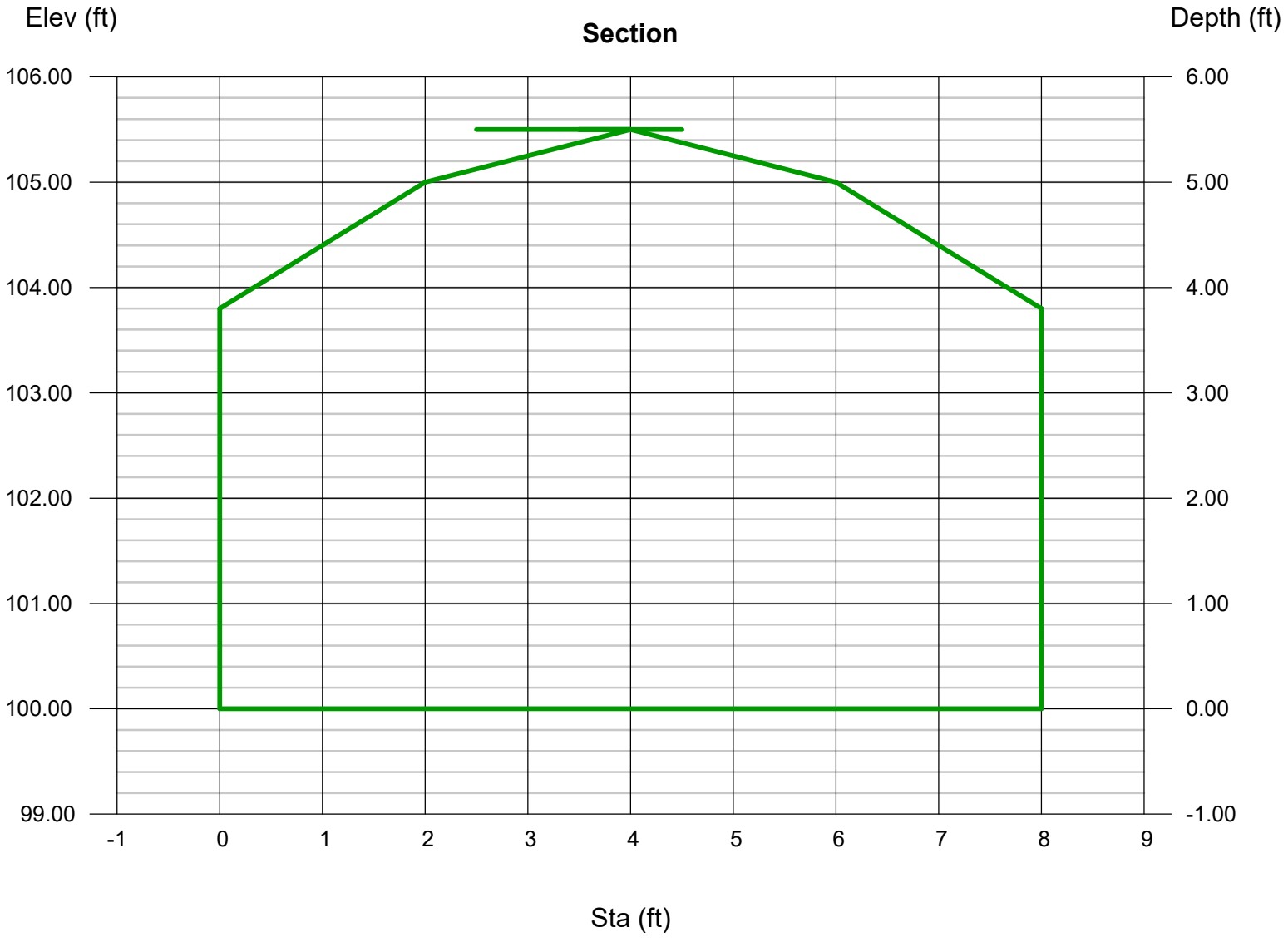
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 5.50
Q (cfs)	= 234.17
Area (sqft)	= 38.60
Velocity (ft/s)	= 6.07
Wetted Perim (ft)	= 24.39
Crit Depth, Yc (ft)	= 2.99
Top Width (ft)	= 0.00
EGL (ft)	= 6.07

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

(3.50, 105.50)-(4.00, 105.50, 0.017)-(2.00, 105.00, 0.017)-(8.00, 100.00, 0.017)-(8.00, 103.80, 0.017)-(6.00, 105.00, 0.017)-(4.00, 105.50, 0.017)
-(3.50, 105.50, 0.017)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 8 - Reach Between Pembroke Conduit and Meadowbrook Culvert

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.27
N-Value	= Composite

Calculations

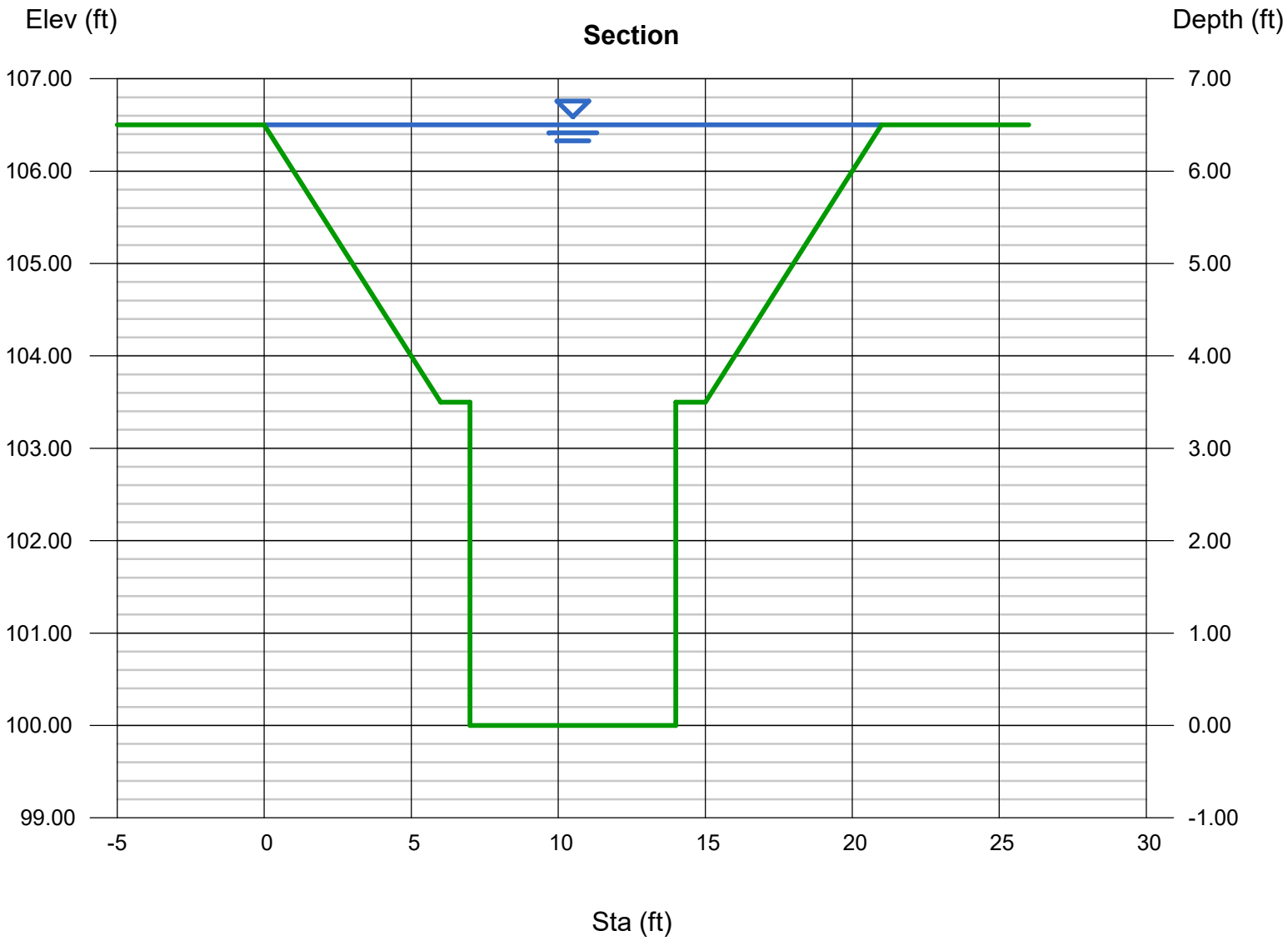
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 6.50
Q (cfs)	= 440.99
Area (sqft)	= 69.50
Velocity (ft/s)	= 6.35
Wetted Perim (ft)	= 29.42
Crit Depth, Yc (ft)	= 5.22
Top Width (ft)	= 21.00
EGL (ft)	= 7.13

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

(0.00, 106.50)-(6.00, 103.50, 0.024)-(7.00, 103.50, 0.024)-(7.00, 100.00, 0.017)-(14.00, 100.00, 0.017)-(14.00, 103.50, 0.024)-(15.00, 103.50, 0.024)
-(21.00, 106.50, 0.024)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 28 2022

Section 9 - Meadowbrook Bridge

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.27
N-Value	= Composite

Calculations

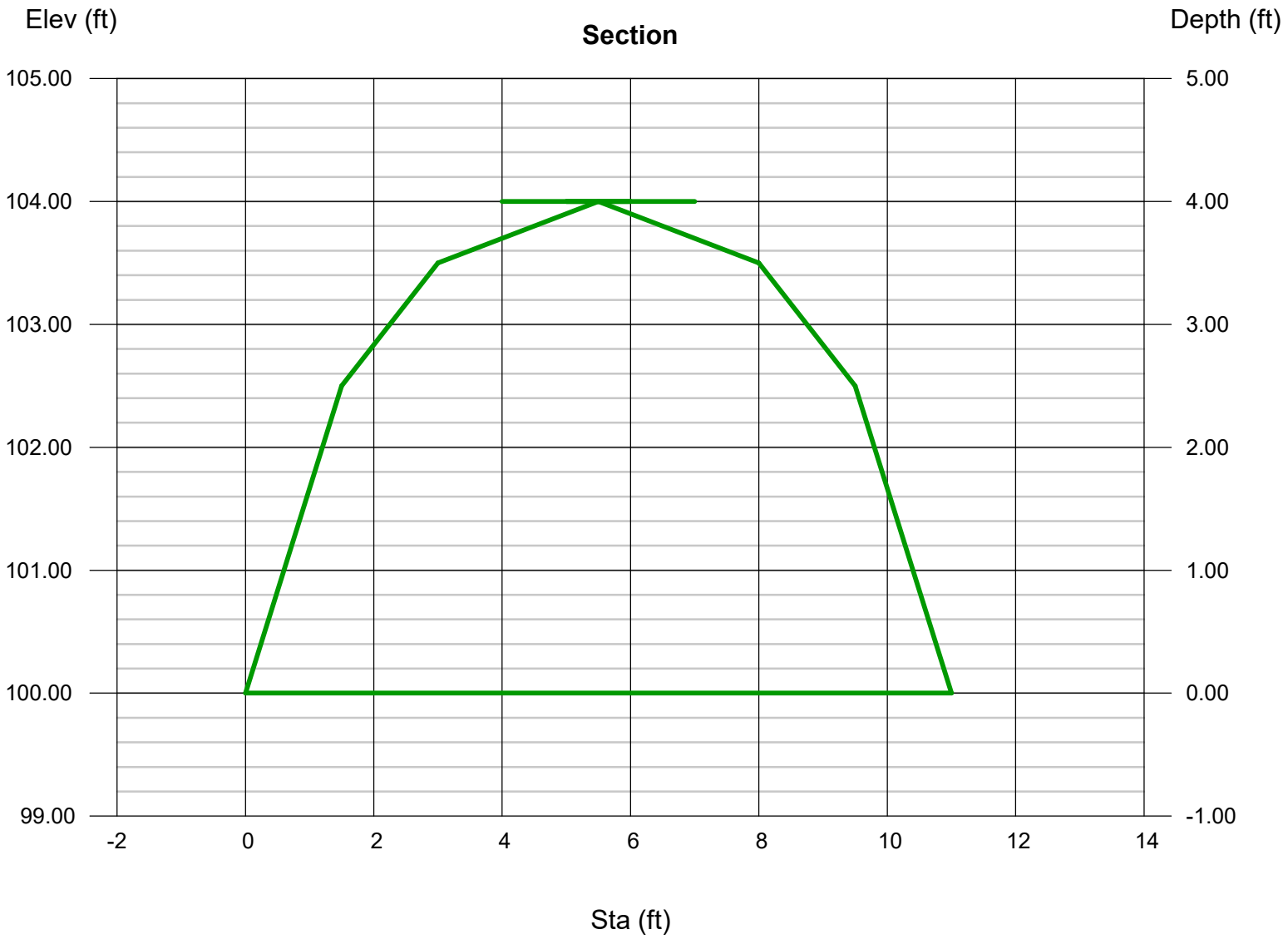
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.00
Q (cfs)	= 164.91
Area (sqft)	= 31.50
Velocity (ft/s)	= 5.24
Wetted Perim (ft)	= 25.54
Crit Depth, Yc (ft)	= 1.98
Top Width (ft)	= 0.00
EGL (ft)	= 4.43

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

(6.00, 104.00)-(5.50, 104.00, 0.017)-(3.00, 103.50, 0.017)-(1.50, 102.50, 0.017)-(11.00, 100.00, 0.017)-(9.50, 102.50, 0.017)-(8.00, 103.50, 0.017) -(5.50, 104.00, 0.017)-(5.00, 104.00, 0.017)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 10

Trapezoidal

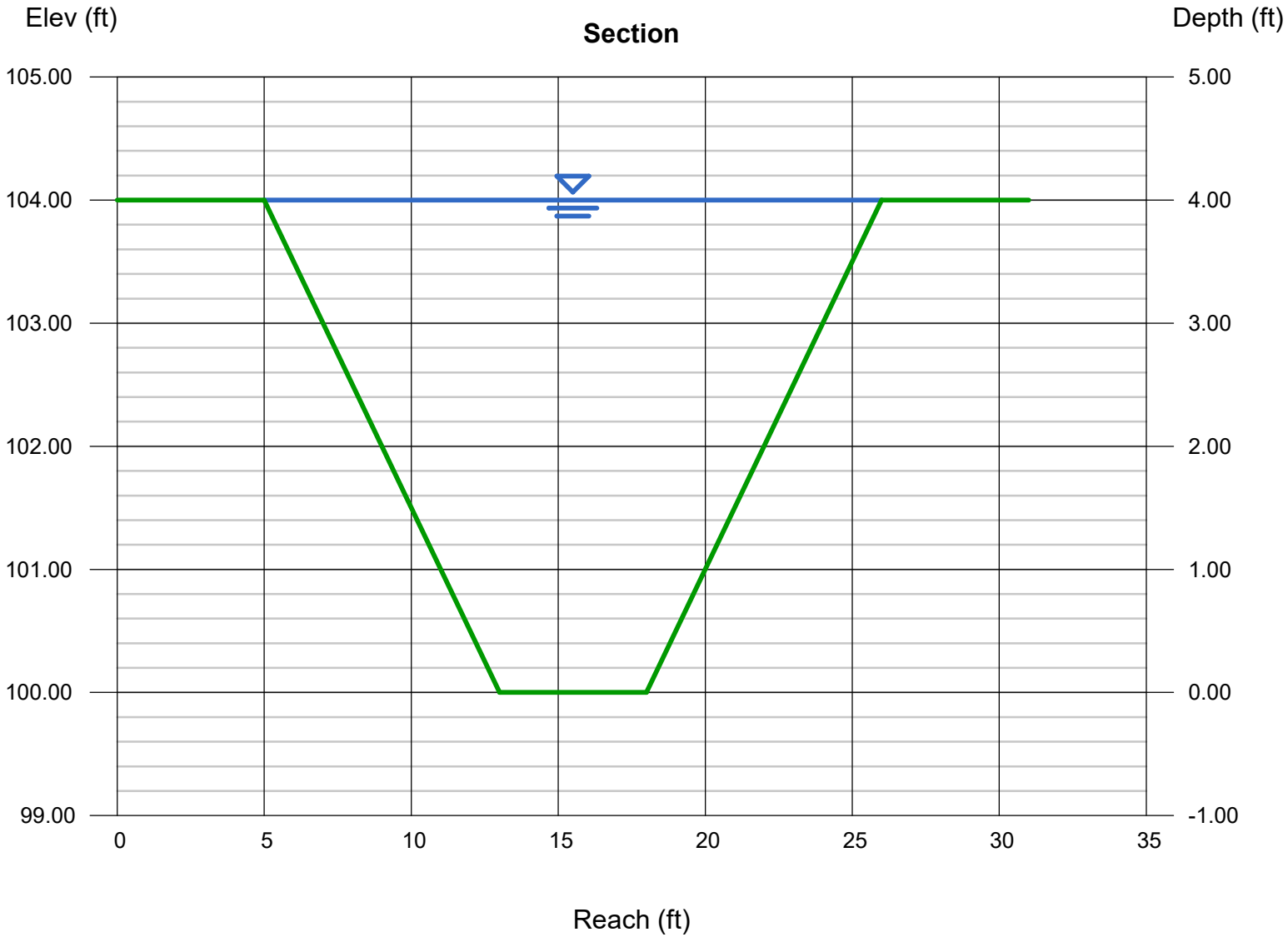
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.99
N-Value	= 0.024

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.00
Q (cfs)	= 553.78
Area (sqft)	= 52.00
Velocity (ft/s)	= 10.65
Wetted Perim (ft)	= 22.89
Crit Depth, Yc (ft)	= 4.00
Top Width (ft)	= 21.00
EGL (ft)	= 5.76



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 11 - Southern Reach Between Meadowbrook Avenue and Orchard Way

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.99
N-Value	= Composite

Calculations

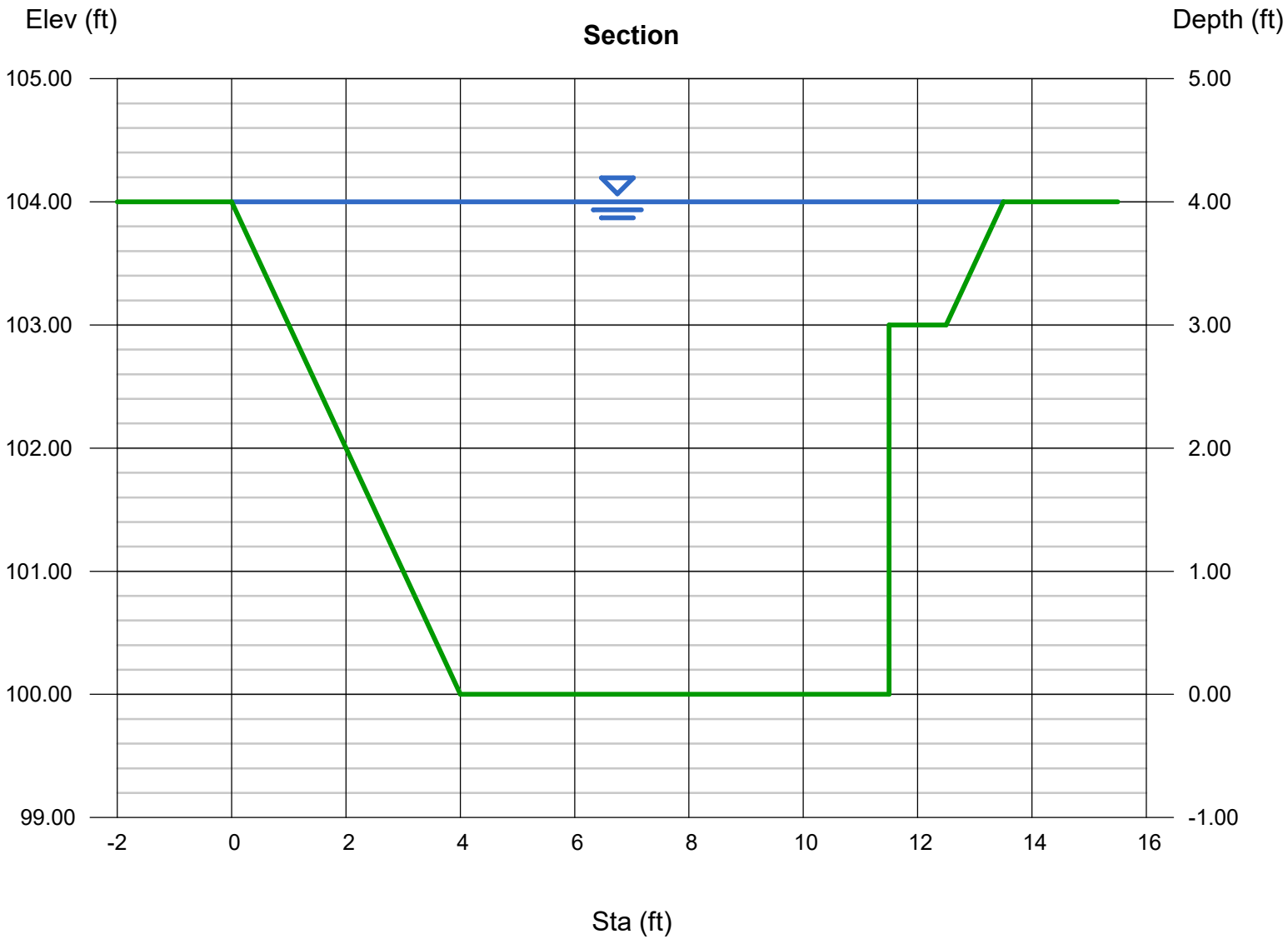
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.00
Q (cfs)	= 428.56
Area (sqft)	= 39.50
Velocity (ft/s)	= 10.85
Wetted Perim (ft)	= 18.57
Crit Depth, Yc (ft)	= 4.00
Top Width (ft)	= 13.50
EGL (ft)	= 5.83

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

(0.00, 104.00)-(4.00, 100.00, 0.024)-(11.50, 100.00, 0.024)-(11.50, 103.00, 0.017)-(12.50, 103.00, 0.017)-(13.50, 104.00, 0.024)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Apr 28 2022

Section 12 - Orchard Bridge

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 0.92
N-Value	= Composite

Calculations

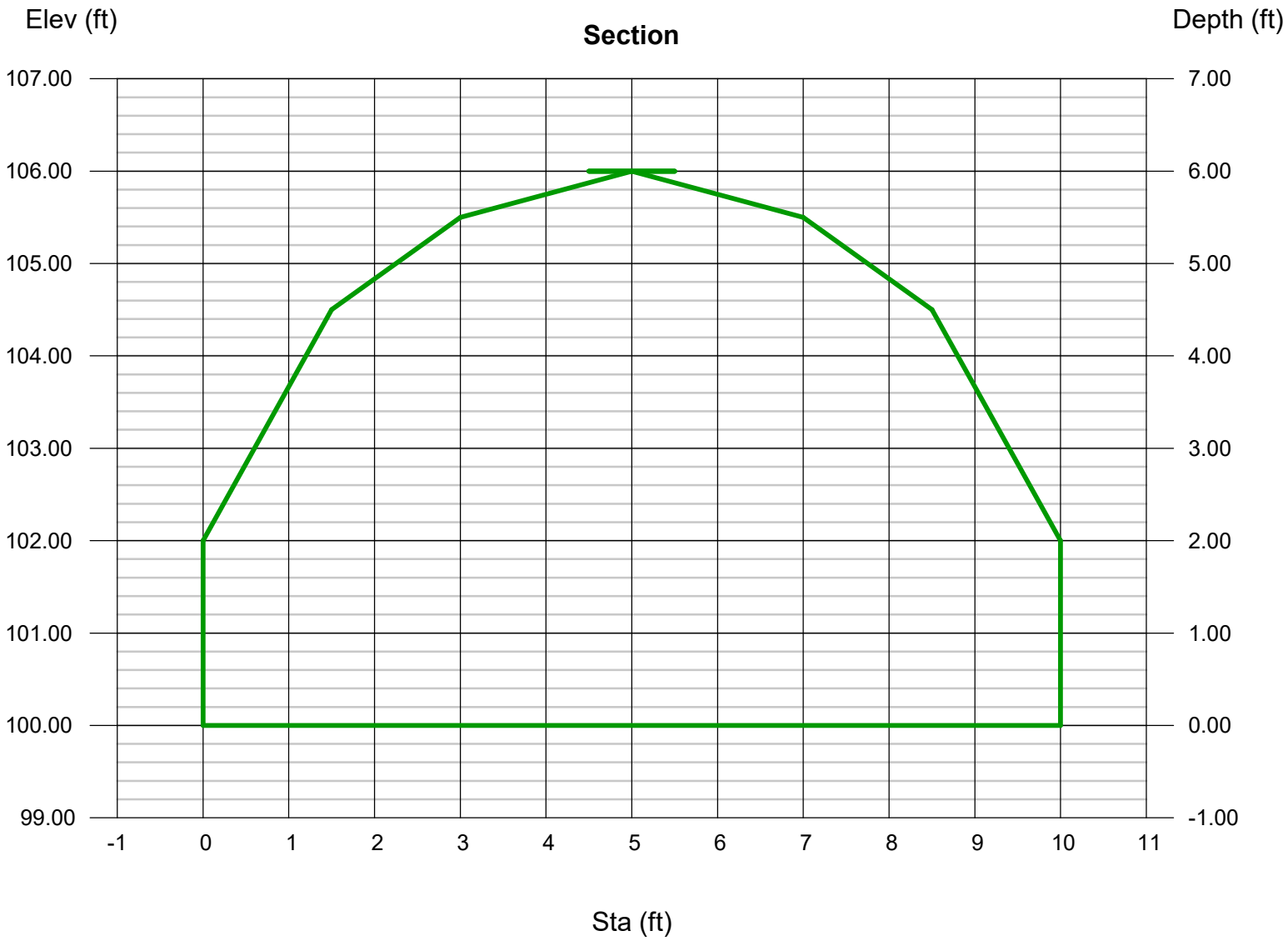
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 6.00
Q (cfs)	= 578.81
Area (sqft)	= 47.75
Velocity (ft/s)	= 12.12
Wetted Perim (ft)	= 27.56
Crit Depth, Yc (ft)	= 4.55
Top Width (ft)	= 0.00
EGL (ft)	= 8.28

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

(5.50, 106.00)-(5.00, 106.00, 0.017)-(3.00, 105.50, 0.017)-(1.50, 104.50, 0.017)-(10.00, 100.00, 0.017)-(10.00, 102.00, 0.017)-(8.50, 104.50, 0.017)
-(7.00, 105.50, 0.017)-(5.00, 106.00, 0.017)-(4.50, 106.00, 0.017)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 13 - Reach Between Orchard Way and Iven Avenue

Trapezoidal

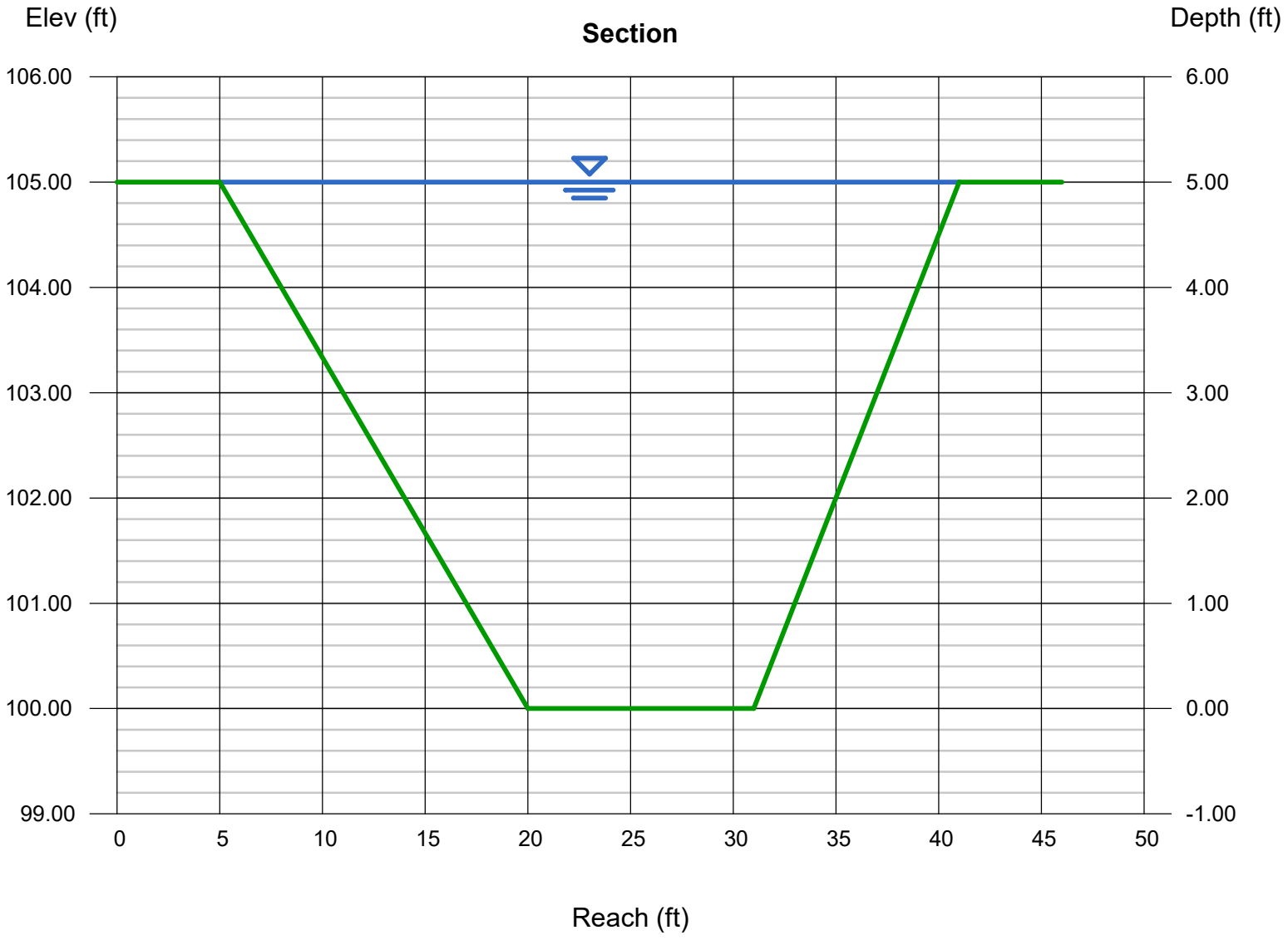
Bottom Width (ft)	= 11.00
Side Slopes (z:1)	= 3.00, 2.00
Total Depth (ft)	= 5.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.62
N-Value	= 0.024

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 5.00
Q (cfs)	= 1,216
Area (sqft)	= 117.50
Velocity (ft/s)	= 10.35
Wetted Perim (ft)	= 37.99
Crit Depth, Yc (ft)	= 5.00
Top Width (ft)	= 36.00
EGL (ft)	= 6.67



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 26 2022

Section 14 - Iven Bridge

User-defined

Invert Elev (ft)	= 100.00
Slope (%)	= 1.10
N-Value	= Composite

Calculations

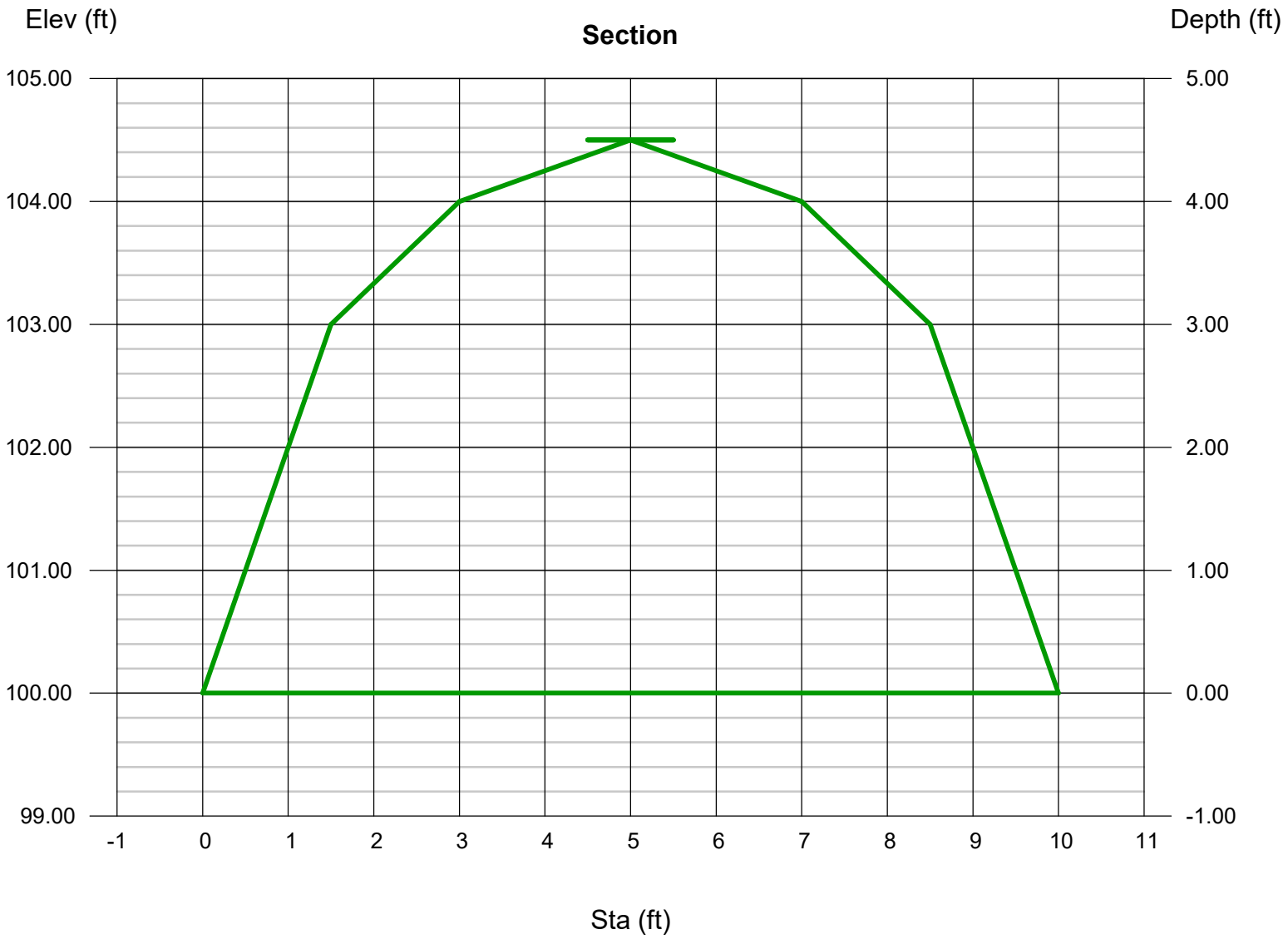
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.50
Q (cfs)	= 351.89
Area (sqft)	= 32.00
Velocity (ft/s)	= 11.00
Wetted Perim (ft)	= 24.44
Crit Depth, Yc (ft)	= 3.41
Top Width (ft)	= 0.00
EGL (ft)	= 6.38

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

(5.50, 104.50)-(5.00, 104.50, 0.017)-(3.00, 104.00, 0.017)-(1.50, 103.00, 0.017)-(10.00, 100.00, 0.017)-(8.50, 103.00, 0.017)-(7.00, 104.00, 0.017)
-(5.00, 104.50, 0.017)-(4.50, 104.50, 0.017)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 1 2022

Section 15 - Township Entrance Bridge 72x96 ECP

User-defined

Invert Elev (ft)	= 97.00
Slope (%)	= 1.00
N-Value	= Composite

Calculations

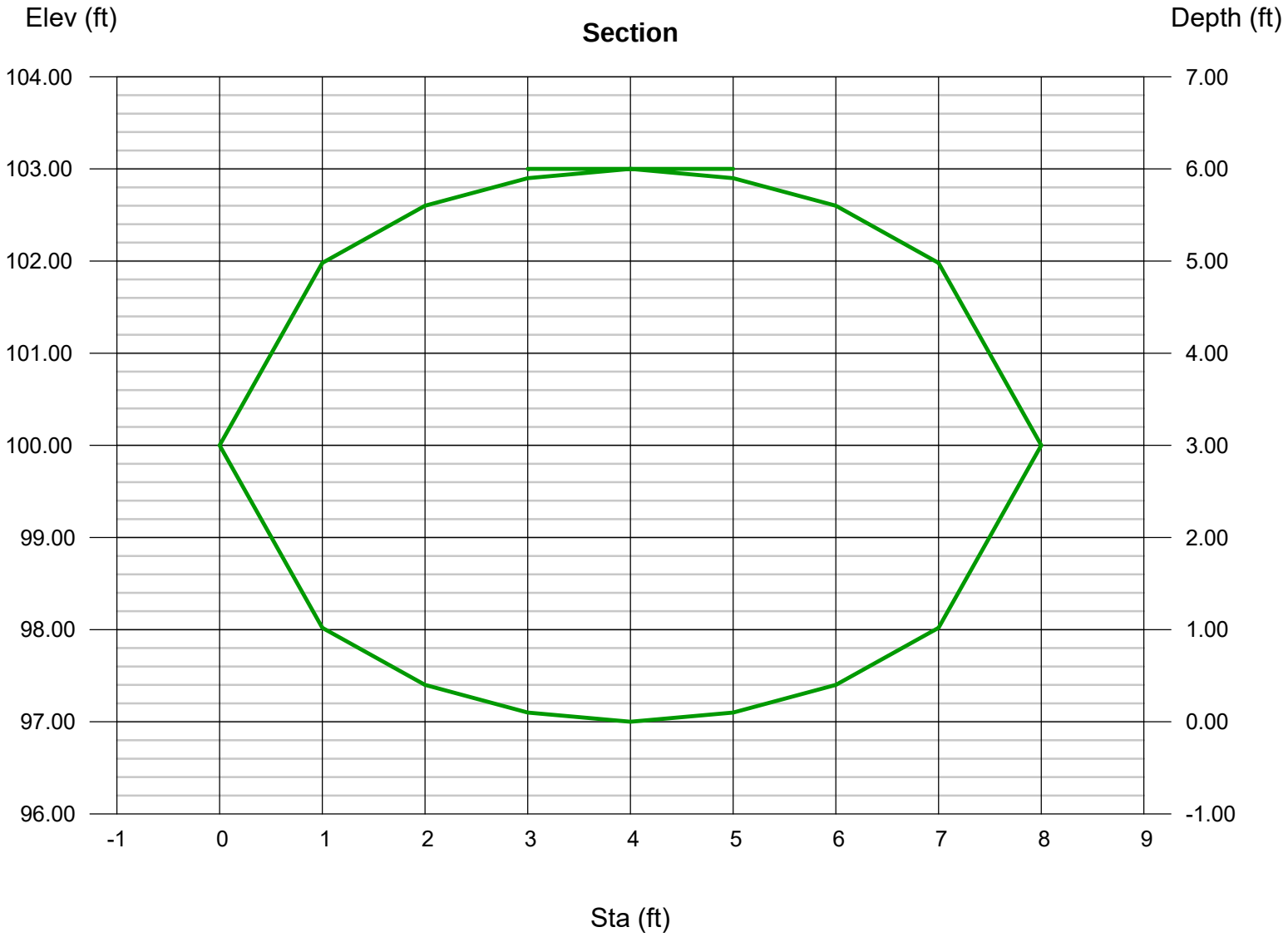
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 6.00
Q (cfs)	= 393.05
Area (sqft)	= 35.92
Velocity (ft/s)	= 10.94
Wetted Perim (ft)	= 21.78
Crit Depth, Yc (ft)	= 4.84
Top Width (ft)	= 0.00
EGL (ft)	= 7.86

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

(4.00, 103.00)-(3.00, 102.90, 0.019)-(2.00, 102.60, 0.019)-(1.00, 101.98, 0.019)-(1.00, 98.02, 0.019)-(2.00, 97.40, 0.019)-(3.00, 97.10, 0.019)
-(4.00, 97.00, 0.019)-(5.00, 97.10, 0.019)-(6.00, 97.40, 0.019)-(7.00, 98.02, 0.019)-(8.00, 100.00, 0.019)-(7.00, 101.98, 0.019)-(6.00, 102.60, 0.019)
-(5.00, 102.90, 0.019)-(4.00, 103.00, 0.019)



PROPOSED SECTIONS

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 1 (Equivalent Circular Pipe) - Elliptical Proposed

Circular

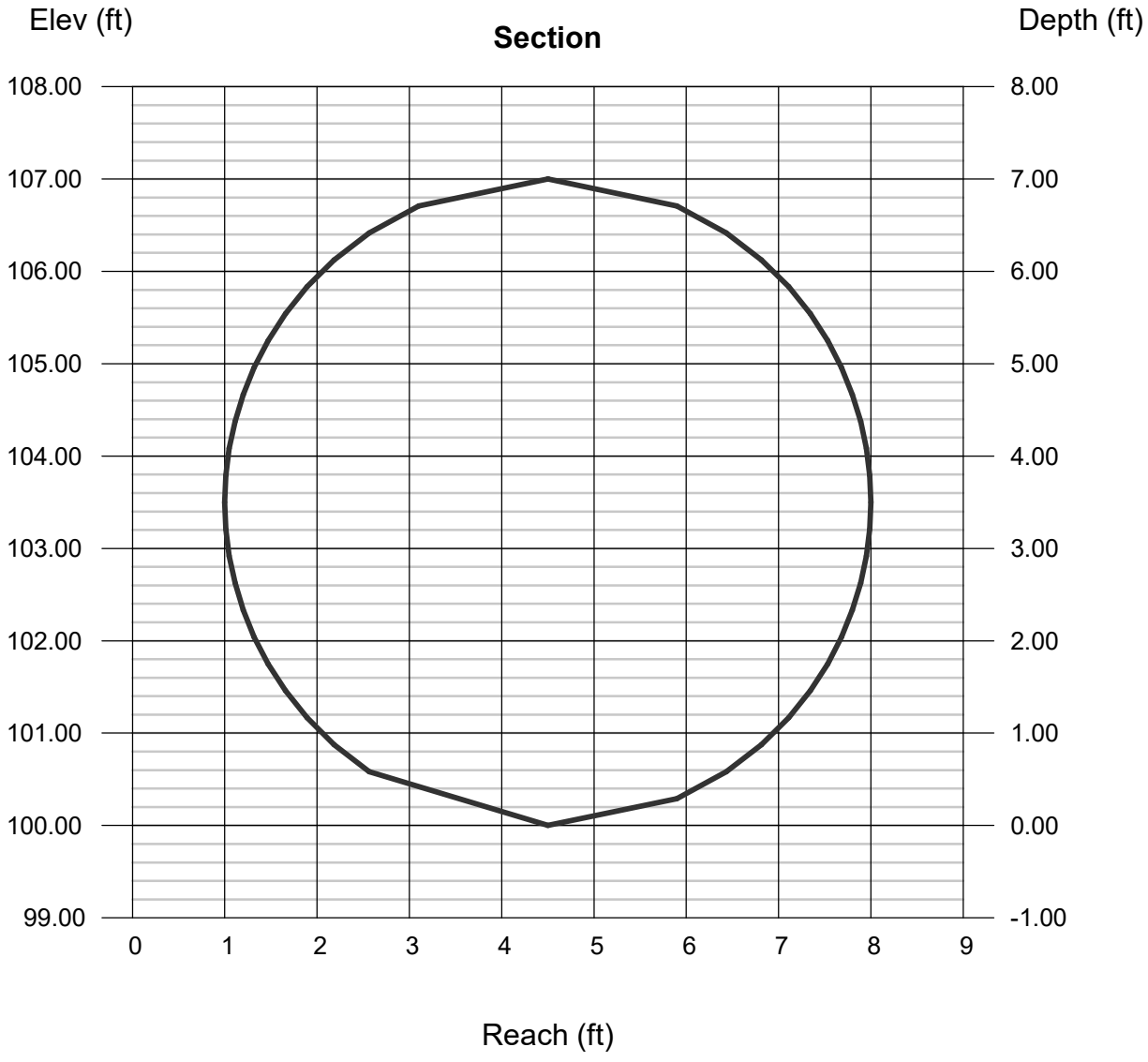
Diameter (ft)	= 7.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.80
N-Value	= 0.017

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 7.00
Q (cfs)	= 437.03
Area (sqft)	= 38.48
Velocity (ft/s)	= 11.36
Wetted Perim (ft)	= 21.99
Crit Depth, Yc (ft)	= 5.49
Top Width (ft)	= 0.00
EGL (ft)	= 9.00



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 22 2022

Section 2 & 3 Proposed

Rectangular

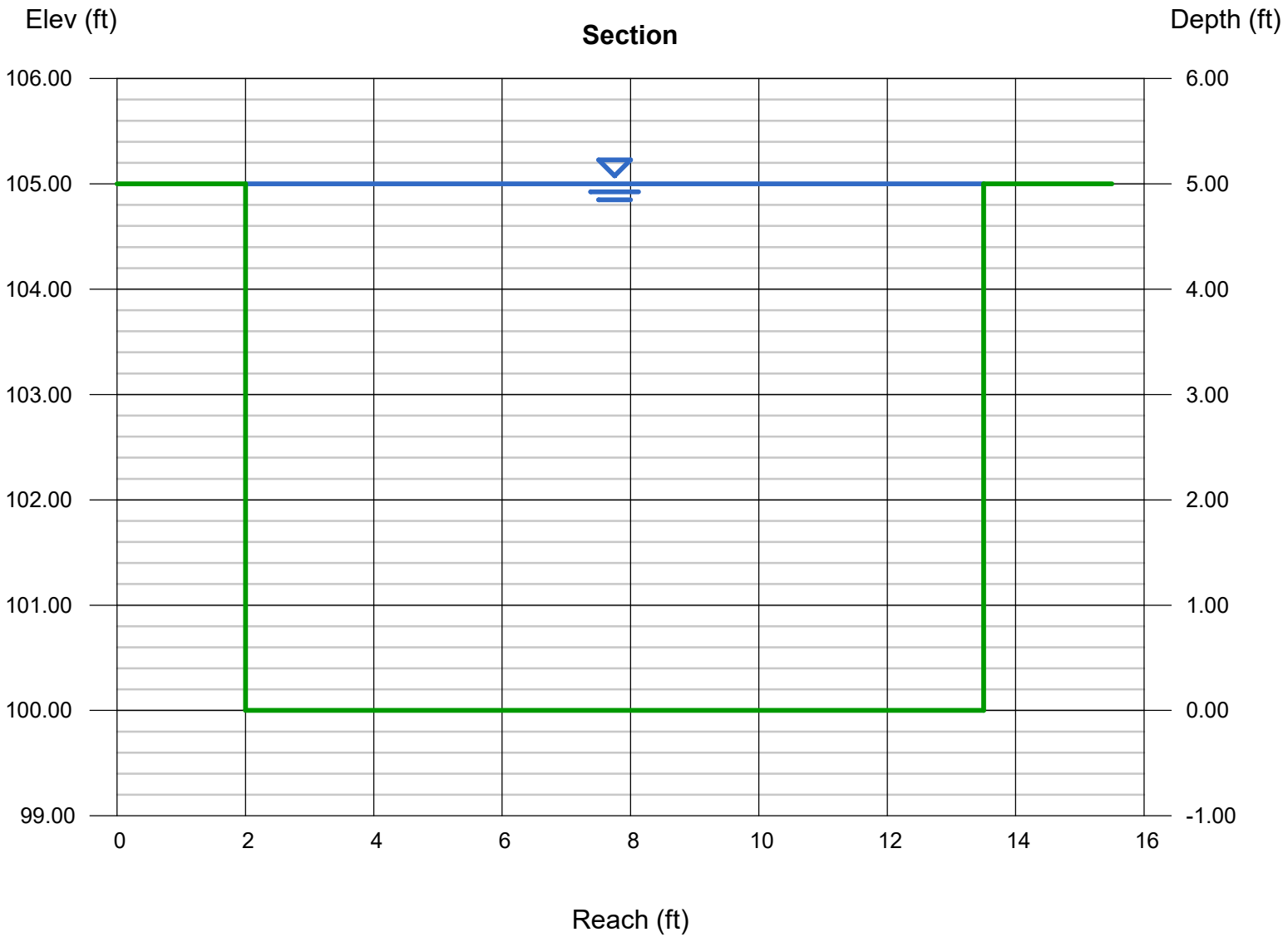
Bottom Width (ft)	= 11.50
Total Depth (ft)	= 5.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.90
N-Value	= 0.024

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 5.00
Q (cfs)	= 650.97
Area (sqft)	= 57.50
Velocity (ft/s)	= 11.32
Wetted Perim (ft)	= 21.50
Crit Depth, Yc (ft)	= 4.64
Top Width (ft)	= 11.50
EGL (ft)	= 6.99



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 4 Proposed

Rectangular

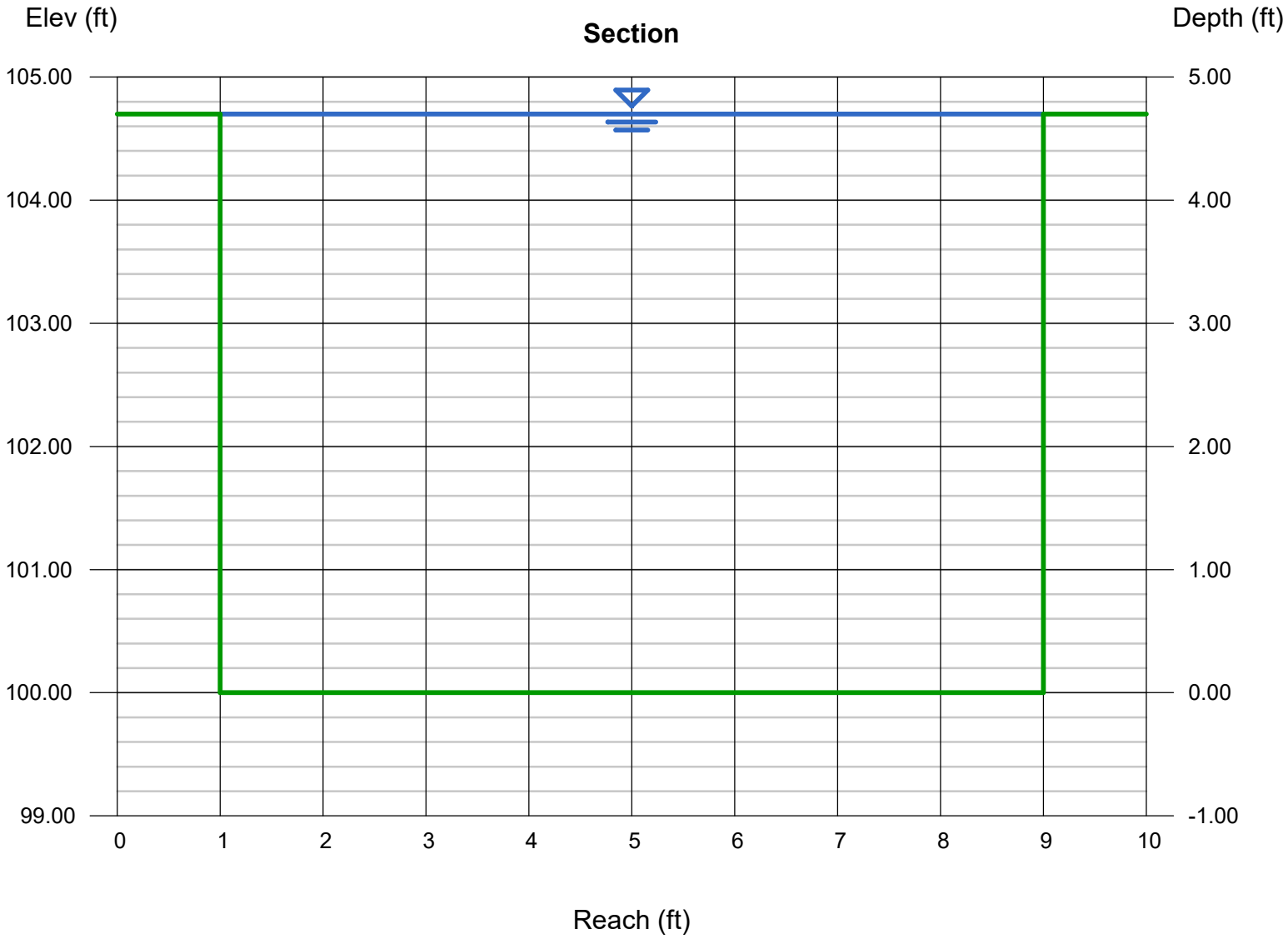
Bottom Width (ft)	= 8.00
Total Depth (ft)	= 4.70
Invert Elev (ft)	= 100.00
Slope (%)	= 1.52
N-Value	= 0.017

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.70
Q (cfs)	= 677.46
Area (sqft)	= 37.60
Velocity (ft/s)	= 18.02
Wetted Perim (ft)	= 17.40
Crit Depth, Yc (ft)	= 4.70
Top Width (ft)	= 8.00
EGL (ft)	= 9.75



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 5 Proposed

Trapezoidal

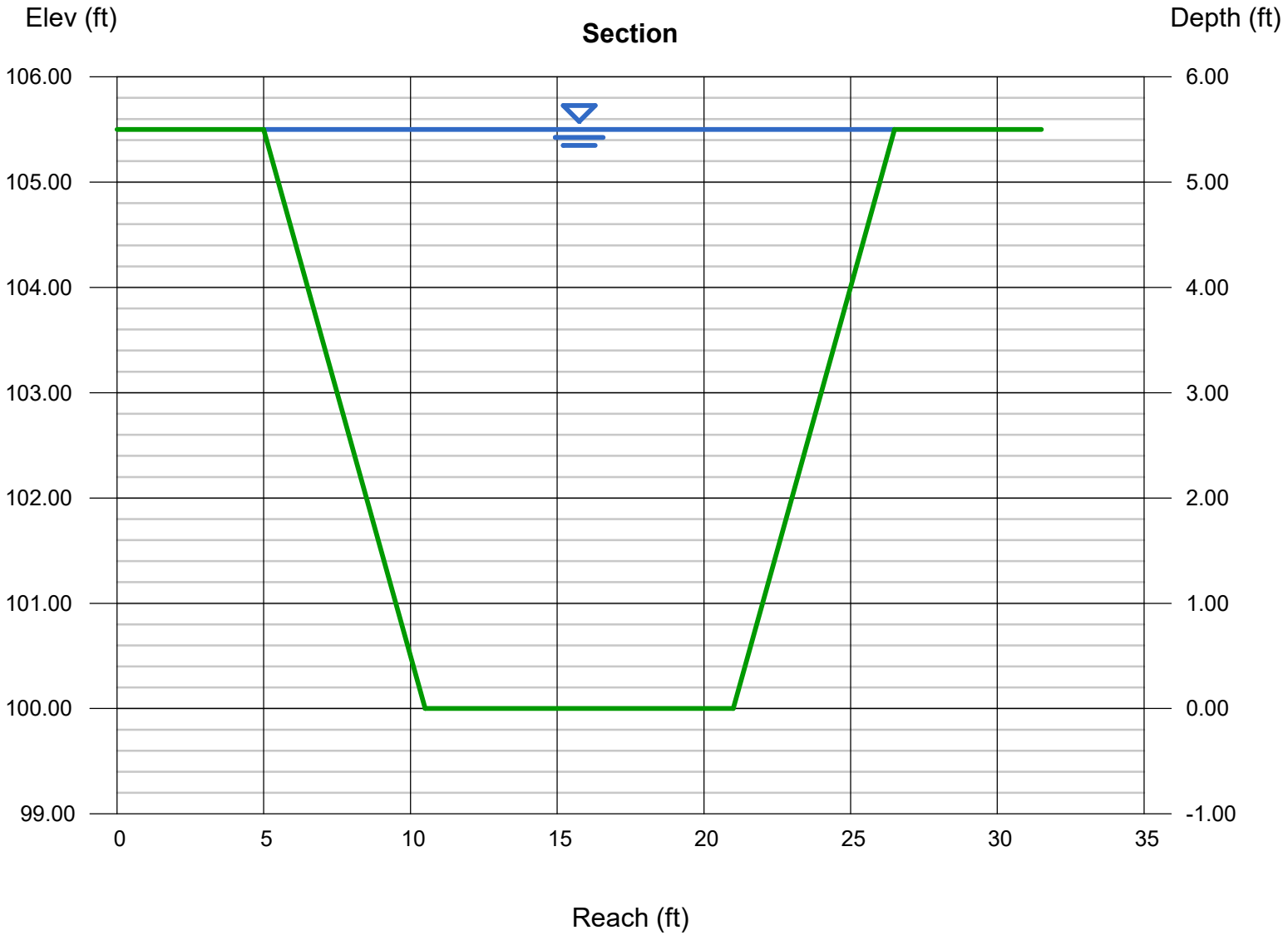
Bottom Width (ft)	= 10.50
Side Slopes (z:1)	= 1.00, 1.00
Total Depth (ft)	= 5.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.30
N-Value	= 0.024

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 5.50
Q (cfs)	= 672.06
Area (sqft)	= 88.00
Velocity (ft/s)	= 7.64
Wetted Perim (ft)	= 26.06
Crit Depth, Yc (ft)	= 4.36
Top Width (ft)	= 21.50
EGL (ft)	= 6.41



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 22 2022

Section 7 Proposed

Rectangular

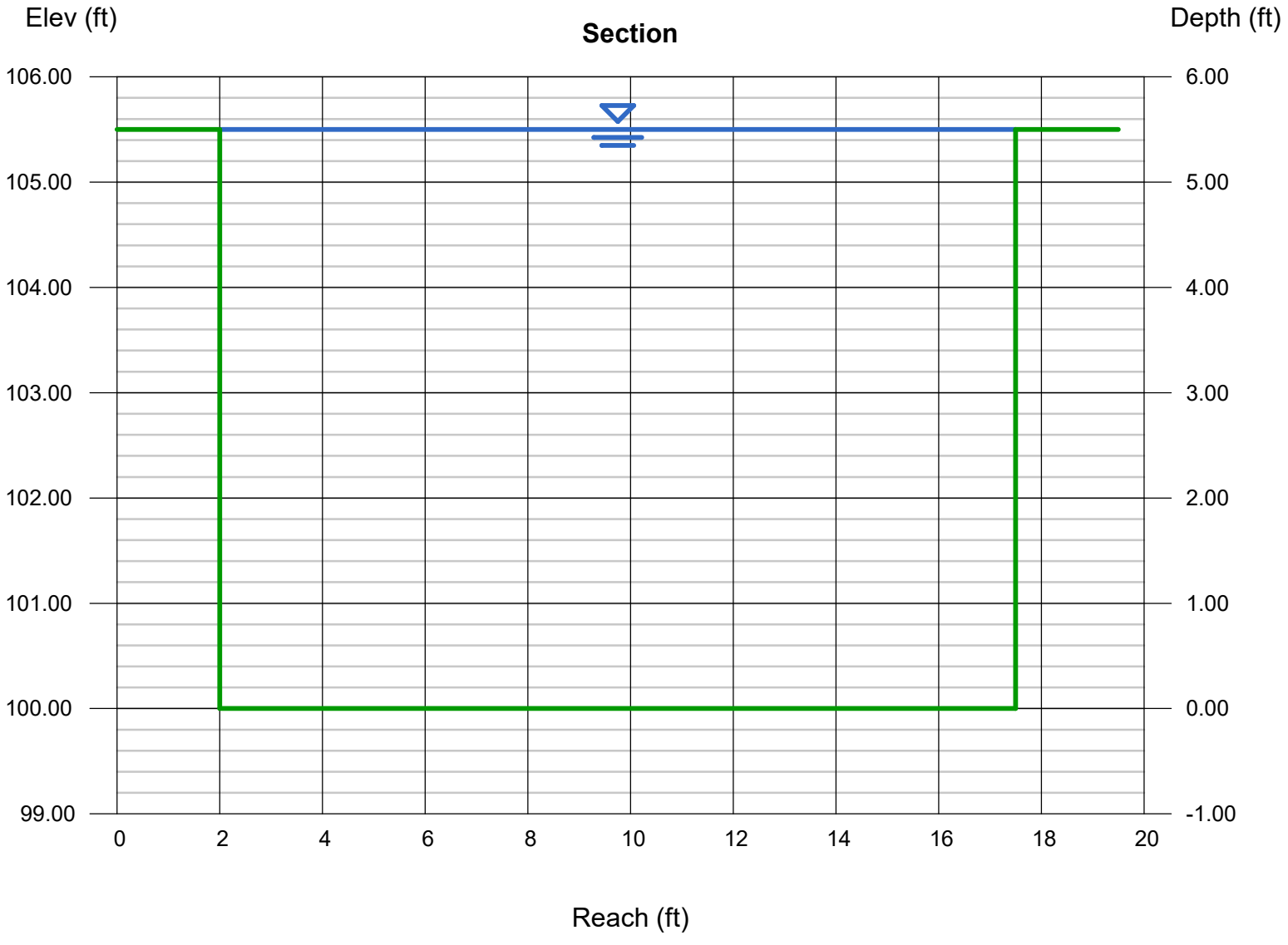
Bottom Width (ft)	= 15.50
Total Depth (ft)	= 5.50
Invert Elev (ft)	= 100.00
Slope (%)	= 0.26
N-Value	= 0.017

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 5.50
Q (cfs)	= 828.36
Area (sqft)	= 85.25
Velocity (ft/s)	= 9.72
Wetted Perim (ft)	= 26.50
Crit Depth, Yc (ft)	= 4.47
Top Width (ft)	= 15.50
EGL (ft)	= 6.97



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 22 2022

Section 8 Proposed

Trapezoidal

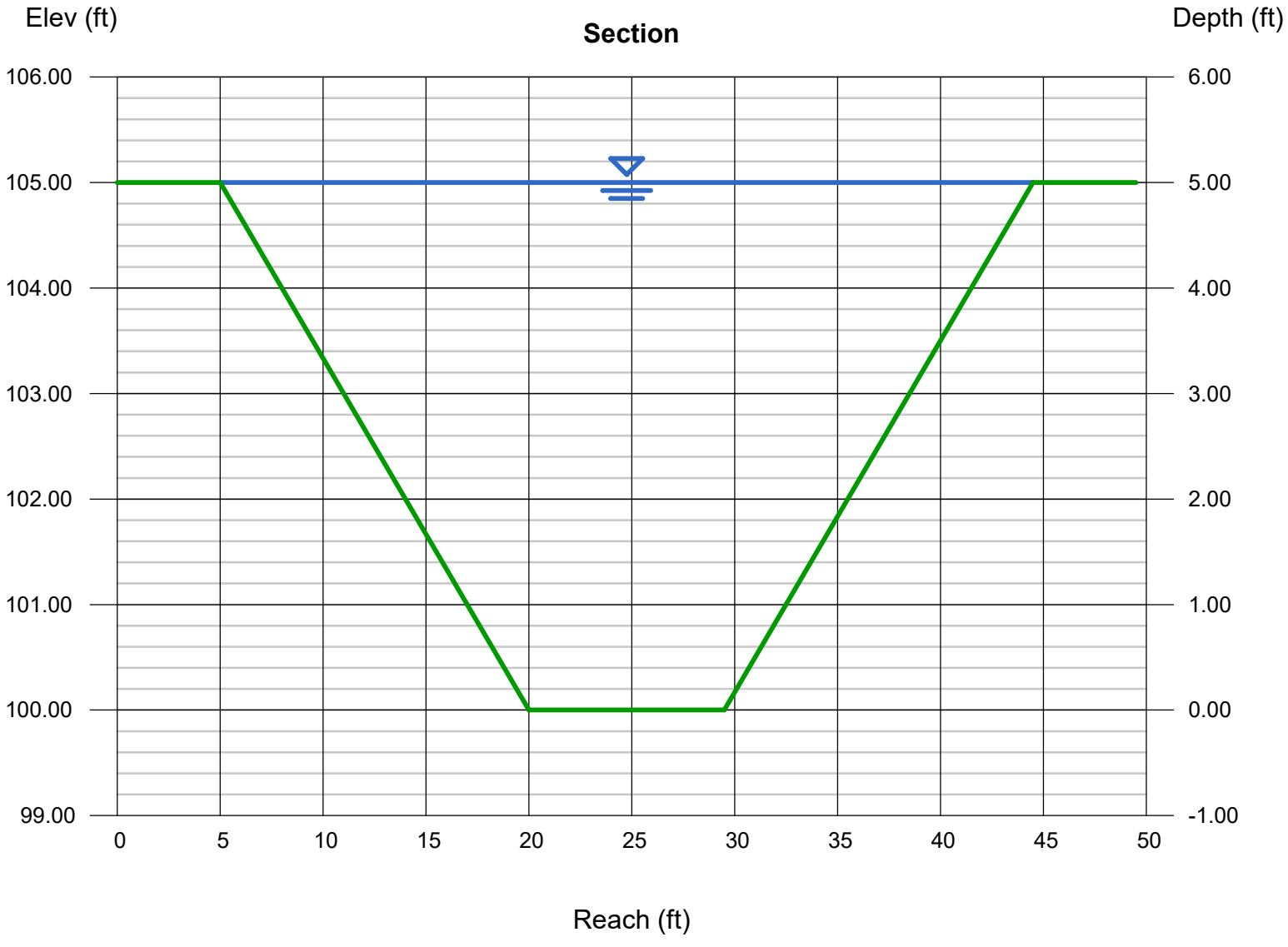
Bottom Width (ft)	= 9.50
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 5.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.27
N-Value	= 0.024

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 5.00
Q (cfs)	= 816.24
Area (sqft)	= 122.50
Velocity (ft/s)	= 6.66
Wetted Perim (ft)	= 41.12
Crit Depth, Yc (ft)	= 4.09
Top Width (ft)	= 39.50
EGL (ft)	= 5.69



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 22 2022

Section 9 Proposed

Rectangular

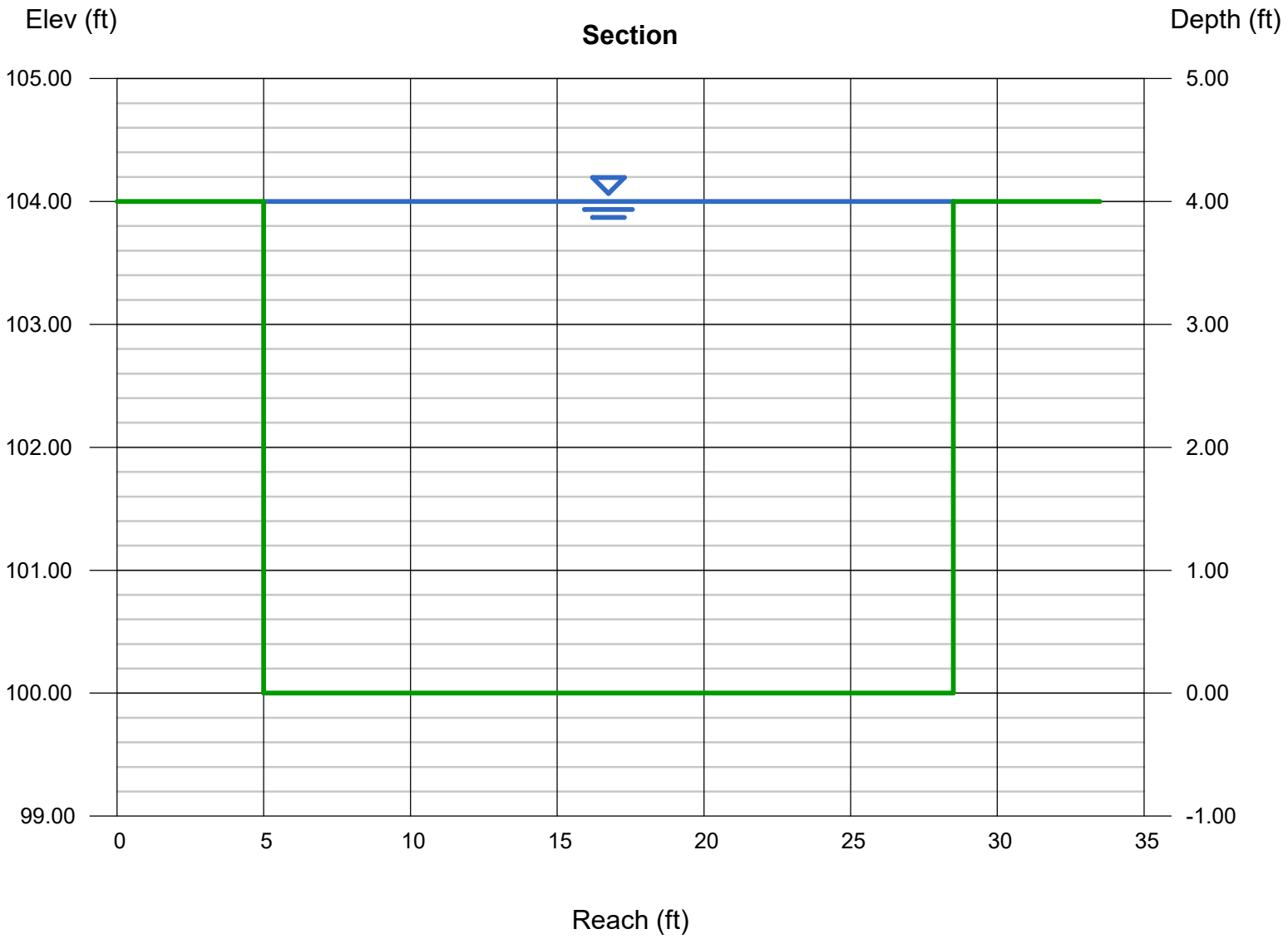
Bottom Width (ft)	= 23.50
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.27
N-Value	= 0.017

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 4.00
Q (cfs)	= 885.28
Area (sqft)	= 94.00
Velocity (ft/s)	= 9.42
Wetted Perim (ft)	= 31.50
Crit Depth, Yc (ft)	= 3.54
Top Width (ft)	= 23.50
EGL (ft)	= 5.38



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Apr 22 2022

Section 10 & 11 Proposed

Trapezoidal

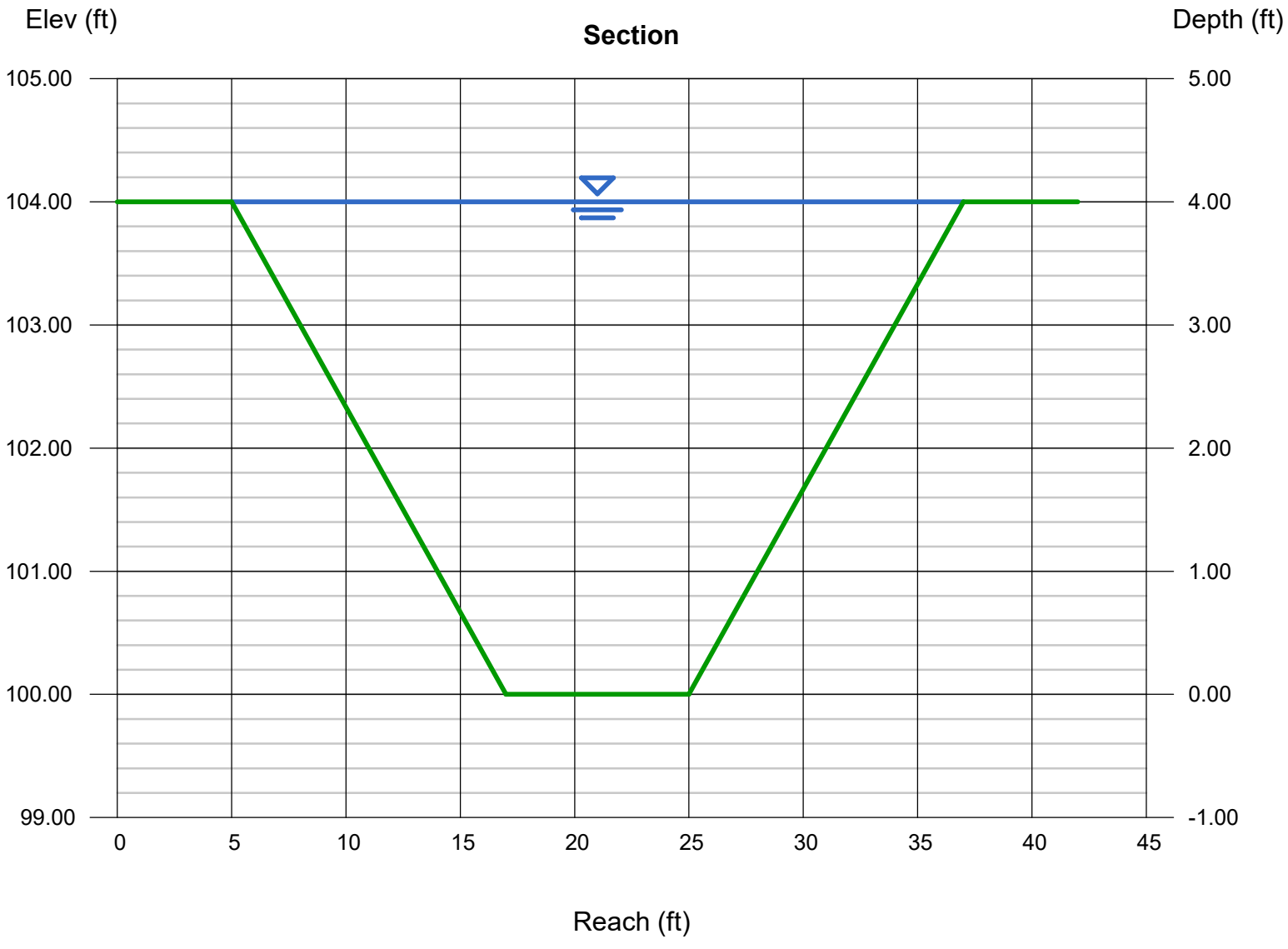
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.99
N-Value	= 0.024

Calculations

Compute by:	Q vs Depth
No. Increments	= 8

Highlighted

Depth (ft)	= 4.00
Q (cfs)	= 884.34
Area (sqft)	= 80.00
Velocity (ft/s)	= 11.05
Wetted Perim (ft)	= 33.30
Crit Depth, Yc (ft)	= 4.00
Top Width (ft)	= 32.00
EGL (ft)	= 5.90



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 27 2022

Section 12 Proposed

Rectangular

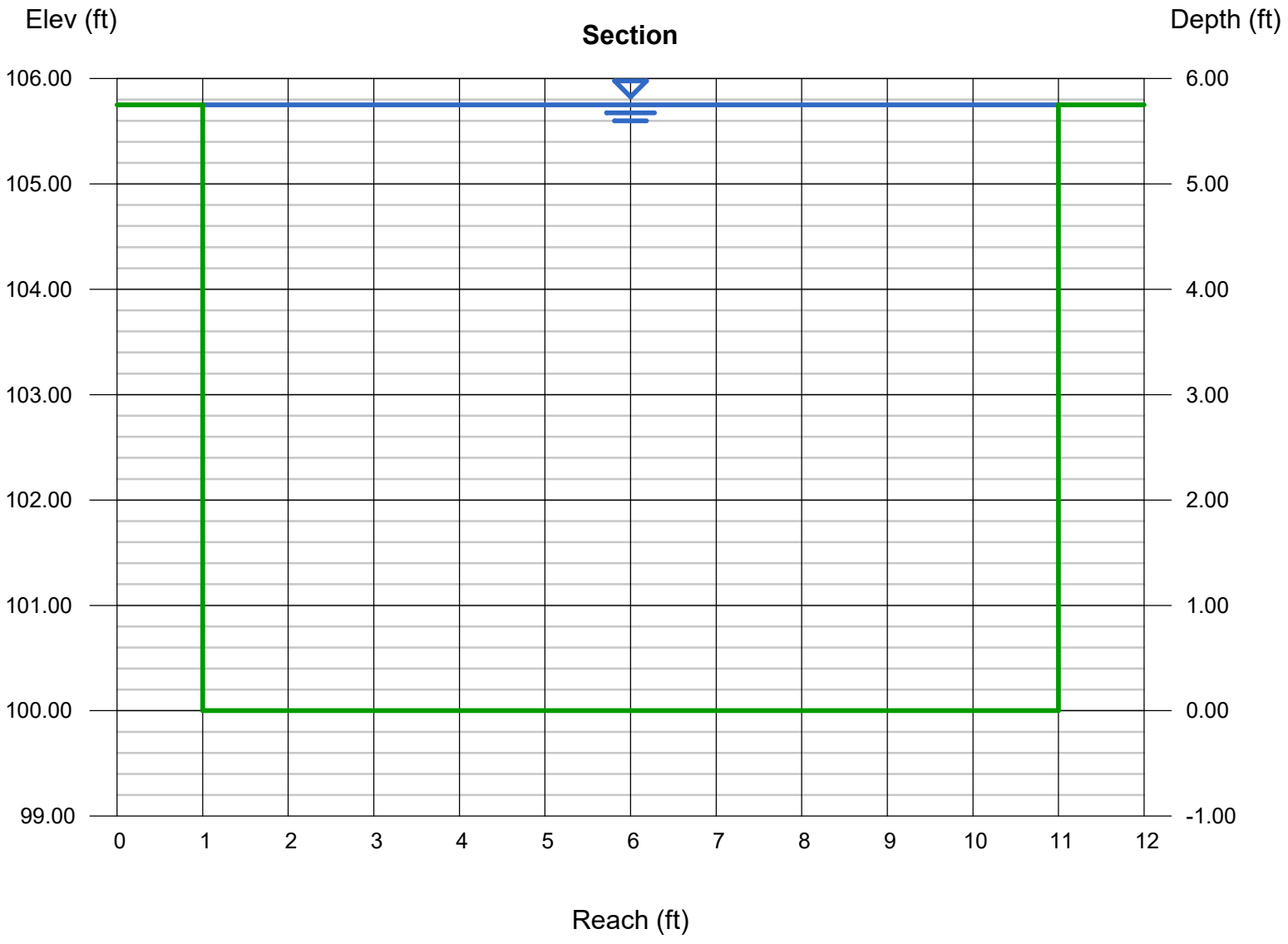
Bottom Width (ft)	= 10.00
Total Depth (ft)	= 5.75
Invert Elev (ft)	= 100.00
Slope (%)	= 0.92
N-Value	= 0.017

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 5.75
Q (cfs)	= 929.17
Area (sqft)	= 57.50
Velocity (ft/s)	= 16.16
Wetted Perim (ft)	= 21.50
Crit Depth, Yc (ft)	= 5.75
Top Width (ft)	= 10.00
EGL (ft)	= 9.81



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, May 31 2022

Section 14 Proposed

Rectangular

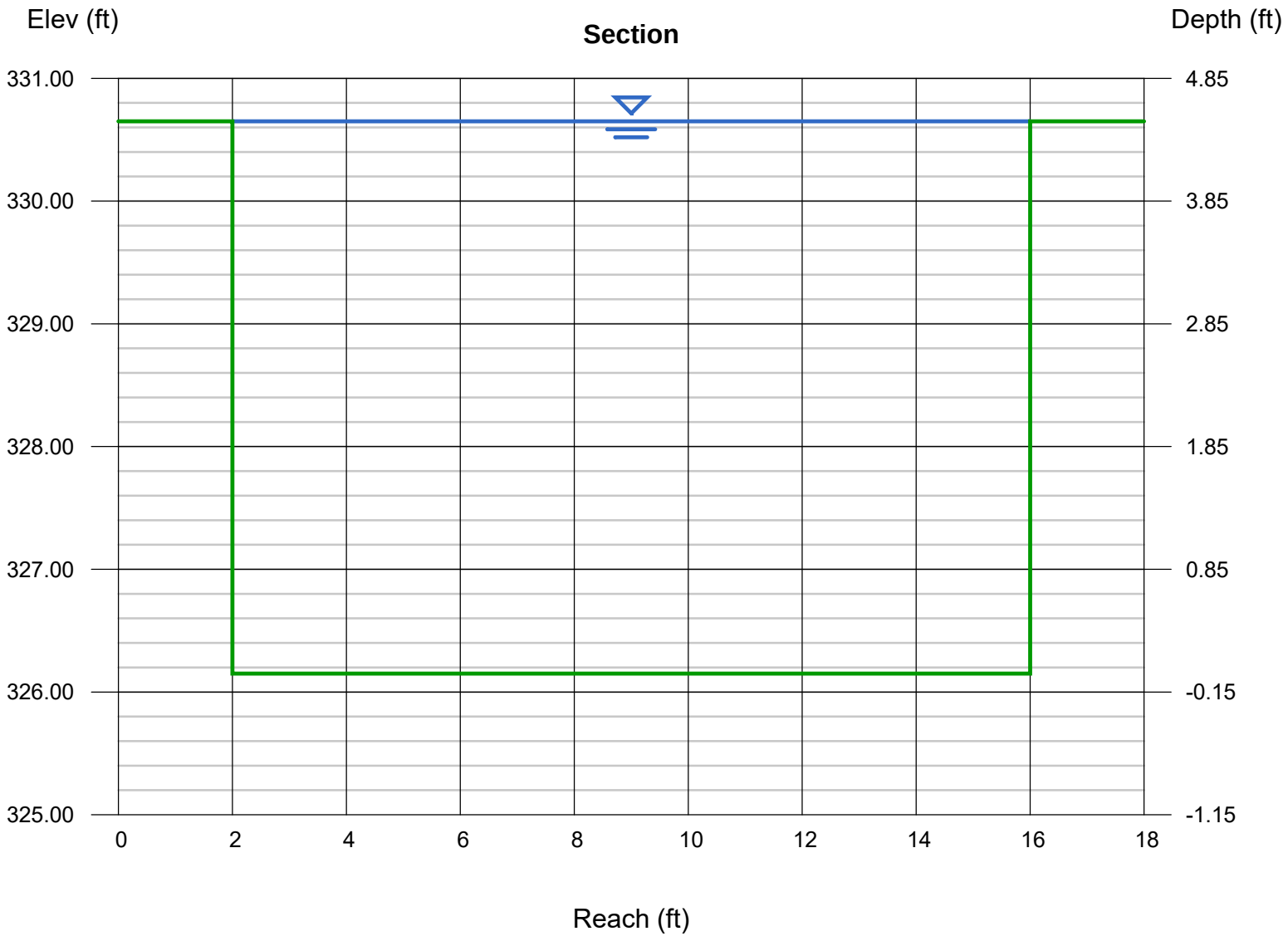
Bottom Width (ft)	= 14.00
Total Depth (ft)	= 4.50
Invert Elev (ft)	= 326.15
Slope (%)	= 1.00
N-Value	= 0.017

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.50
Q (cfs)	= 1,078
Area (sqft)	= 63.00
Velocity (ft/s)	= 17.12
Wetted Perim (ft)	= 23.00
Crit Depth, Yc (ft)	= 4.50
Top Width (ft)	= 14.00
EGL (ft)	= 9.06



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jun 1 2022

Section 15 Proposed

Rectangular

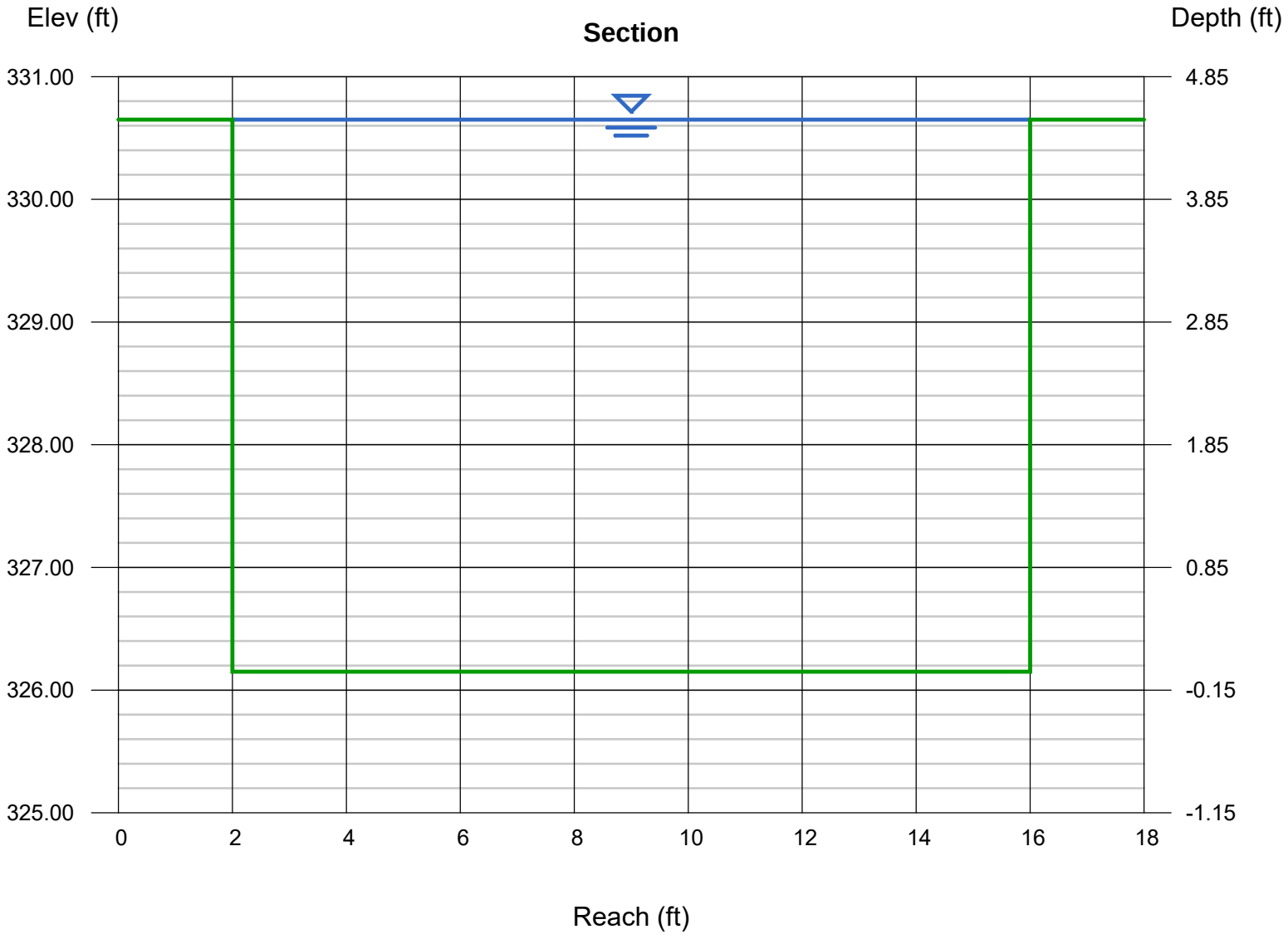
Bottom Width (ft)	= 14.00
Total Depth (ft)	= 4.50
Invert Elev (ft)	= 326.15
Slope (%)	= 1.00
N-Value	= 0.017

Calculations

Compute by:	Q vs Depth
No. Increments	= 1

Highlighted

Depth (ft)	= 4.50
Q (cfs)	= 1,078
Area (sqft)	= 63.00
Velocity (ft/s)	= 17.12
Wetted Perim (ft)	= 23.00
Crit Depth, Yc (ft)	= 4.50
Top Width (ft)	= 14.00
EGL (ft)	= 9.06

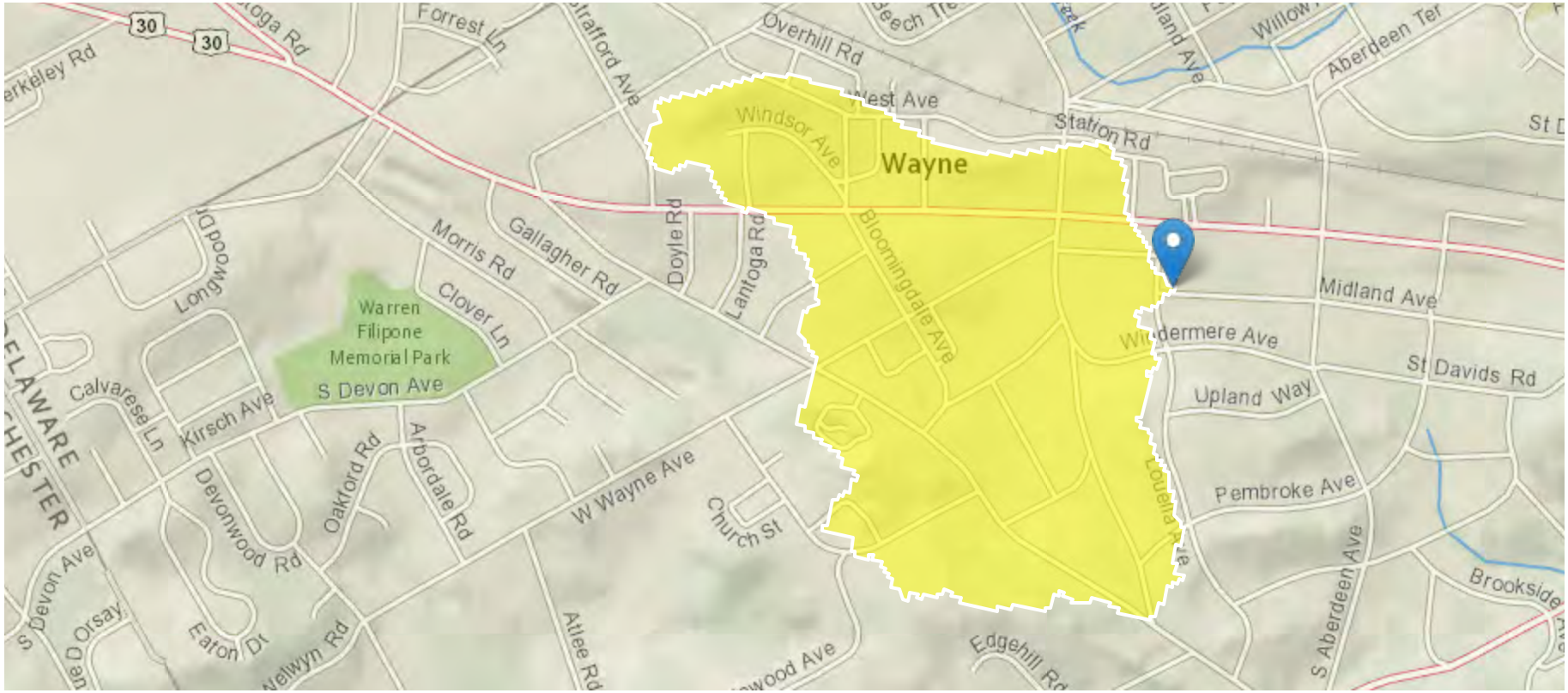


APPENDIX D: DRAINAGE AREA MAPS

Louella Ave

Region ID: PA
Workspace ID: PA20220408132014135000
Clicked Point (Latitude, Longitude): 40.04270, -75.38503
Time: 2022-04-08 09:20:33 -0400

SECTION 1



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.3	square miles
FOREST	Percentage of area covered by forest	0.8068	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	97.426	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.3	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	98.6	ft^3/s
20-percent AEP flood	181	ft^3/s
10-percent AEP flood	252	ft^3/s
4-percent AEP flood	358	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	449	ft^3/s
1-percent AEP flood	548	ft^3/s
0.5-percent AEP flood	657	ft^3/s
0.2-percent AEP flood	820	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.3	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	0.8068	percent	5.1	100
URBAN	Percent Urban	97.426	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.137	ft^3/s
Base Flow 25 Year Recurrence Interval	0.122	ft^3/s
Base Flow 50 Year Recurrence Interval	0.114	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

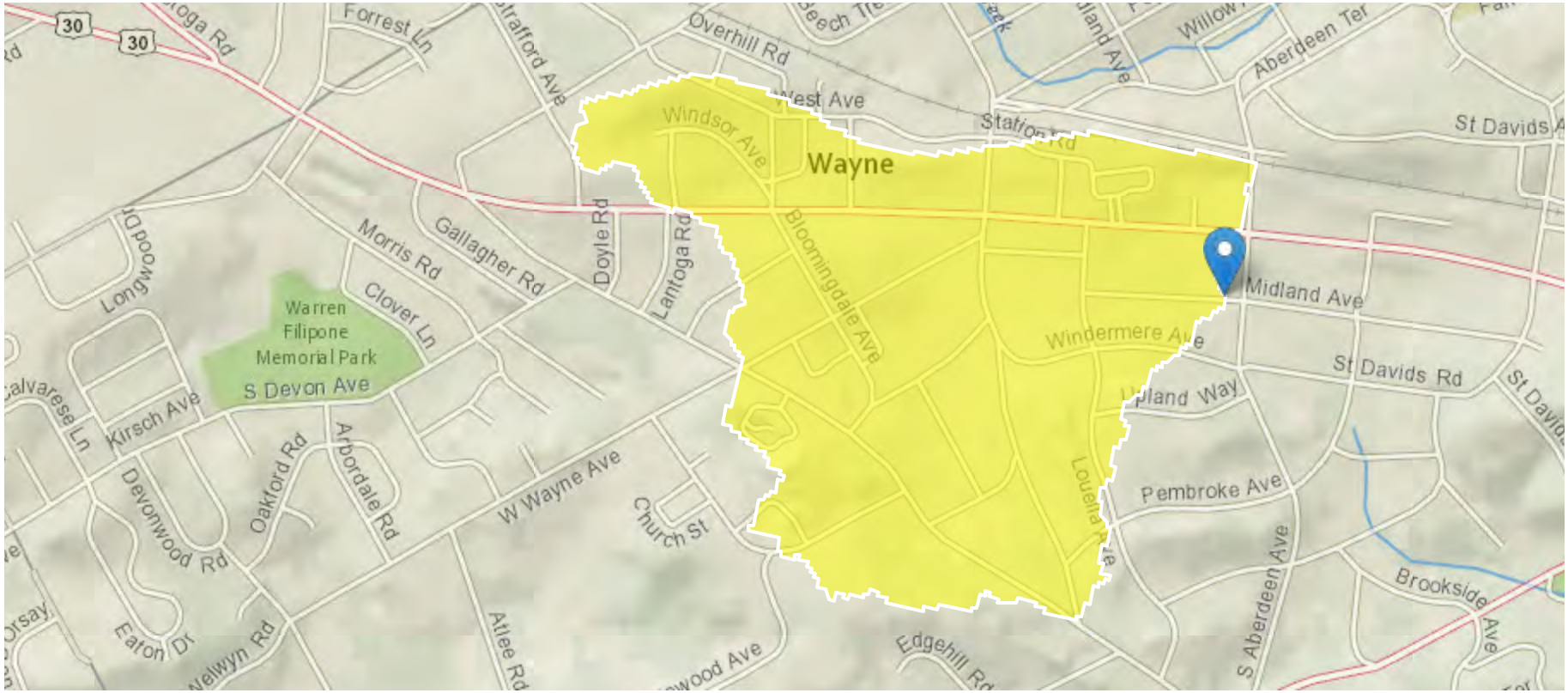
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

StreamStats Report

Region ID: PA
Workspace ID: PA20220421114051027000
Clicked Point (Latitude, Longitude): 40.04250, -75.38192
Time: 2022-04-21 07:41:10 -0400

SECTION 2



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.37	square miles
FOREST	Percentage of area covered by forest	0.7453	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	97.5365	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.37	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	114	ft^3/s
20-percent AEP flood	208	ft^3/s
10-percent AEP flood	289	ft^3/s
4-percent AEP flood	410	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	513	ft^3/s
1-percent AEP flood	626	ft^3/s
0.5-percent AEP flood	749	ft^3/s
0.2-percent AEP flood	934	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.37	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	0.7453	percent	5.1	100
URBAN	Percent Urban	97.5365	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.169	ft^3/s
Base Flow 25 Year Recurrence Interval	0.15	ft^3/s
Base Flow 50 Year Recurrence Interval	0.14	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

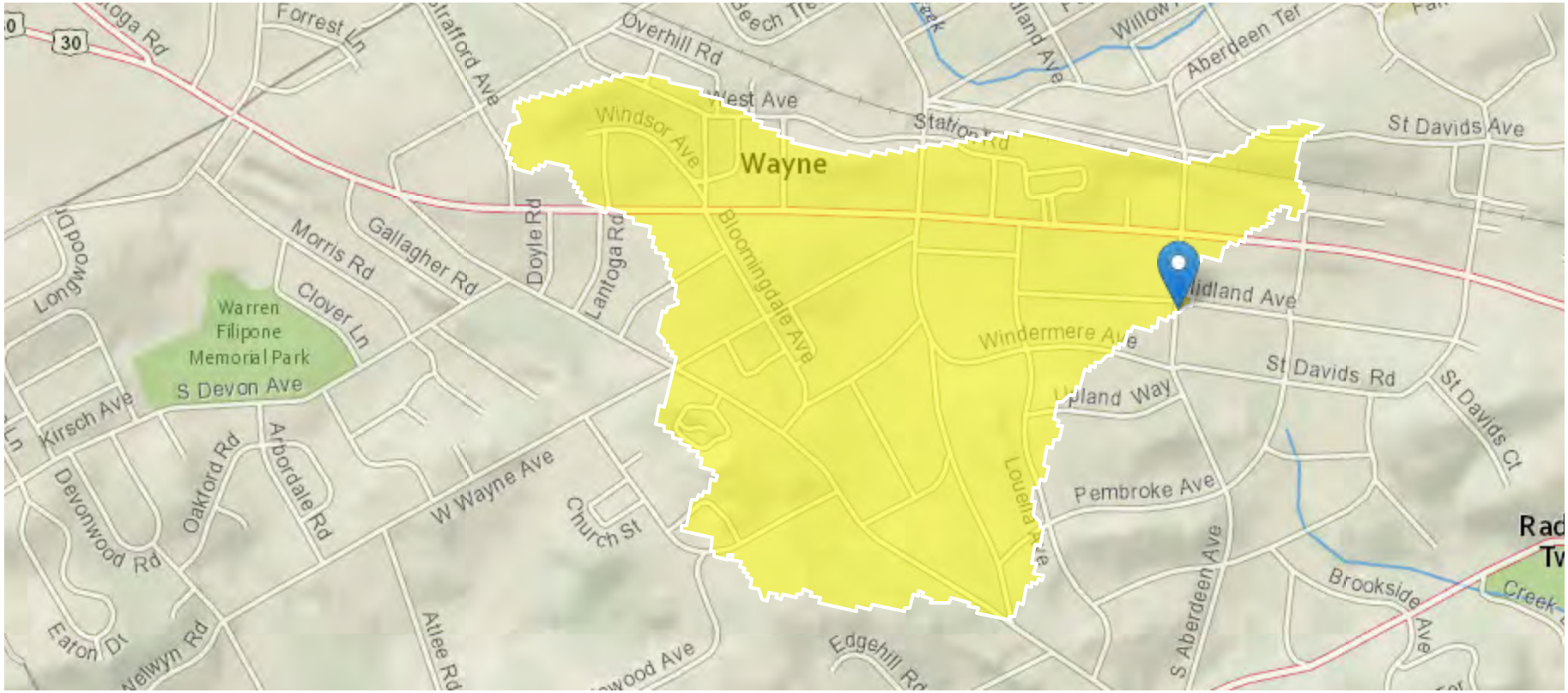
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

StreamStats Report

Region ID: PA
Workspace ID: PA20220421115131591000
Clicked Point (Latitude, Longitude): 40.04217, -75.38140
Time: 2022-04-21 07:51:51 -0400

SECTION 3 & 4



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.4	square miles
FOREST	Percentage of area covered by forest	0.7858	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	97.6038	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.4	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	121	ft^3/s
20-percent AEP flood	220	ft^3/s
10-percent AEP flood	305	ft^3/s
4-percent AEP flood	431	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	539	ft^3/s
1-percent AEP flood	657	ft^3/s
0.5-percent AEP flood	786	ft^3/s
0.2-percent AEP flood	980	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.4	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	0.7858	percent	5.1	100
URBAN	Percent Urban	97.6038	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.183	ft^3/s
Base Flow 25 Year Recurrence Interval	0.163	ft^3/s
Base Flow 50 Year Recurrence Interval	0.152	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

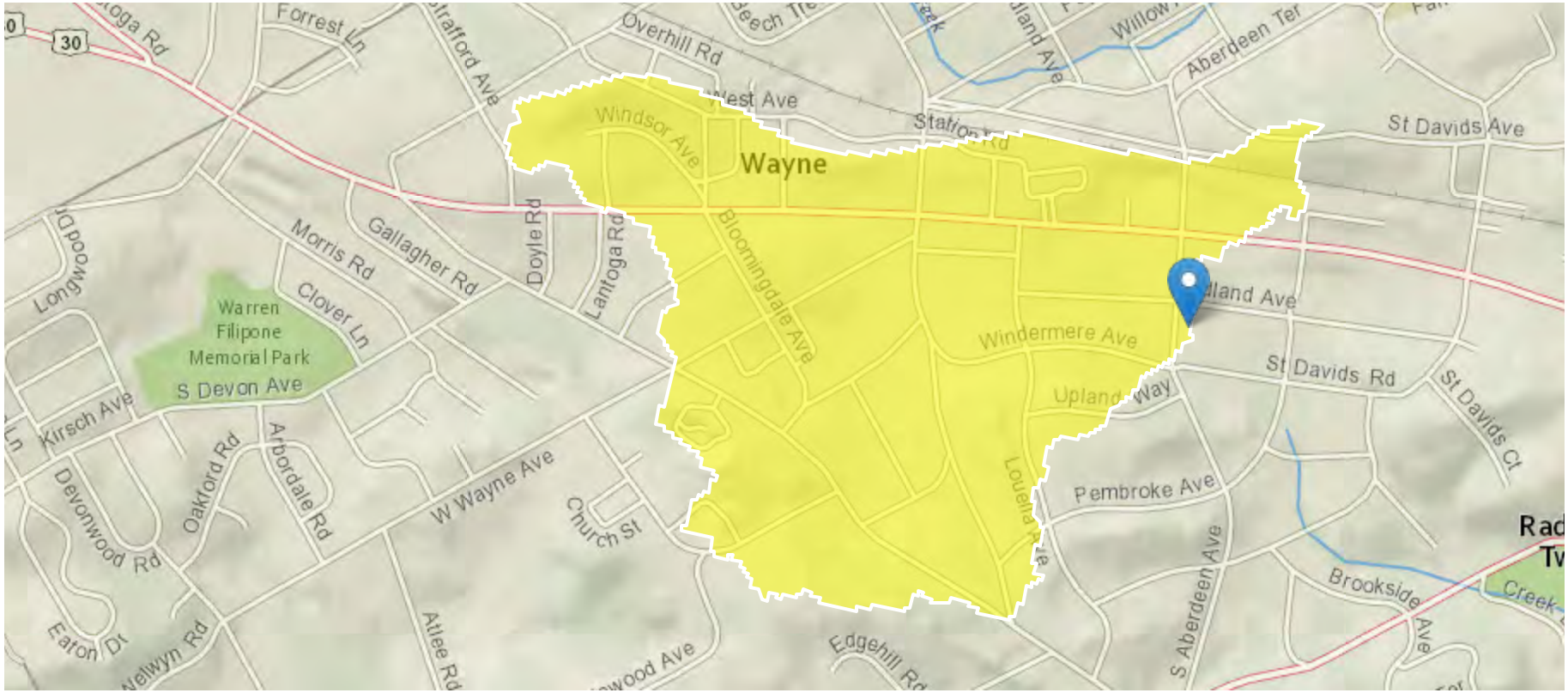
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

South Aberdeen

Region ID: PA
Workspace ID: PA20220408133756708000
Clicked Point (Latitude, Longitude): 40.04192, -75.38117
Time: 2022-04-08 09:38:17 -0400

SECTION 5



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.41	square miles
FOREST	Percentage of area covered by forest	0.763	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	97.6733	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.41	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	123	ft^3/s
20-percent AEP flood	223	ft^3/s
10-percent AEP flood	310	ft^3/s
4-percent AEP flood	438	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	547	ft^3/s
1-percent AEP flood	668	ft^3/s
0.5-percent AEP flood	799	ft^3/s
0.2-percent AEP flood	995	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.41	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	0.763	percent	5.1	100
URBAN	Percent Urban	97.6733	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.188	ft^3/s
Base Flow 25 Year Recurrence Interval	0.167	ft^3/s
Base Flow 50 Year Recurrence Interval	0.155	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

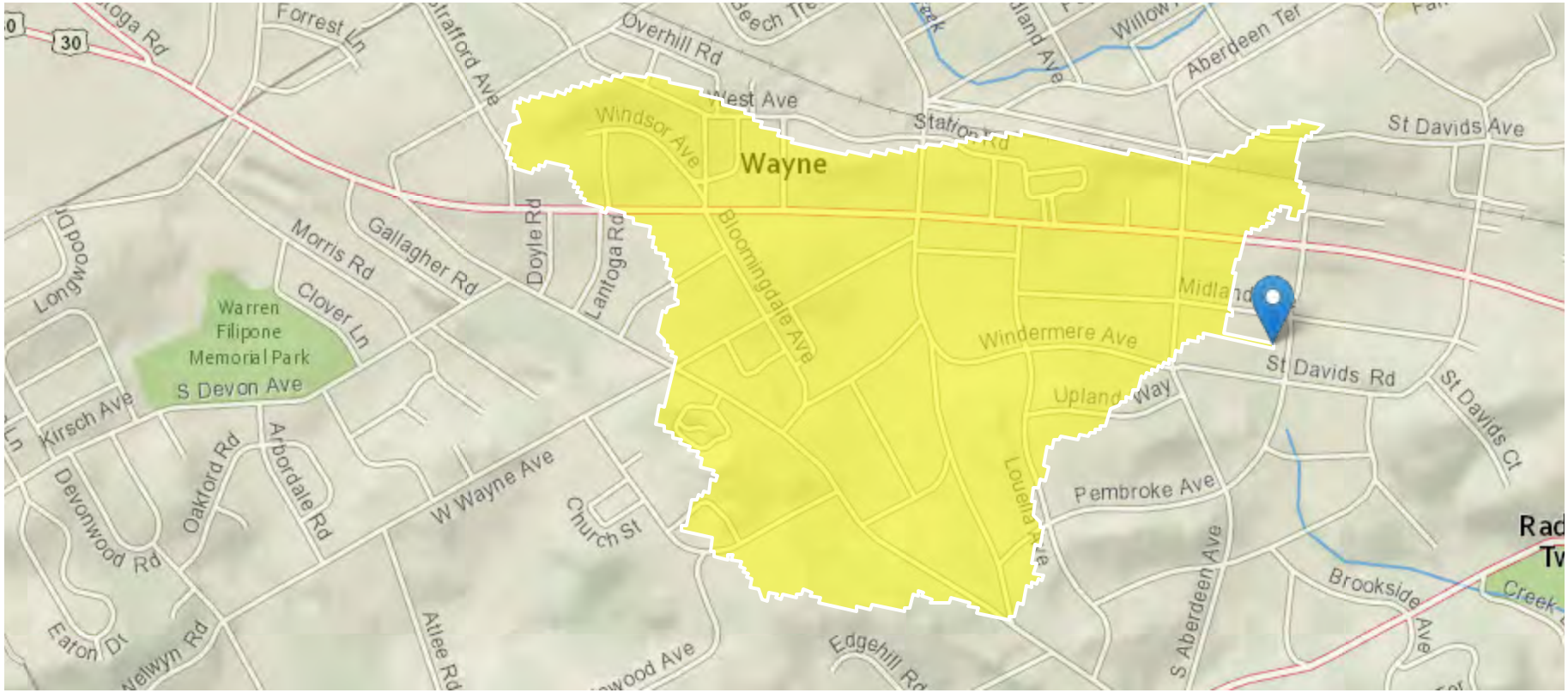
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

StreamStats Report

Region ID: PA
Workspace ID: PA20220421120419748000
Clicked Point (Latitude, Longitude): 40.04160, -75.37902
Time: 2022-04-21 08:04:46 -0400

SECTION 6



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.42	square miles
FOREST	Percentage of area covered by forest	0.9185	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	97.3838	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.42	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	125	ft^3/s
20-percent AEP flood	227	ft^3/s
10-percent AEP flood	315	ft^3/s
4-percent AEP flood	445	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	556	ft^3/s
1-percent AEP flood	678	ft^3/s
0.5-percent AEP flood	811	ft^3/s
0.2-percent AEP flood	1010	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.42	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	0.9185	percent	5.1	100
URBAN	Percent Urban	97.3838	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.192	ft^3/s
Base Flow 25 Year Recurrence Interval	0.171	ft^3/s
Base Flow 50 Year Recurrence Interval	0.159	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

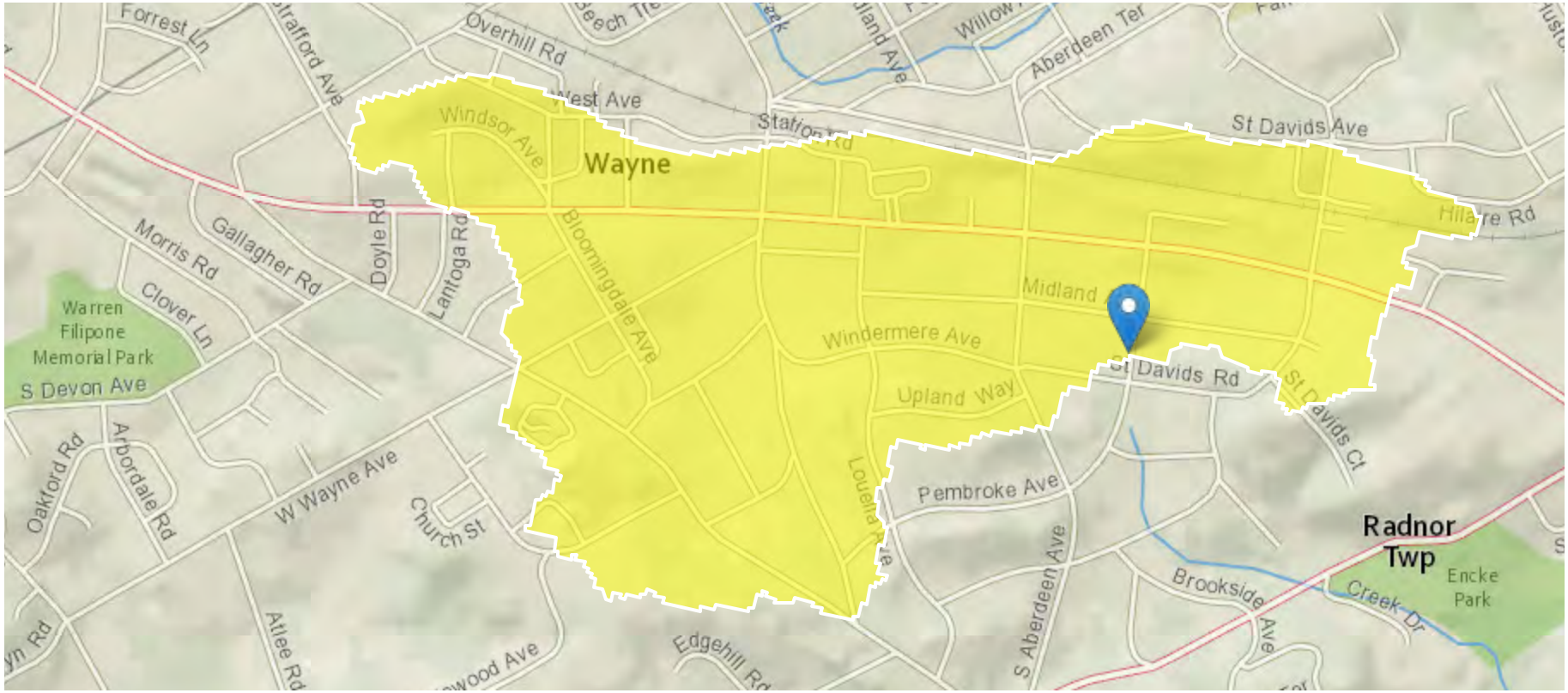
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

StreamStats Report

Region ID: PA
Workspace ID: PA20220421122115687000
Clicked Point (Latitude, Longitude): 40.04148, -75.37874
Time: 2022-04-21 08:21:39 -0400

SECTION 7 & 8



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.56	square miles
FOREST	Percentage of area covered by forest	1.8149	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	96.3424	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.56	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	153	ft^3/s
20-percent AEP flood	275	ft^3/s
10-percent AEP flood	380	ft^3/s
4-percent AEP flood	536	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	668	ft^3/s
1-percent AEP flood	813	ft^3/s
0.5-percent AEP flood	971	ft^3/s
0.2-percent AEP flood	1210	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.56	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	1.8149	percent	5.1	100
URBAN	Percent Urban	96.3424	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.259	ft^3/s
Base Flow 25 Year Recurrence Interval	0.23	ft^3/s
Base Flow 50 Year Recurrence Interval	0.215	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

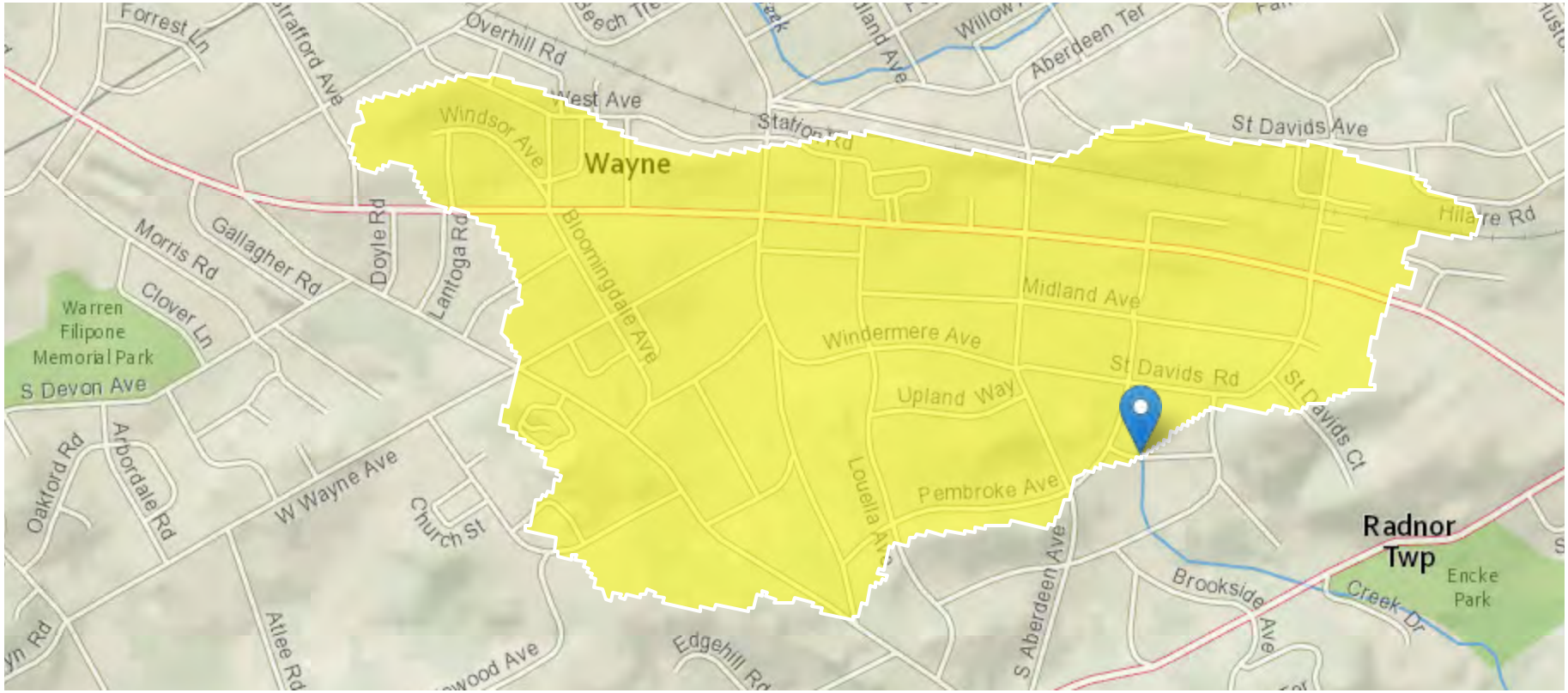
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

Meadowbrook Avenue

Region ID: PA
Workspace ID: PA20220408134617690000
Clicked Point (Latitude, Longitude): 40.03948, -75.37846
Time: 2022-04-08 09:46:37 -0400

SECTION 9



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.61	square miles
FOREST	Percentage of area covered by forest	1.643	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	96.6889	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.61	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	162	ft^3/s
20-percent AEP flood	292	ft^3/s
10-percent AEP flood	402	ft^3/s
4-percent AEP flood	566	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	705	ft^3/s
1-percent AEP flood	858	ft^3/s
0.5-percent AEP flood	1020	ft^3/s
0.2-percent AEP flood	1270	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.61	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	1.643	percent	5.1	100
URBAN	Percent Urban	96.6889	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.282	ft^3/s
Base Flow 25 Year Recurrence Interval	0.251	ft^3/s
Base Flow 50 Year Recurrence Interval	0.234	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

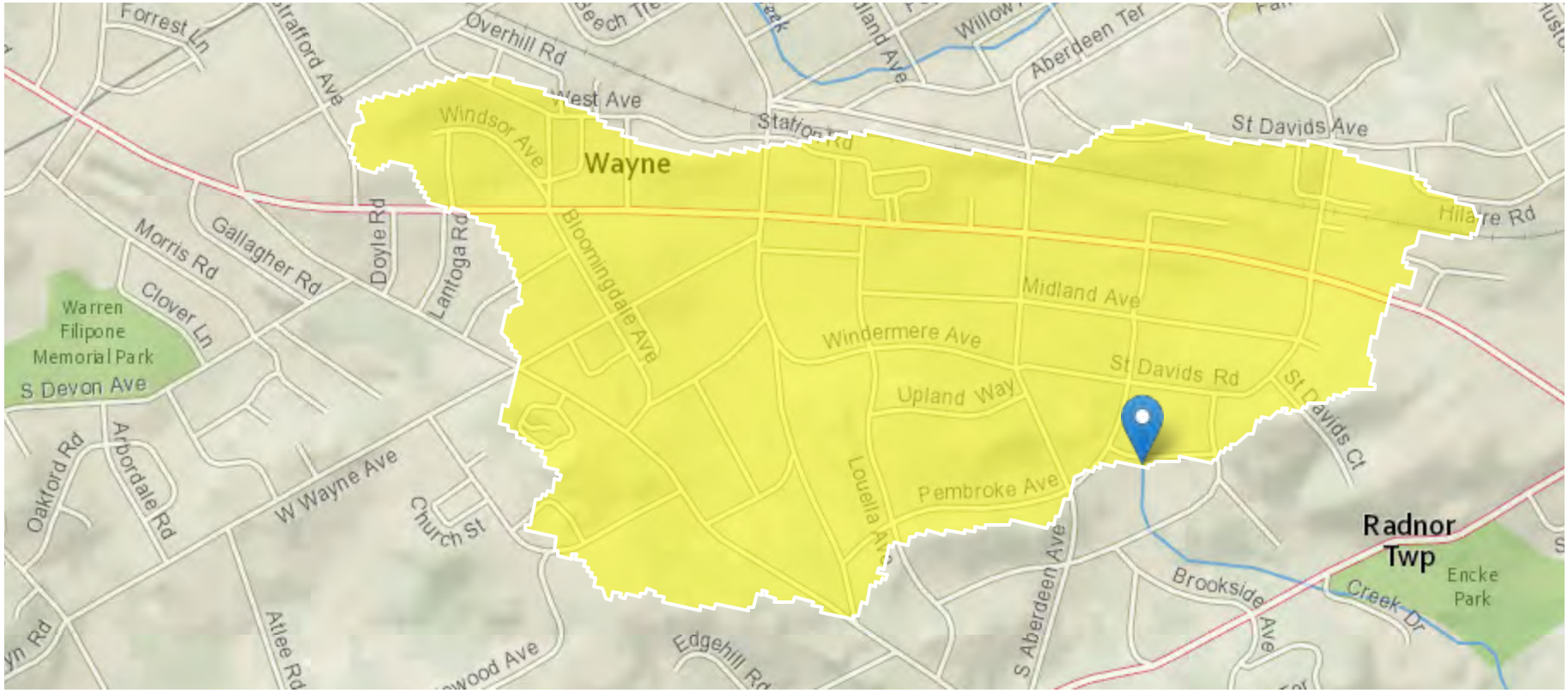
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

StreamStats Report

Region ID: PA
Workspace ID: PA20220421122557678000
Clicked Point (Latitude, Longitude): 40.03928, -75.37838
Time: 2022-04-21 08:26:17 -0400

SECTION 10



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.62	square miles
FOREST	Percentage of area covered by forest	1.6241	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	96.7268	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.62	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	164	ft^3/s
20-percent AEP flood	295	ft^3/s
10-percent AEP flood	406	ft^3/s
4-percent AEP flood	572	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	712	ft^3/s
1-percent AEP flood	867	ft^3/s
0.5-percent AEP flood	1030	ft^3/s
0.2-percent AEP flood	1290	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.62	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	1.6241	percent	5.1	100
URBAN	Percent Urban	96.7268	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.286	ft^3/s
Base Flow 25 Year Recurrence Interval	0.255	ft^3/s
Base Flow 50 Year Recurrence Interval	0.237	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

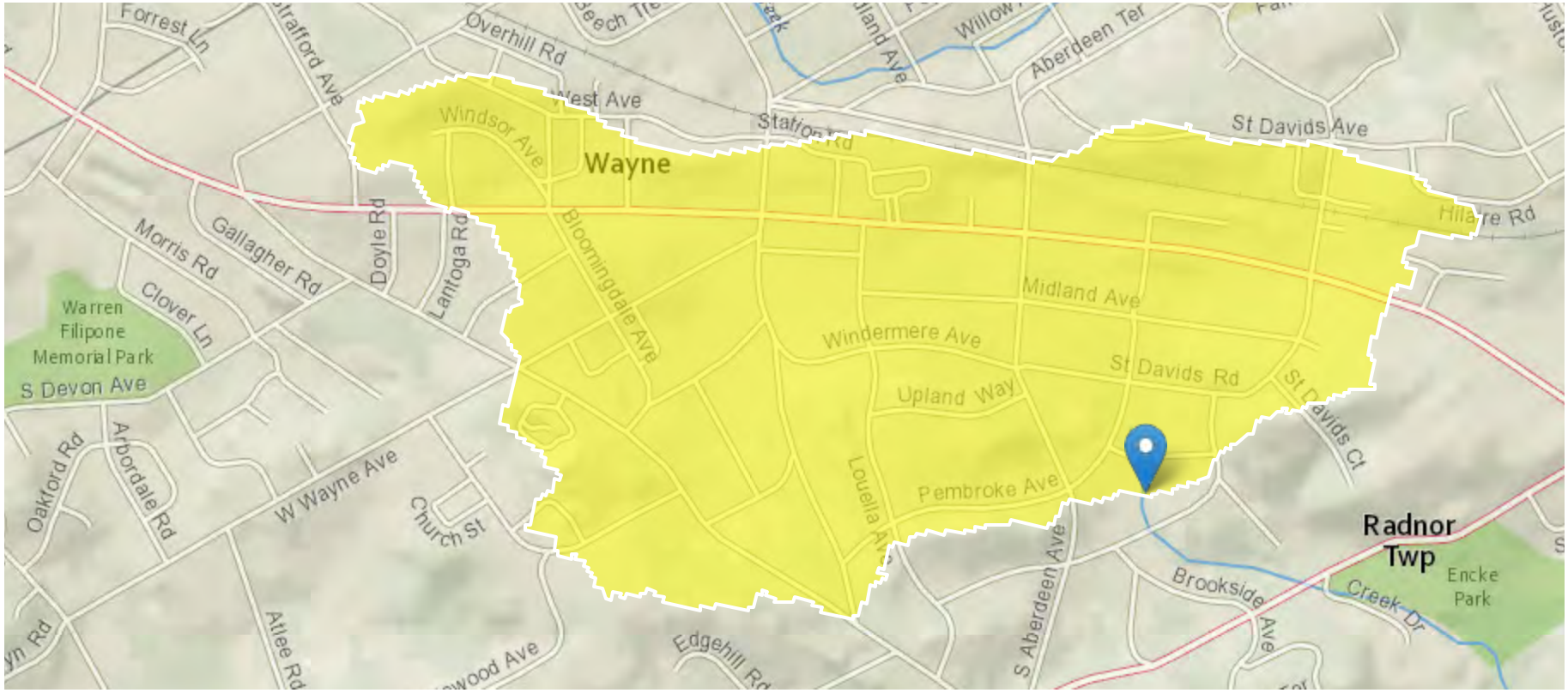
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

StreamStats Report

Region ID: PA
Workspace ID: PA20220421131051758000
Clicked Point (Latitude, Longitude): 40.03867, -75.37827
Time: 2022-04-21 09:11:19 -0400

SECTION 11



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.63	square miles
FOREST	Percentage of area covered by forest	1.6062	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	96.7631	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.63	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	166	ft^3/s
20-percent AEP flood	298	ft^3/s
10-percent AEP flood	411	ft^3/s
4-percent AEP flood	578	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	720	ft^3/s
1-percent AEP flood	875	ft^3/s
0.5-percent AEP flood	1050	ft^3/s
0.2-percent AEP flood	1300	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.63	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	1.6062	percent	5.1	100
URBAN	Percent Urban	96.7631	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.291	ft^3/s
Base Flow 25 Year Recurrence Interval	0.259	ft^3/s
Base Flow 50 Year Recurrence Interval	0.241	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

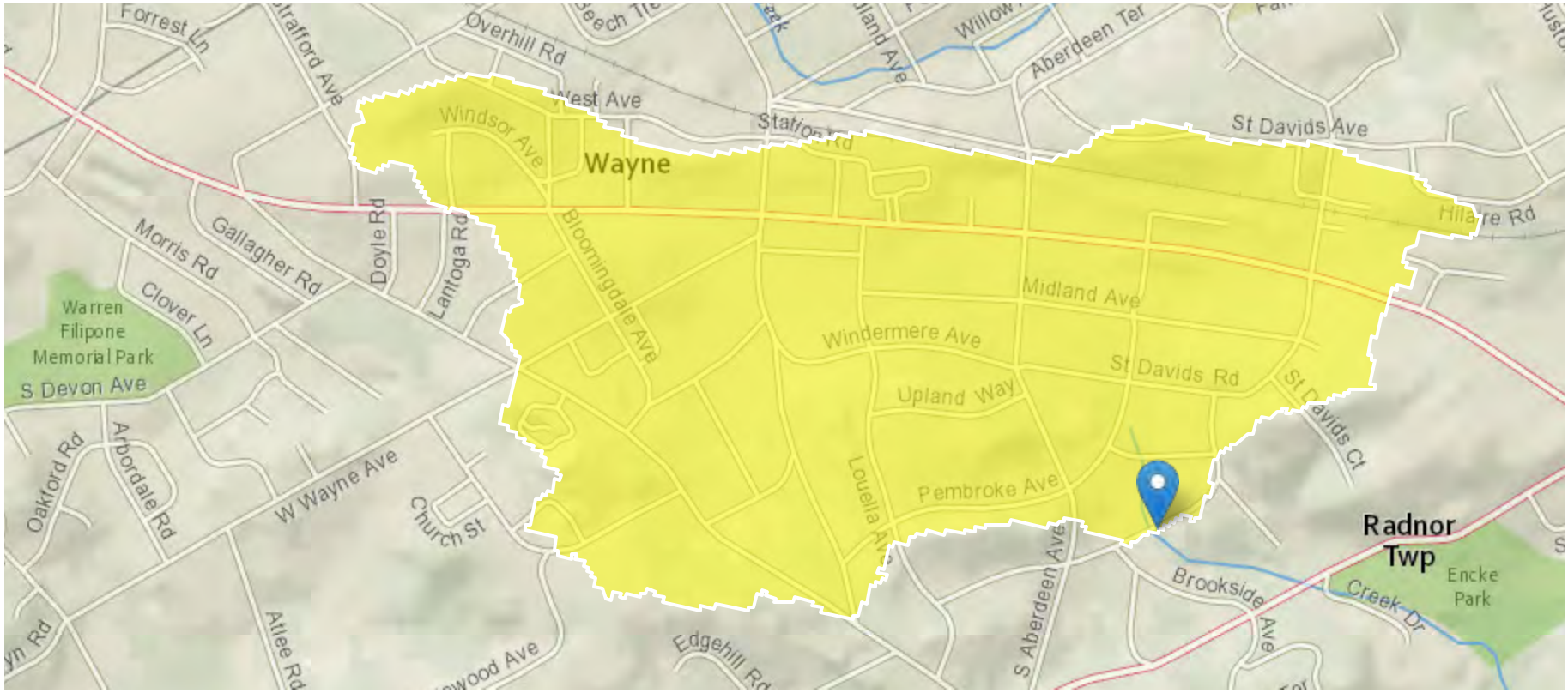
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

StreamStats Report

Region ID: PA
Workspace ID: PA20220421131528718000
Clicked Point (Latitude, Longitude): 40.03801, -75.37810
Time: 2022-04-21 09:15:58 -0400

SECTION 12



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.64	square miles
FOREST	Percentage of area covered by forest	1.5837	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	96.8083	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.64	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	168	ft^3/s
20-percent AEP flood	301	ft^3/s
10-percent AEP flood	415	ft^3/s
4-percent AEP flood	584	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	727	ft^3/s
1-percent AEP flood	884	ft^3/s
0.5-percent AEP flood	1060	ft^3/s
0.2-percent AEP flood	1310	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.64	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	1.5837	percent	5.1	100
URBAN	Percent Urban	96.8083	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.296	ft^3/s
Base Flow 25 Year Recurrence Interval	0.263	ft^3/s
Base Flow 50 Year Recurrence Interval	0.245	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

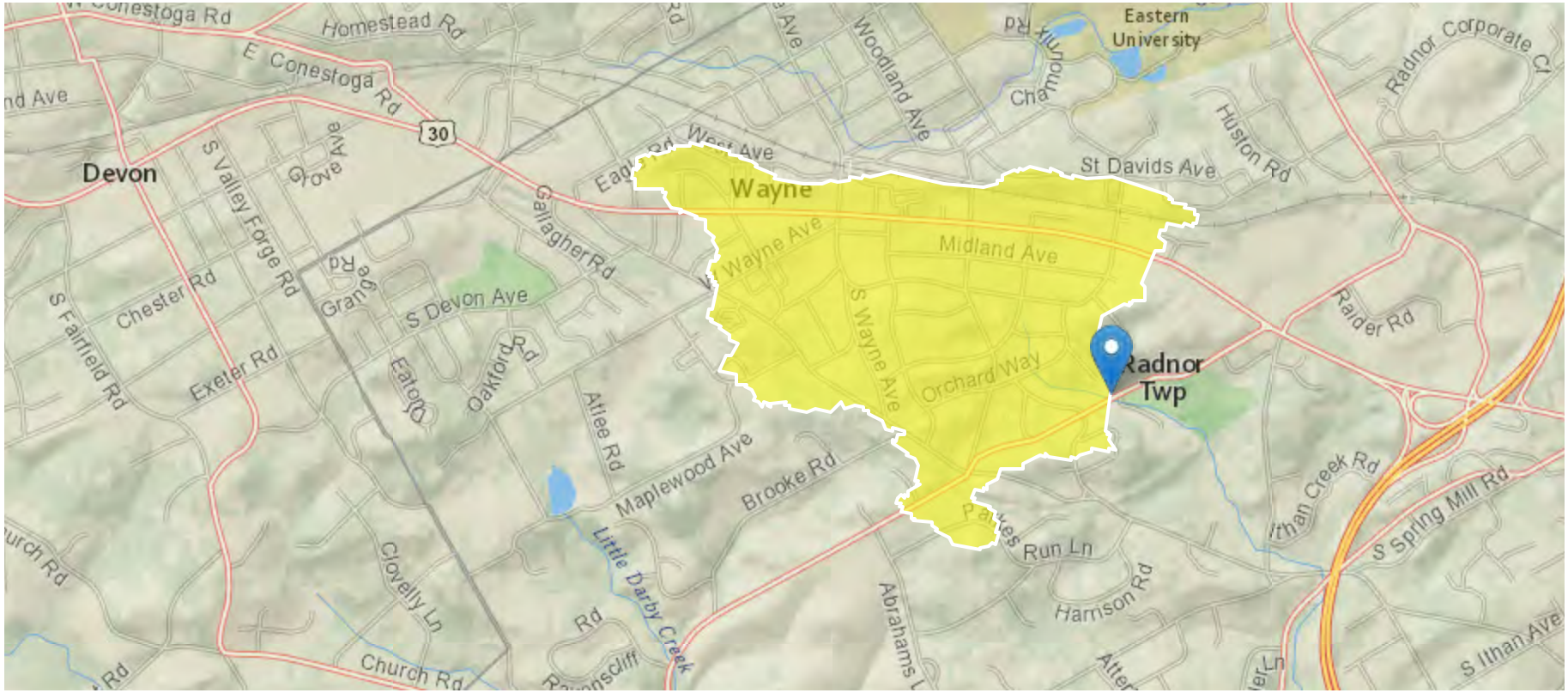
StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

StreamStats Report

Region ID: PA
Workspace ID: PA20220421131929315000
Clicked Point (Latitude, Longitude): 40.03716, -75.37434
Time: 2022-04-21 09:19:58 -0400

SECTION 13,14,15



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
CARBON	Percentage of area of carbonate rock	0	percent
DRNAREA	Area that drains to a point on a stream	0.83	square miles
FOREST	Percentage of area covered by forest	1.2205	percent
PRECIP	Mean Annual Precipitation	45	inches
URBAN	Percentage of basin with urban development	97.4841	percent

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.83	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

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

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	201	ft^3/s
20-percent AEP flood	359	ft^3/s
10-percent AEP flood	493	ft^3/s
4-percent AEP flood	691	ft^3/s

Statistic	Value	Unit
2-percent AEP flood	858	ft^3/s
1-percent AEP flood	1040	ft^3/s
0.5-percent AEP flood	1240	ft^3/s
0.2-percent AEP flood	1540	ft^3/s

Peak-Flow Statistics Citations

Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133 /sir20195094)

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.83	square miles	2.26	1720
PRECIP	Mean Annual Precipitation	45	inches	33.1	50.4
CARBON	Percent Carbonate	0	percent	0	99
FOREST	Percent Forest	1.2205	percent	5.1	100
URBAN	Percent Urban	97.4841	percent	0	89

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

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

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Base Flow 10 Year Recurrence Interval	0.382	ft^3/s
Base Flow 25 Year Recurrence Interval	0.34	ft^3/s
Base Flow 50 Year Recurrence Interval	0.317	ft^3/s

Base Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)

Application Version: 4.8.1

StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2

APPENDIX E: RAINFALL DATA

NOAA Atlas 14, Volume 2, Version 3
Location name: Wayne, Pennsylvania, USA*
Latitude: 40.0409°, Longitude: -75.3788°
Elevation: 351.26 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/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.18** (3.84-4.55)	**4.97** (4.57-5.41)	**5.83** (5.34-6.34)	**6.43** (5.89-7.00)	**7.14** (6.50-7.76)	**7.62** (6.90-8.29)	**8.09** (7.30-8.82)	**8.50** (7.62-9.29)	**8.95** (7.97-9.83)	**9.30** (8.21-10.2)
10-min	**3.34** (3.07-3.63)	**3.98** (3.66-4.33)	**4.67** (4.28-5.08)	**5.14** (4.71-5.59)	**5.69** (5.18-6.19)	**6.07** (5.50-6.60)	**6.43** (5.80-7.00)	**6.73** (6.04-7.36)	**7.09** (6.30-7.78)	**7.32** (6.46-8.07)
15-min	**2.78** (2.56-3.02)	**3.33** (3.07-3.63)	**3.94** (3.61-4.28)	**4.33** (3.97-4.72)	**4.80** (4.38-5.23)	**5.12** (4.64-5.57)	**5.42** (4.88-5.90)	**5.66** (5.08-6.19)	**5.94** (5.28-6.52)	**6.13** (5.40-6.76)
30-min	**1.91** (1.75-2.07)	**2.30** (2.12-2.51)	**2.80** (2.56-3.04)	**3.14** (2.88-3.42)	**3.56** (3.24-3.87)	**3.86** (3.49-4.20)	**4.15** (3.74-4.52)	**4.41** (3.96-4.82)	**4.73** (4.20-5.19)	**4.96** (4.38-5.47)
60-min	**1.19** (1.09-1.29)	**1.44** (1.33-1.57)	**1.79** (1.64-1.95)	**2.04** (1.87-2.22)	**2.37** (2.16-2.58)	**2.61** (2.37-2.84)	**2.86** (2.58-3.11)	**3.09** (2.77-3.38)	**3.39** (3.02-3.72)	**3.62** (3.20-3.99)
2-hr	**0.712** (0.650-0.780)	**0.864** (0.791-0.946)	**1.08** (0.984-1.18)	**1.24** (1.13-1.36)	**1.45** (1.31-1.59)	**1.62** (1.46-1.77)	**1.79** (1.60-1.96)	**1.96** (1.74-2.15)	**2.18** (1.91-2.40)	**2.36** (2.04-2.60)
3-hr	**0.518** (0.474-0.568)	**0.628** (0.574-0.689)	**0.785** (0.716-0.860)	**0.905** (0.823-0.991)	**1.06** (0.962-1.17)	**1.19** (1.07-1.30)	**1.32** (1.18-1.44)	**1.45** (1.28-1.59)	**1.62** (1.41-1.79)	**1.75** (1.51-1.94)
6-hr	**0.323** (0.296-0.356)	**0.391** (0.358-0.430)	**0.487** (0.444-0.535)	**0.564** (0.513-0.619)	**0.672** (0.606-0.736)	**0.759** (0.679-0.831)	**0.851** (0.754-0.932)	**0.946** (0.830-1.04)	**1.08** (0.931-1.19)	**1.19** (1.01-1.32)
12-hr	**0.195** (0.179-0.216)	**0.236** (0.216-0.261)	**0.296** (0.269-0.327)	**0.345** (0.313-0.381)	**0.417** (0.374-0.459)	**0.477** (0.424-0.525)	**0.543** (0.476-0.598)	**0.613** (0.531-0.677)	**0.715** (0.606-0.793)	**0.801** (0.666-0.891)
24-hr	**0.113** (0.104-0.124)	**0.136** (0.125-0.149)	**0.171** (0.157-0.187)	**0.200** (0.183-0.218)	**0.242** (0.220-0.264)	**0.277** (0.251-0.302)	**0.315** (0.284-0.343)	**0.356** (0.319-0.387)	**0.416** (0.368-0.452)	**0.466** (0.408-0.506)
2-day	**0.065** (0.060-0.071)	**0.079** (0.072-0.086)	**0.099** (0.091-0.108)	**0.116** (0.105-0.126)	**0.139** (0.126-0.152)	**0.158** (0.143-0.173)	**0.179** (0.161-0.195)	**0.201** (0.180-0.219)	**0.233** (0.206-0.253)	**0.258** (0.228-0.282)
3-day	**0.046** (0.042-0.050)	**0.055** (0.051-0.061)	**0.069** (0.064-0.076)	**0.081** (0.074-0.088)	**0.097** (0.088-0.106)	**0.110** (0.100-0.120)	**0.125** (0.112-0.136)	**0.140** (0.125-0.152)	**0.161** (0.143-0.176)	**0.179** (0.158-0.195)

Note: Our recommendations for proposed improvements to the stream / culverts are for the 100-yr storm intensity (2.86 inches per hour for the 1 hour storm) which exceeds the 10-year 1hour rainfall intensityof 2.04 which was previously noted by Meliora to be most attributable to localized flooding.

4-day	**0.036** (0.033-0.040)	**0.044** (0.040-0.048)	**0.055** (0.050-0.060)	**0.063** (0.058-0.069)	**0.076** (0.069-0.083)	**0.086** (0.078-0.094)	**0.097** (0.088-0.106)	**0.109** (0.098-0.119)	**0.126** (0.112-0.137)	**0.139** (0.123-0.152)
7-day	**0.024** (0.022-0.026)	**0.029** (0.027-0.032)	**0.036** (0.033-0.039)	**0.041** (0.038-0.045)	**0.050** (0.045-0.054)	**0.056** (0.051-0.061)	**0.063** (0.058-0.069)	**0.071** (0.064-0.077)	**0.081** (0.073-0.089)	**0.090** (0.080-0.098)
10-day	**0.019** (0.018-0.021)	**0.023** (0.021-0.025)	**0.028** (0.026-0.030)	**0.032** (0.030-0.035)	**0.038** (0.035-0.041)	**0.042** (0.039-0.046)	**0.047** (0.043-0.051)	**0.052** (0.047-0.056)	**0.059** (0.053-0.064)	**0.065** (0.058-0.070)
20-day	**0.013** (0.012-0.014)	**0.015** (0.014-0.017)	**0.018** (0.017-0.020)	**0.021** (0.019-0.022)	**0.024** (0.022-0.026)	**0.026** (0.025-0.028)	**0.029** (0.027-0.031)	**0.031** (0.029-0.034)	**0.035** (0.032-0.037)	**0.037** (0.034-0.040)
30-day	**0.011** (0.010-0.011)	**0.013** (0.012-0.013)	**0.015** (0.014-0.016)	**0.016** (0.016-0.017)	**0.019** (0.018-0.020)	**0.020** (0.019-0.021)	**0.022** (0.021-0.023)	**0.023** (0.022-0.025)	**0.026** (0.024-0.027)	**0.027** (0.025-0.029)
45-day	**0.009** (0.009-0.010)	**0.011** (0.010-0.011)	**0.012** (0.012-0.013)	**0.014** (0.013-0.014)	**0.015** (0.014-0.016)	**0.016** (0.015-0.017)	**0.017** (0.016-0.018)	**0.018** (0.017-0.019)	**0.020** (0.018-0.021)	**0.021** (0.019-0.022)
60-day	**0.008** (0.008-0.009)	**0.010** (0.009-0.010)	**0.011** (0.010-0.012)	**0.012** (0.011-0.013)	**0.013** (0.013-0.014)	**0.014** (0.013-0.015)	**0.015** (0.014-0.016)	**0.016** (0.015-0.017)	**0.017** (0.016-0.018)	**0.018** (0.017-0.018)

[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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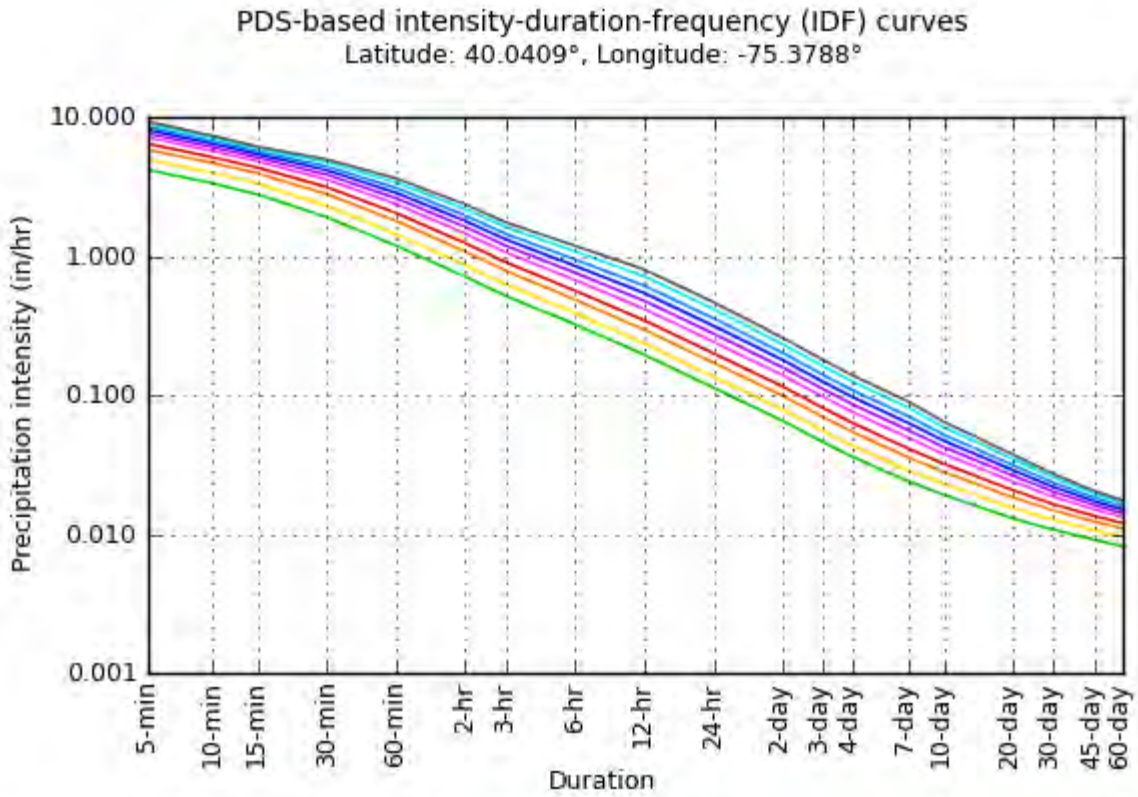
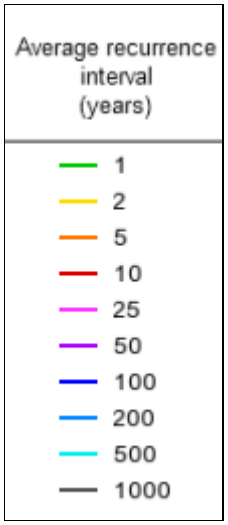
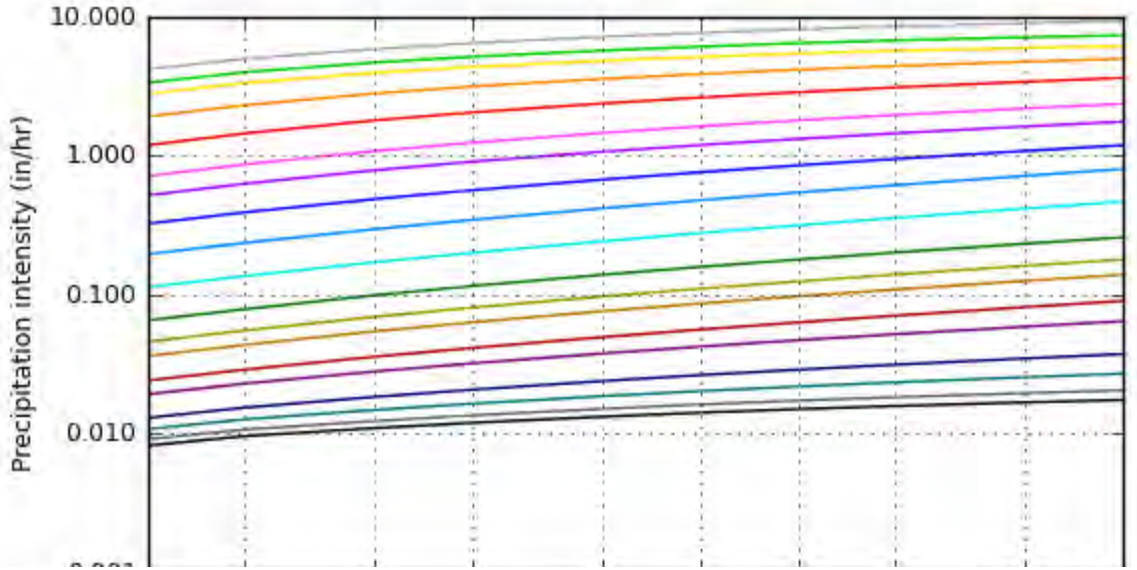
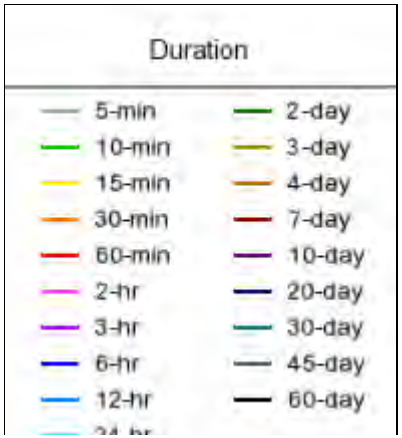
PF graphical


PDS-based intensity-duration-frequency (IDF) curves
Latitude: 40.0409°, Longitude: -75.3788°
Precipitation intensity (in/hr)
10.000
1.000
0.100
0.010
0.001
5-min
10-min
15-min
30-min
60-min
2-hr
3-hr
6-hr
12-hr
24-hr
2-day
3-day
4-day
7-day
10-day
20-day
30-day
45-day
60-day
Duration


Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000


Precipitation intensity (in/hr)
10.000
1.000
0.100
0.010


Duration
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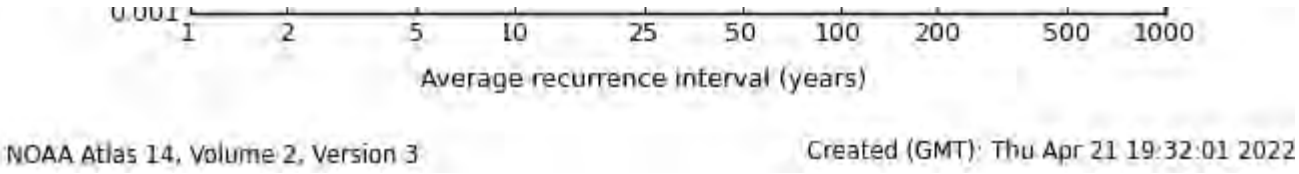
10-min
15-min
30-min
60-min
2-hr
3-hr
6-hr
12-hr
2-day
3-day
4-day
7-day
10-day
20-day
30-day
45-day
60-day



NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Thu Apr 21 19:32:01 2022

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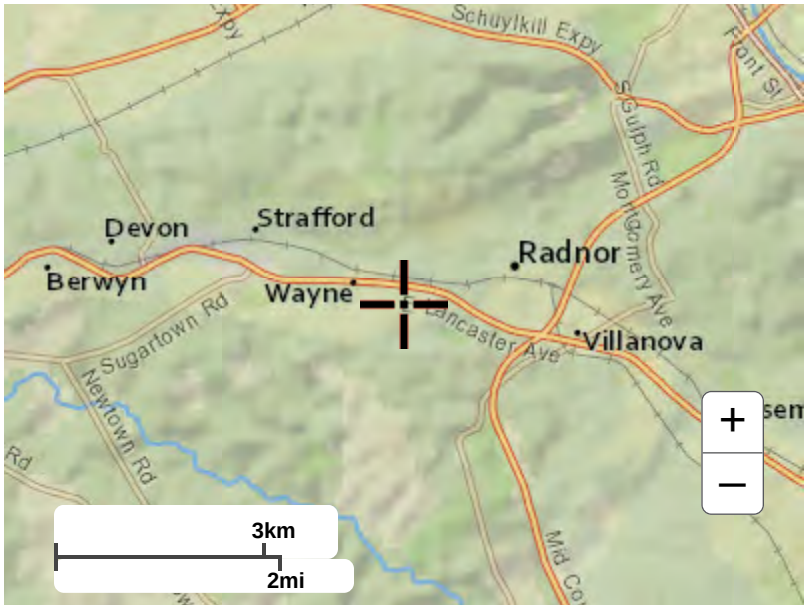
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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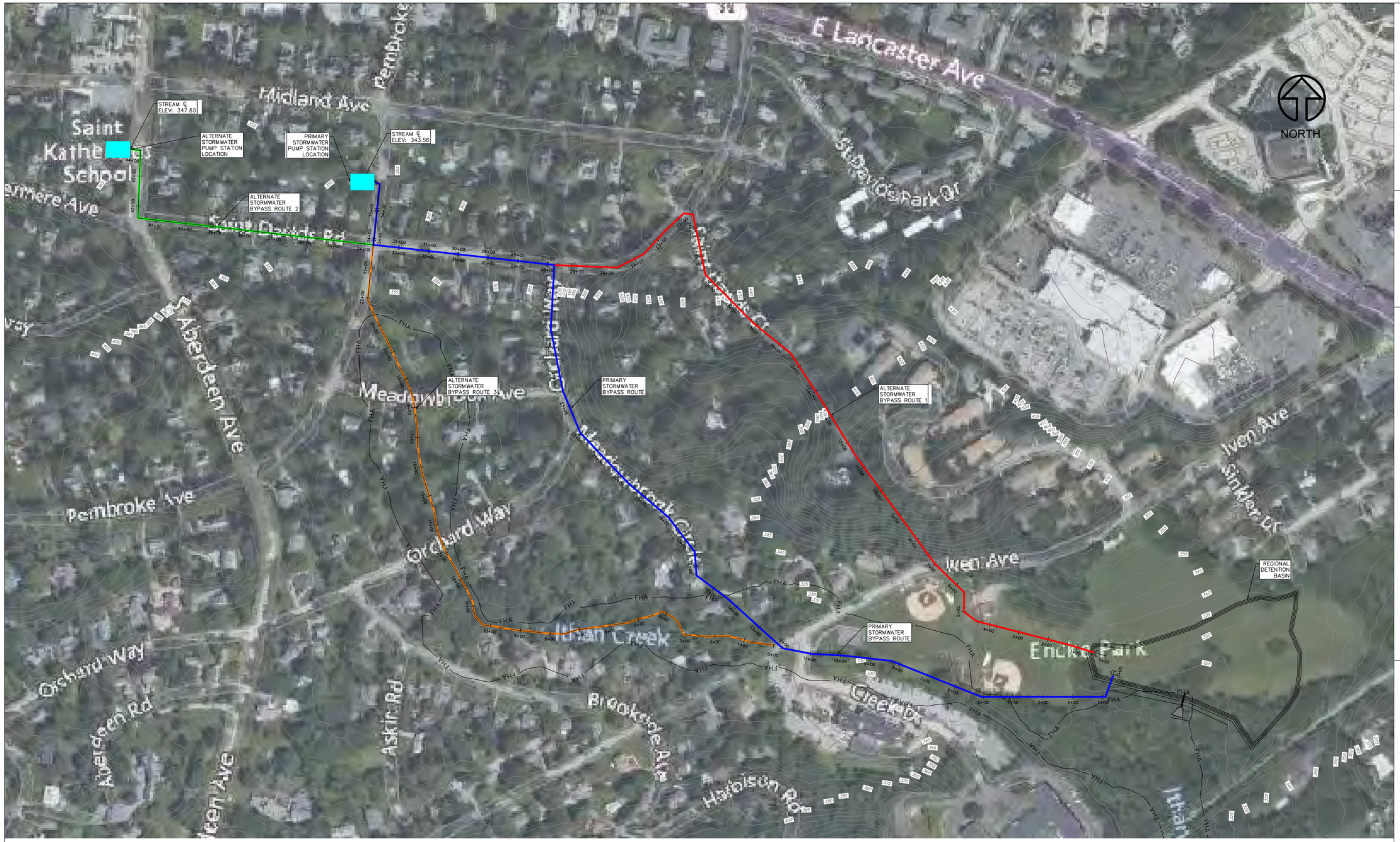
APPENDIX F: STORM SEWER BYPASS PLANS



	STORMWATER BYPASS SUMMARY TABLE		
		PIPE DIA. (IN)	TOTAL LENGTH
	PRIMARY BYPASS	84	3601 LF
	ALTERNATE BYPASS 1 (SAINT DAVIDS)	84	3506 LF
	ALTERNATE BYPASS 2 (SAINT KATHERINE'S PS LOCATION)	84	4422 LF
	ALTERNATE BYPASS 3 (PARALLEL TO ITHAN CREEK)	84	3818 LF

PROPOSED SWM FACILITY STORAGE				
STAGE	ELEVATION	CONTOUR AREA (SF)	INCREMENTAL STORAGE (CF)	TOTAL STORAGE (CF)
0	325.00	165,848	–	–
1	326.00	169,699	167,774	167,774
3	328.00	177,501	347,200	514,974
5	330.00	185,434	362,935	877,909
7	332.00	193,497	378,931	1,256,840

GRAPHIC SCALE

150 0 75 150 300 600

(IN FEET)
1 inch = 150 ft.

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STORM SEWER BYPASS CONCEPTUAL PLAN

SOUTH WAYNE DRAINAGE IMPROVEMENTS FEASIBILITY STUDY

SITUATED IN
RADNOR TOWNSHIP, DELAWARE COUNTY

PREPARED FOR
RADNOR TOWNSHIP
301 IVEN AVE
WAYNE, PA 19087

NO.	DATE	DESCRIPTION
		INITIALS

DATE 4-22-2022
CADD FILE 2119900004
JOB NO 21-1990

DSG BY CAP
DWN BY MEW
CKD BY WNM
SCALE 1"=150'
DRAWER NUMBER –
SHEET 1 OF 4 SHEETS

DRAWING NUMBER
C-101

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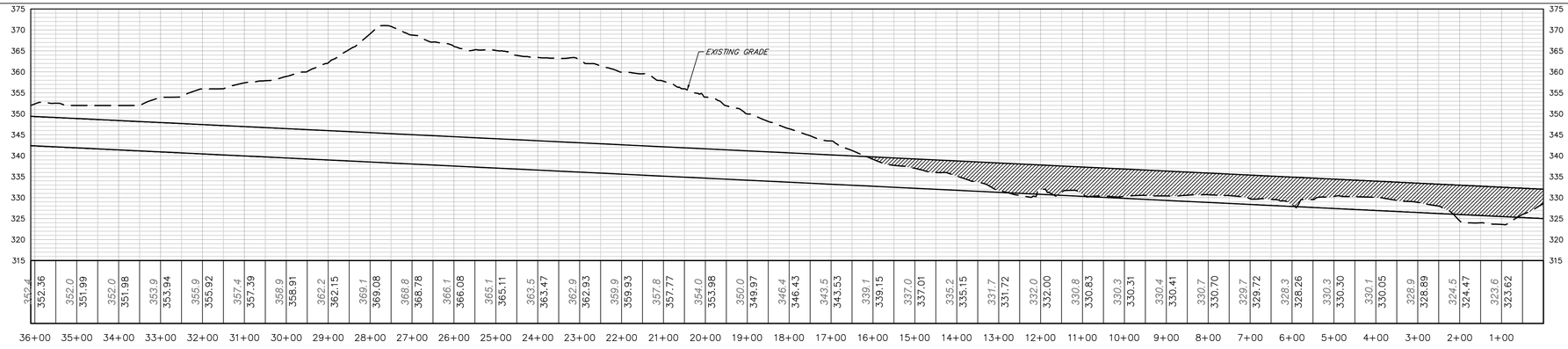
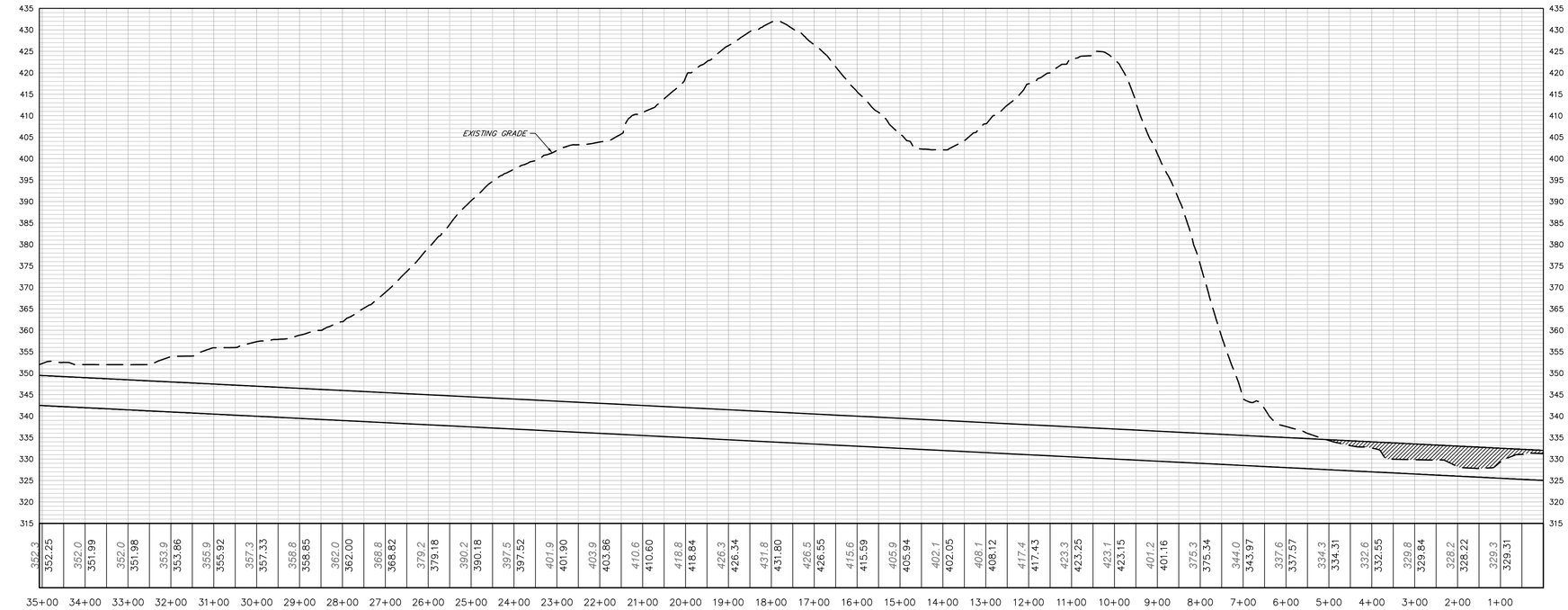


ITHAN CREEK BYPASS PROFILE
SCALE: HORIZ 1"=150'
VERT 1"=15'



ITHAN CREEK BYPASS ALTERNATE 1 PROFILE
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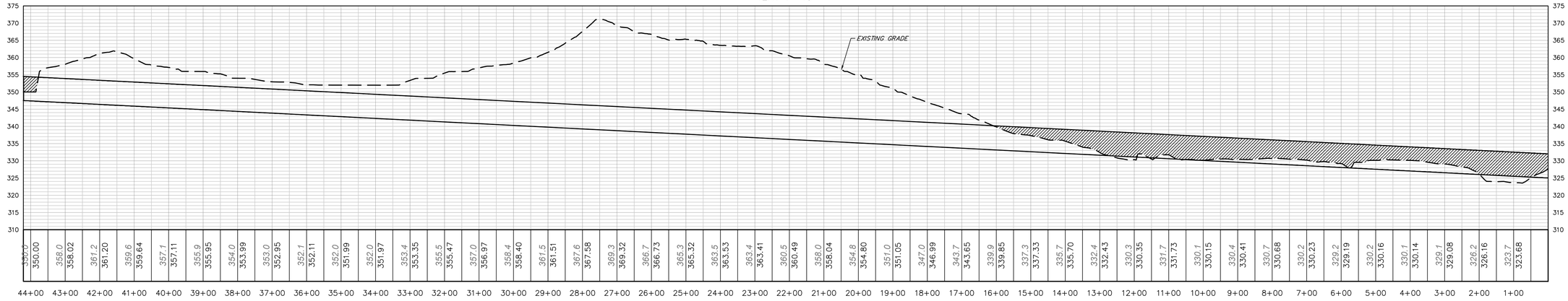
VERT 1"=15'



ITHAN CREEK BYPASS ALTERNATE 2 PROFILE
SCALE: HORIZ 1"=150'
VERT 1"=15'

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STORM SEWER BYPASS GRAVITY PIPE PROFILES

SOUTH WAYNE DRAINAGE IMPROVEMENTS FEASIBILITY STUDY

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PREPARED FOR
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		DESCRIPTION

DATE	4-22-2022
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CKD BY	WNM
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DRAWING NUMBER
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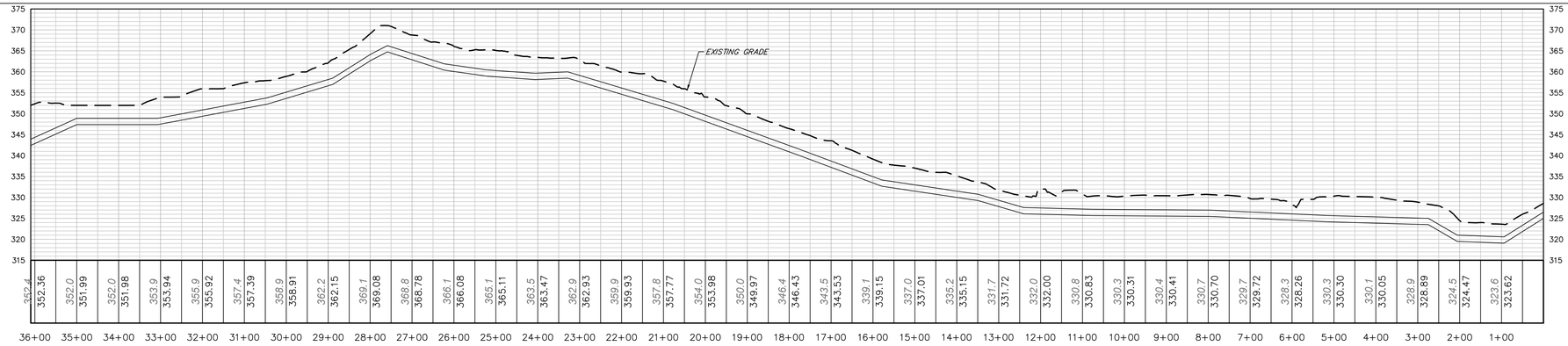

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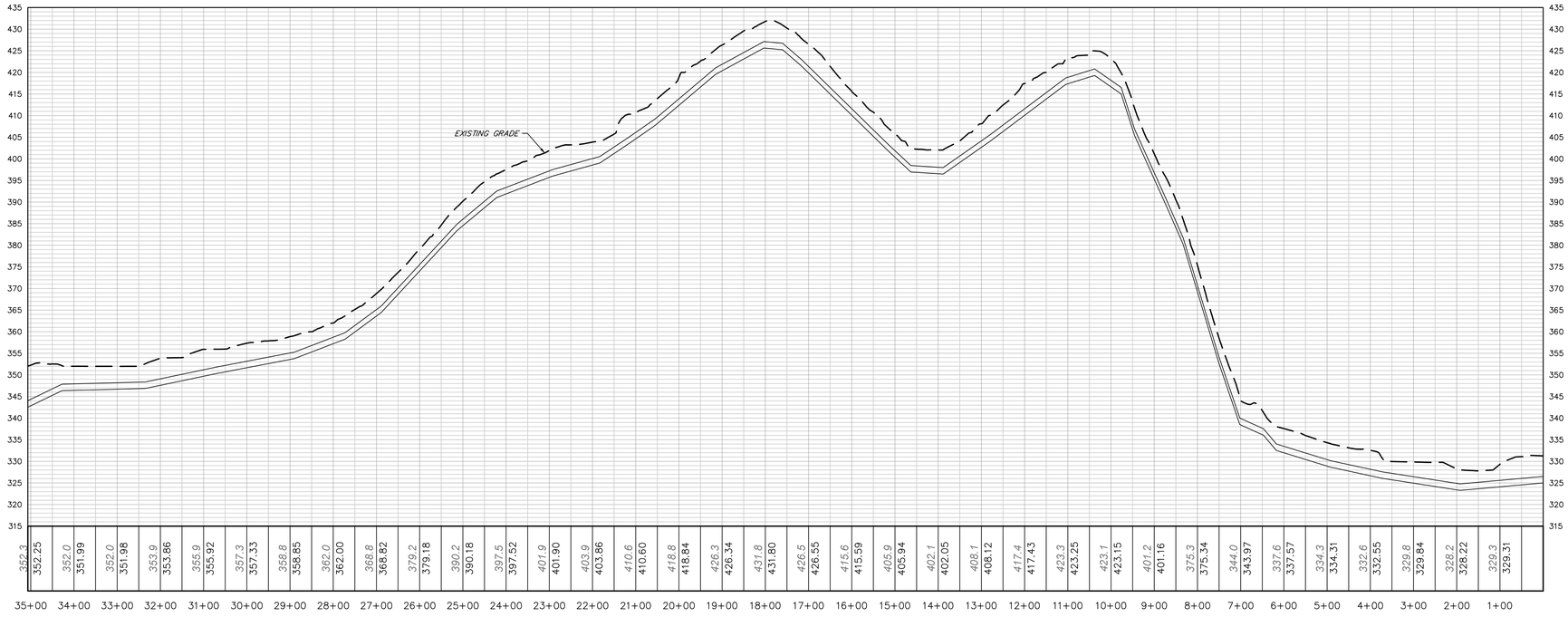

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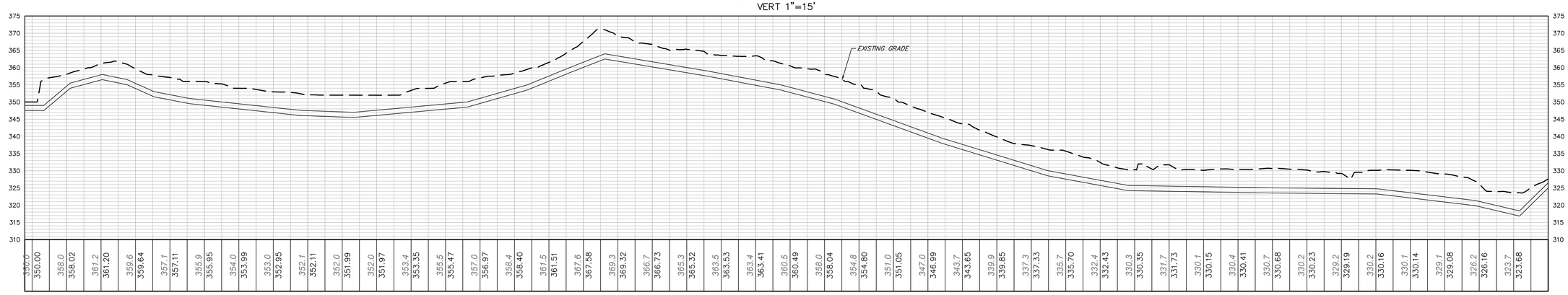

ITHAN CREEK BYPASS ALTERNATE 2 PROFILE
SCALE: HORIZ 1"=150'
VERT 1"=15'

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STORM SEWER BYPASS PRESSURE PIPE PROFILES

SOUTH WAYNE DRAINAGE IMPROVEMENTS FEASIBILITY STUDY

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JOB NO	21-1990
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CKD BY	WNM
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DRAWING NUMBER
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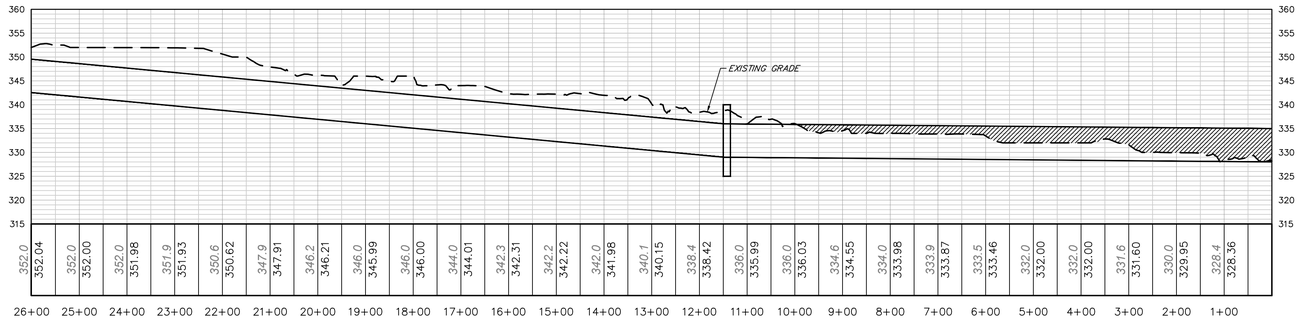

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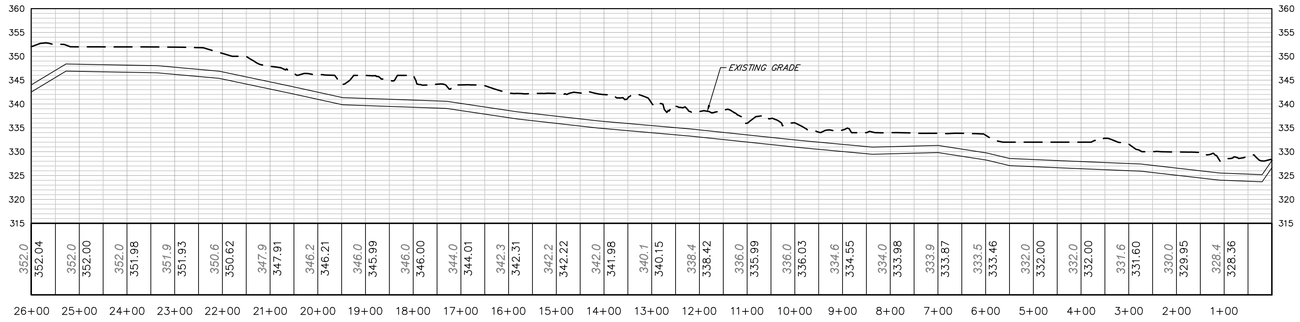

ITHAN CREEK BYPASS ALTERNATE 3 PROFILE
SCALE: HORIZ 1"=150'
VERT 1"=15'

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STORM SEWER BYPASS
ALTERANTE 3 PROFILES

SOUTH WAYNE DRAINAGE IMPROVEMENTS
FEASIBILITY STUDY
SITUATED IN
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NO.	DATE	DESCRIPTION
		INITIALS

DATE	4–22–2022
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